RACISM AND THE SCIENCE CLASSROOM:

TOWARDS A CRITICAL BIOLOGY EDUCATION

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ABSTRACT

This study explores how students experience oppression and subordination in and through biology education. The exploration is guided by the following questions: how is racism/discrimination played out in my biology classroom; in what way/s are the classroom practices of both the students and the teacher racist/discriminatory ; and what reinforces such racist/discriminatory practices and why. Since the critical perspective allows for oppressions, subordinations and discriminatory practice to be named and challenged this then became the perspective within which the study was located.

The methodology, guided by the critical perspective, and used to generate the data in this search is therefore a critical ethnography within which a critical self ethnography is also employed. Through foregrounding the oppression of race and racism, this methodology made it possible to generate data on the various oppressions and subordinations that are perpetuated in and through biology education. The data was generated from biology lessons on cell division, human reproduction, genetics and biological determinism in a Grade 11 class. This class had in it 34 fe/male students from three different race groups viz. Indian, Black and Coloured. Ten students who volunteered to be interviewed also contributed to the data generated in this study.

At a first level of analysis, the data generated from the lessons and the interviews were written up and presented as factionalised stories. This was then used to provide, at a second level a descriptive cross-case analysis grounded in the data of the stories. This cross-case analysis generated categories of oppression, subordination and discriminatory practice that included race and colour; gender and patriarchy; bodies and sexuality; class, poverty and sexually transmitted diseases; institutional power and hierarchy; religion; and language. These categories of oppression and subordination, although described separately, are mutually inclusive categories. From this description it became possible to name and theorise, at a third level of analysis, oppressions and subordinations within biology education. The theorisations deliberated on issues of race, class, gender, language and power. The naming and challenging of existing oppressions, subordinations and discriminatory practice

required that a traditional contemporary biology education be replaced by a critical biology education.

This study, in engaging a critical biology education, shows how biology may be taught differently when the agenda is social transformation in efforts towards social justice. Whilst it is accepted that social justice in all forms may never be attained, this study shows possibilities for how that contained within current Life Sciences policy for human rights and social justice, could be realised.

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LIST OF APPENDICES

DISCLAIMER

I hereby declare that this thesis is my original work and has not been submitted before to any other institution for assessment purposes.

Further, I acknowledge all sources used and cited these in the references.

Researcher: Farida Patel

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DEDICATION

FOR MY STUDENTS

AND

REHANA

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CHAPTER 1

BIOLOGY *IS* A RESPECTED AND VALID SCIENCE!

(WHAT DELUSIONS THEN OF DISCRIMINATION?)

I know we're in a new South Africa. I know he's cute. But he's Black. And since he's been goin' out with her he thinks he's the greatest. And the Black students think he's cool just because he's got an Indian girl. But it's not right. I mean when they kiss and their mouths come together – his Black saliva and her Indian saliva. It's just not right! And what if they carry on going out, get married and then have children. Who will want to have anything to do with those children? I mean take my cousin Indira – she's only 5 years old but she won't play with the neighbour Sàde - 'cause Sàde is Black. Sàde's 7 years old. Sàde has to first say she's Coloured before Indira will play with her. That's what will happen to the children. They too will not be accepted – not by us anyway. Anyway I have to go now – my friends will be wondering where I am.

It was lunch break. The biology lesson had ended and the class had just left. We were talking – Kashmira and I (her biology teacher). Kashmira was upset. I was the recipient of her thoughts. She trusted me and shared her disgust and her fears. She got me thinking. Through biology education we had shared that humans were part of the animal kingdom; as a species they shared the same characteristics. This was not what Kashmira lived with. An incompatibility between what went on in the lives of people and the teaching and learning of biology – I had failed Kashmira as a biology educator. How many others had I failed? How else had I failed? I needed to know.

1.1 INTRODUCTION

From whence came this passion, this desire to research oppression, subordination and discrimination? It started in my childhood and continued as I lived and grew - as an Indian South African born of a Muslim and a Hindu parent in apartheid South Africa. Although there are many facets that contribute to my person, it is this person who informs this study that I introduce to you as the researcher in this chapter. I now teach biology at a school that once catered for Indian people exclusively in accordance with the segregationist policies of apartheid South Africa. This school challenged these policies in 1984 and opened its doors to all South African persons in South Africa. This invitation by the school to all was taken up by Black students and later by Coloured students. White students have never applied for admission to the school even in post-apartheid times. In 1987 I arrived at this school to teach General Science to Grades 8 and 9 students and Biology to students

at the senior secondary phase of schooling in Grades 10, 11 and 12. My classroom was recognised by the students as one where negative disruptions had no place and where biology, student care and communication with parents worked alongside each other. As a biology teacher I became aware that I was not addressing oppressions, subordinations and discriminations that had come from the historical past into my biology classroom's historical present. The biology education I offered to the students allowed for the existing oppressions and subordinations to fester unchecked. It was this that I needed to address. The interim biology curriculum and the proposed life sciences curriculum (biology now finding a home in the proposed life sciences) both look at human rights and social justice, as principles of the curriculum through which informed and responsible citizens in the community and in South African society will be produced. This study looks to how this could be possible from the perspective of biology education, racism and research. How this study then engaged with this process is provided in a summary of this dissertation at the end of this chapter.

1.2 THE RESEARCHER

I was born in South Africa and was classified as an Indian. It was years before I understood that I was an African of Indian origin. My Indian classification was located within the apartheid structure of the state. I was cosseted and protected by parents and a community from the discriminations of an apartheid environment. I lived in an Indian environment and went to a prestigious Indian all-girls primary school staffed by mainly White English teachers whose task it was to turn us into law-abiding good Indian girls with an English identity. The prestige and status disallowed for any questioning of the presence of White teachers – we were the privileged. My peers and I were protected from that which was not allowed Indians and kept away from the prestigious White environments, dissolute Coloured areas and dangerous Black African townships. This was possible because the city I was born and grew up in had the largest population of people of Indian origin outside of India. At the same time and despite the protection from parents and community living in the city, the commercial hub, meant that there was contact with persons of the different race groups. Where these persons came from and went back to was comfortably contained within the knowledge of prestigious, the dissolute and the dangerous. The dissolute and dangerous were not favoured and the prestigious could be worked towards through the privileged schooling we were favoured with. In this way the raced difference of the children around me and myself was masked.

Yet I knew I was different. I was born of a Muslim father and a Hindu mother. My father's family that enjoyed social status within the community made sure that we knew that this made us different.

This happened subversively because my father, the eldest in a patriarchal-headed family, could not be openly challenged. My close contact with the maternal family that included participation in Hindu religious practice and equally close contact with non-Muslim neighbours and participating in Catholic practices was frowned upon by my Muslim paternal family. The paternal family made certain that my sister, two brothers and I knew that this together with their patronising acceptance of my mother was what made us different. Acceptance was only possible through conforming with a Muslim lifestyle as determined by the paternal family – a lifestyle that would mean rejecting, amongst others, all that was non-Muslim and in acknowledging and accepting that my mother was solely 'responsible' for all 'unacceptable' non-Muslim influences in our father's and our lives.

I refused to conform and in this I was aided and abetted by my father. I refused to dress as a Muslim girl should; I cut my hair; my playmates were both boys and girls; I refused to learn household skills – I preferred street soccer (the streets being our playgrounds) and fishing. My greatest victory was when my father refused to bow to family pressure and allowed for me to continue with schooling. The family made sure that I knew I was different through their actions and verbalisations. Midway through primary school I became aware that I was different also because I was an Indian. I went on to a prestigious all-girls Indian secondary school staffed by several White teachers from England, some White South African teachers and Indian teachers. Indian teachers at the school had been either to the University of Fort Hare in the Eastern Cape, a university for Black South Africans or from Springfield Teacher Training College in the city, the only teacher training college for Indian South Africans. My refusal to conform as a Muslim and the closeness of my school to the venue where political rallies against apartheid were held taught me that I was different – not only in terms of how I was located within the Muslim community but also as an Indian in apartheid South Africa. The dissolute Coloured and the dangerous Black African became persons I identified with – as Black South Africans.

Indian teachers at the school who had been to the university shared with us, during lessons, their understanding of apartheid and discrimination. Through them we also learnt that the British and White teachers received a special allowance called a 'sufferance pay' for teaching at the Indian school. The railing and ranting of White teachers when students refused to sing the national anthem, stole and got rid of the national flag, cut the rope on the flagpole - on special occasions that commemorated the apartheid state furthered our knowledge of ourselves as raced persons discriminated against. We were lambasted for our lack of gratitude for what these White teachers were bringing to us – our mute response from the youngest to the oldest students at the school only

served to anger them further. I remember well the tears they shed at whole-school assemblies because we were ingrates. Our unhappiness with Afrikaans as the compulsory second language, our questioning of the history curriculum, our challenging of the presence of White teachers at the school and their acceptance of a special allowance for teaching us was for these teachers another example of our lack of gratitude dealt with through detention and notices to parents informing them of behaviour that was transgressing the law of the state. The teachers never once questioned, to my knowledge, why we engaged with symbols and practices commemorating and perpetuating the apartheid state in the ways we did.

I was privileged and went on to the only university for Indians in the country. This university was in the city – but far removed and located on what was once a naval base on the far side of the harbour and next to a whaling station. My political self as a raced Black South African became clearer to me. I started a science degree, the university moved to a distant hill on the western outskirts of the city, got married to a Muslim who was a medical doctor, had a daughter, finished my degree and became a widow. I grew up suddenly – I was now a Black South African, single parent with a responsibility to my daughter who was just over a year old. My widowhood also brought home to me my difference as a woman in a man's world. I now began to think about a career for myself. I decided that I wanted to be a teacher but that I needed to "educate" myself. With the support of my family, who took over with caring for my daughter I went back to university and did an Arts degree but with a focus on education. I also dabbled with some philosophy and religious studies in this time. This was a particularly tense time in South Africa. It was the early 1980's and the state was moving towards being its most repressive. University and protest against the apartheid state became synonymous and was expressed through symbolic and physical violence by the authorities on the student body. This was true for universities for Black persons throughout the country. I left university as a teacher trained to teach biology and geography. I was placed at a secondary school for Indians at that time when the state became its most repressive. After I started teaching I continued to further my professional development as a teacher. I also became a counsellor with Lifeline – a non-governmental organisation that provides voluntary telephonic and face-to-face counselling for people in the community.

1.3 THE SCHOOL

I now teach at Centennial Secondary School[1]. This school was named to celebrate the coming of Indians as labourers to South Africa in 1860 and was officially opened in 1960 – hence its name.

[1] The name of the school and all participants have been changed to maintain confidentiality.

Centennial Secondary School was established as an Indian school in South Africa to serve the needs of people who were only Indians. This school is but one of the many schools that is part of South Africa's apartheid legacy of segregation on the basis of race. Key apartheid laws that entrenched and maintained segregation on the basis of race included amongst them laws like the Group Areas Act, the Land Act and the Population Act. In education, through legislative provisions from 1953 through to 1984 education for the different race groups was entrenched and enacted through the nineteen education departments. Through the Bantu Education Act of 1953, the Coloured Persons Act of 1963, the Indian Education Act of 1965, the National Education Policy Act 39 of 1967 and the National Policy for General Education Affairs Act No. 76 of 1984, White education was controlled by the White House of Assembly; Indian education was controlled by the House of Delegates; Coloured education through the House of Representatives; urban Black Africans through the Department of Education and Training and; homeland education for the ethnically diverse Black Africans through fifteen Departments of Co-Operation and Development – one for each ethnic homeland group.

As part of South Africa's legislated policy of segregation race identity amongst Whites was fluid – it was possible for a person who was White to be reclassified as Coloured or Black African – this usually happened through schooling where learners whose race classification raised doubt were subjected to tests such as the 'pencil test'. The pencil test involved putting a pencil through the hair of the individual – if the curls held back the pencil then the person could and was often reclassified as Coloured. Other tests included those where skin colour, lip width and width of nose across the nostrils was used to determine the race of a person. Such tests were based on the notion of what went into the outward physical appearance of a Caucasian person that symbolised Whiteness. When school learners were reclassified on the basis of such tests families were usually split apart – the laws refused to acknowledge the genetic roots of such diversities amongst White persons. Reclassification was always from White to Coloured or Black African race groups. There was rarely reclassification into the White race group.

Centennial Secondary School that was called Centennial Indian High School[2] when it was first opened was established in an Indian residential area to service only the Indian population. In defiance of apartheid Centennial Secondary together with schools that had been established to cater for Indians only began admitting Black African students in 1984. Although the school was open to

[2] This name is still used by organisations such as the South African National Blood Transfusion Service (SANBS) that collects blood from students at the school at least three times a year. The SANBS uses the name to identify the school as having a low-risk population with regard to HIV.

all races no White or Coloured students came to the school – only Black African students from distant townships whose parents worked as nurses at a nearby hospital. This experience was true for all schools that had opened admission to all students regardless of race – the school did not attract students of race groups other than that group for which the school was established and Black African students. Centennial Secondary was located in a middle class Indian area and serviced students both from that area and the neighbouring working class area. The area in which the school was located was an area of political foment against apartheid. Branches of political organisations against apartheid were active in the area and some leaders of these organisations lived in this area. The organisations included the Natal Indian Congress and later the United Democratic Front and a cell of the then banned African National Congress. As a result of the political activity in the area, as in others, students were politically aware and acted by supporting teacher action against the state. In 1994 South Africa changed from an apartheid state to a democratic state. Repressive laws that kept people segregated on the basis of race were removed from the statutes and the Constitution was founded on the basis of non-racism and other non-discriminatory ideals. Since 1994, students at Centennial Secondary came from the area in which the school was located – they were Indians, Coloureds and Black Africans from both the formal housing and the informal squatter housing that had sprung up in the area. Many Black African students also travelled from the distant townships to the school. No White students sought admission at the school. The school now also has amongst its student population a small number of students that are classified as refugees from Burundi, Rwanda and The Democratic Republic of Congo.

1.4 THE BIOLOGY CLASSROOM

The students come to the school at Grade 8 – the start of their secondary schooling. This too was true for the students who participated in this study with me. I had taught some of them at Grade 8 and some of them in Grade 9. In that time I had learnt not only about the student's academic ability but had also got to meet parents. Being the person I am I had visited many homes – either to take students who got ill home and needed to be taken home or to visit parents in the evening if I believed that I needed to work together with the student and her/his parents where the student was underachieving or was being negatively disruptive. This allowed me to engage directly with where students came from. It also established a working understanding for students who came into my class – they did not want me visit their homes for reasons linked to negative disruptions. If during the school day a student wanted to go home the students knew that I provided a "taxi" service and would arrive at the classroom. The "taxi" service also provided opportunities for students and me to

talk about matters other than formal schooling. Teachers at the school, including school management, used the skills I had learnt at Lifeline and also sent students to me if they needed counselling and caring. Students over the years had also learnt that if they spoke to me in confidence that confidence was never breached. In class itself students knew that no question was a stupid question; that everyone of them was free to disagree with and challenge me and each other – but not in a way that was disrespectful especially of each other; that any information on what was being taught in the class was always welcome especially from newspapers, magazines and other texts since it was this that allowed all of us in the class to engage with new ideas; and that if there was a burning valid issue in the school that needed addressing by the management I would ensure that they were at least heard by management – even if nothing came of the hearing. Over the years at Centennial Secondary having parents waiting at my classroom door to talk through difficulties at home or with a student I was teaching or not teaching also became commonplace. It was all this that informed the students about who I was and which made it possible for the students to share in the ways that they did during the study including their willingness to participate during school holidays. It was also this knowledge by parents that allowed for them to let their children participate in the study without hesitation when approached for their permission.

1.5 THE BIOLOGY TEACHER

My university training gave me the credentials to teach biology – a science that was a status subject. Biology's status also derived from it being an essential requirement in the career trajectory for those intending to find a home in the health sciences – especially medicine that held the highest status amongst all possible careers. As a respected and valid science, biology is concerned with the facts of life. These facts explain all there is to know about life in all kinds of detail – from the macroscopic to the ultramicroscopic. These facts are objective and neutral – they derive from the principles of any valid science that demands objectivity, neutrality and rationalism and is value-free. What else could there be then to teaching biology but bringing to students a content and a knowledge about the facts of life. Over the years and especially since the advent of democracy teaching this understanding about life and the facts of life filled me with increasing disquiet because the learners who passed through my classroom still saw themselves as Indian, Black African or Coloured, as privileged and oppressed, despite the biology they engaged with and the history of the area being one steeped in a political activism against apartheid. My own experience with difference and especially that of race sensitised me to the differences and related discriminations around me and within my biology classroom. The biology that I taught was in no way a biology that addressed

discrimination of race and racism since the students saw themselves as raced persons. I was not comfortable with the knowledge that I 'knew' what it was that always went on in my biology classroom. I became more and more convinced that life was more than the sum of known facts – there was also the 'unknown'. It was this 'unknown' that beckoned. It beckoned because the more I taught the known, the more things remained the same. Privilege and power, oppression and discrimination – these were slow to change or never changed. These too were facts of life. It was these facts of life that I wanted to know about within my classroom. I needed to know more about these unknowns if I was to get to know life and my students better.

My quest then was to develop an understanding of operationalisations of privilege, power, oppression and discrimination as facts of lived lives. I planned to do this in my biology classroom – in and through the biology that I taught. How was this to be realised. In my naivety I latched onto the oppositional binaries of White-Black racism as that source of privilege and discrimination that had historically shaped lives in a colonised world and especially in apartheid South Africa and continued to shape lives in the historically lived present. I placed race at the centre of my agenda as I began my search for answers. The search soon disabused me of my own bias – racism was but one of a myriad of discriminations. Racism did not operate on its own. At the same time racism provided me with the lens through which I could begin to view the various privileges and discriminations as they revealed themselves to me. These revelations served to inform that not all would or could be revealed because for every privilege and discrimination that surfaced others would continue to remain invisible.

1.6 THE BIOLOGY CURRICULUM (OF POSTAPARTHEID SOUTH AFRICA)

My quest was guided too by the Constitution of the Republic of South Africa. The country had moved from apartheid to democracy. Had this move really occurred within the lived lives of the peoples of South Africa; had social transformation been effected with constitutional legislation; had social transformation taken root and grown within and through science and biology education – this is what needed establishing. The Constitution of the Republic of South Africa as adopted on May 8 1996 and amended on 11 October 1996 states in Chapter 1, Section 1b states that '*The Republic of South Africa is one sovereign, democratic state founded on ... non-racialism and non-sexism.*' In the chapter on the Bill of Rights, Section 9.2 on Equality states that *'Equality includes the full and equal enjoyment of all rights and freedoms.'* Section 29, 1a on Education states that *'Everyone has the right to receive education ...* ' Education then needs to be developed and offered to South

Africans such that discriminatory possibilities could be countered and turned around if the Constitution was to be followed according to its letter. This intent of the Constitution makes itself known within the South African Schools Act (1996) within the Preamble which includes that '*this country requires a new national system for schools that will redress past injustices in educational provision, provide an education of progressively high quality for all learners and in so doing lay a strong foundation for the development of all our people's talents and capabilities, advance the democratic transformation of society, combat racism ...*' The new national system advocated has been translated into structural changes in the main as new systems are put into place with the focus being the provision of and access to education for a compulsory period of 10 years.

A new education policy has also been developed and legislated as the National Curriculum Statement, which states that the Constitution of the Republic of South Africa (Act 108 of 1996) is what provides the basis for curriculum transformation and development in South Africa. One of the aims of the Constitution that underpins curriculum transformation includes, amongst others, that which speaks of healing divisions of the past and the establishing of a society based on democratic values, social justice and fundamental human rights. The National Curriculum Statement Grades 10 to 12 (General) then spells out key principles and values for the achievement of the Constitutional aims. Amongst the 10 principles spelt out that underpin the curriculum are the principles of:

- social transformation; and
- human rights, inclusivity, environmental and social justice.

Social transformation is aimed at ensuring that educational imbalances of the past that are a legacy of apartheid are redressed; and that educational opportunities are provided to all sections of the South African population. The principle of human rights, social justice and environmental justice will be addressed through the curriculum's sensitivity to issues of poverty, inequality, race, language, age, disability and other factors.

Biology in the new curriculum will be part of Life Sciences that involves '*the systematic study of life in the changing natural and human-made environment. This systematic study involves critical inquiry, reflection and the understanding of concepts and processes and their application in society.*' (National Curriculum Statement, Grades 10-12(General), Life Sciences, 2003). Part of the purpose of Life Sciences is that it will allow students to apply scientific knowledge in their personal lives and that the study will develop an understanding of the interrelationship of science, technology, indigenous knowledge, environment and society. As part of its scope then the subject will also develop, through Learning Outcome 3, competency in understanding of the relationships

between the Life Sciences, technology, the environment and society which will contribute to students becoming responsible and informed citizens in their community and in South African society. This then requires that students also understand that '*the knowledge that is contested and accepted often depends on social, religious and* ***political*** *factors*' (my emphasis). Even though there are critics such an Jansen (1995), Motala (2001) and Carrim (2001) who see the curriculum policy as part of only a political symbolism unable to be realized within the classroom the policy does provide scope for teacher agency in realising the principles of the policy towards social justice. It provides that space where the teacher can take the suggested core knowledge and develop teaching-learning contexts in the Life Sciences classroom that questions sciences and specifically biology's role in issues of racism and the various discriminations that still continues to characterise society. Life Sciences will also continue to prepare students for careers in higher education in areas such as medicine, bioengineering, psychology, nursing, education, marine biology and environmental science. In the new curriculum biology in the form of Life Sciences thus maintains its status as a valid science preparing for careers in the respected sciences with status.

1.7 BIOLOGY EDUCATION, RACISM AND RESEARCH QUESTIONS

Access to education in post-apartheid South Africa had translated into desegregated schools. Violent racial conflicts led to research into school desegregation in a study conducted by the South African Human Rights Commission on Racism, Racial Integration and Desegregation in South African Public Secondary Schools (Vally and Dalamba) and released in a report on 4 March 1999 revealed '*instances where blatantly racist, segregationist and generally discriminatory practices flourish.*' Soudien (1994) and Jansen (1995) had alluded to the reality of desegregation being akin to access and of diversity being 'legitimately' assimilated through a deficit model with deafening silences around how policy and curriculum at the local and school level were to meet proposed notions of social transformation. Motala (2001) and Carrim (2001) also identified that desegregation was limited to schooling access. Desegregation provided the superficial veneer of respectability required to entrench and maintain existing invisible pervasive injustices. Desegregation did not translate into non-oppression and non-discrimination.

Despite continued sporadic outbreaks of both violent and symbolic racist confrontation at schools throughout the country, schools and governing bodies adopted an ostrich response to what simmered beneath the surface. The assimilationist response by schools, teachers and parents on school governing bodies of "we do not see colour, we see only children" was a neat way of

silencing any dialogue and response to the racisms and associated discriminations that which continued to simmer. It was my recognition that injustices of oppression and discrimination continued to prevail not only in the country but also in and through my biology classroom that compelled me into making the injustices visible and known and through them then unmask, where possible, privilege, power, oppression and discrimination in the lives of my students – facts of their lives.

Biology that had historically validated racism provided both my students and me with a vantage point through which we could attempt to make visible and unmask ***how racism/discrimination was played out in my biology classroom***. This required that I needed to think through how I could teach biology differently without alienating the students, the school and the community. I was aware of the possibility of alienation around issues of racism and discrimination since these issues, which caused great discomfort because they confronted the realities of social injustices, were best dealt with through silence and through invisibility. Alienation was a real possibility since I intended to make visible the ways in which ***practices of myself as a teacher and my students in my biology classroom were racist/discriminatory from the learners' perspective***. Alienation and closure of dialogue was a distinct possibility since this would also require a delving into the lives of the students outside of the biology classroom. My attempts to ***explain the continued existence of these racist/discriminatory practices*** would then possibly make visible the challenges that would need to be engaged with if the racist/discriminatory practices could be turned around in and of themselves in any efforts towards social justice. This also was surrounded by risk since it would expose the various locations of power in the classroom, the school and the wider community – secure, comfortable and unquestioned historically determined locations that remained unchallenged because of their invisibility. Racism, it must be remembered, was placed at the centre of my queries and would be my lens through which a variety of discriminations could be revealed.

Learning about racism/discrimination in science and especially biology education would begin to fill the existing void in the research that exists in both science and biology education. Current research still focuses on access to science and biology through addressing deficits or add-on assimilative processes. Critical science education research in remaining focused on access to science education slips back into the deficit-fix-up approach. The absence of research into issues around racism and discrimination and social injustices that owe their historic validation to biology and science and the unwillingness to name race, racism and discrimination in biology and science education is perhaps telling of the power bases that drive current research agendas – power bases

that would find themselves unacceptably powerless in research agendas committed to attaining social justice.

1.8 THE DISSERTATION: A SUMMARY

Chapter 2 begins with looking at how race is constructed as an identity. From the construction of race various perspectives of racism from the biological to the civilisational emerge. Both visible and non-visible oppressions and subordinations including racism are examined with reference to how it is that they are domesticated and silenced. This domesticated silencing of lived oppressions and subordinations in education and science education specifically then serves to maintain dominant interests and the existing global social status quo. Science education's and biology education's failure at efforts towards transformation of existing oppressions and subordinations is located in science education's and biology education's non-acknowledgement of the domestication of both visible and non-visible oppressions, subordinations and discriminatory practice. A politicised biology education, through fore-grounding race, is suggested in an effort towards social justice.

Through critical pedagogy, in Chapter 3, questions are raised about how knowledge is produced and existing social inequities with a view towards social transformation. Race is fore-grounded and various theorisations of racism and related oppressions and subordinations are then explored. These include amongst others the racial formation theory, racial modality, racial identity theory, a critical pedagogy of race and critical race pedagogy. In the critical perspective the revolutionary working class pedagogy is also considered. A critical antiracist pedagogy and the feminist perspective are also included. A critical science education emerging from a critical antiracist science education and a feminist science education to address oppressions and subordinations towards social justice is identified.

The naming and the challenging of existing oppressions and subordinations in biology education required the use of a critical perspective. In Chapter 4 the critical perspective contributes to the unmasking and making visible of named oppressions and subordinations through the use of a critical ethnography. This methodology was used in the generation of data that focused explicitly on existing oppressions and subordinations amongst students in my biology classroom. A critical self ethnography therefore made it possible to scrutinise myself as the biology teacher with reference to oppressions and subordinations. The research site and the strategies used to generate the data

through selected biology lessons and student interviews are described. The process through which factionalised stories were generated is also explained.

Ten factionalised stories from audiotaped interviews with ten students are presented in Chapter 5. The students who were interviewed did so voluntarily. The stories reveal the oppressions and subordinations the students engage with in the biology classroom, the school and the wider society. How biology education challenged students to confront these discriminations in their lives form the perspectives of both the oppressed and the oppressor is revealed. The stories also tell of the value placed by students on a biology education for assessment through which students were guaranteed success in biology and in schooling. They provide a learners' perspective.

Four selected units of biology taught to the Grade 11 students were audiotaped. From these units the data generated is presented as lesson stories in Chapter 6. Four units of biology were taught from which six stories were generated. The unit on cell division was used to generate one story. From the unit on human reproduction two lesson stories were generated viz. one on human reproduction and the other on sexually transmitted diseases and HIV AND AIDS. Two stories were also generated from the unit on genetics viz. one on genetics and the other on abortion. The last unit of biology was a unit that I included as part of the elective curriculum. This unit was on biological determinism and the focus in this unit was explicitly race and racism. This unit too was written up as a story. The stories show how biology education could be taught differently if the focus is the unmasking of oppressions and subordinations at attempts towards social justice and provide the teacher's perspective.

A first level of analysis that is largely descriptive is presented in Chapter 7. This chapter is still tightly connected and grounded in the data in Chapters 5 and 6. The description emerges from a cross-case analysis of the data generated and presented as student stories and lesson stories in the previous two chapters. The analysis makes visible marginalised identities located in race, gender, class, language and religion. The identities were used to generate categories of oppression and subordination that included race and colour; gender and patriarchy; bodies and sexuality; class, poverty and sexually transmitted diseases; institutional power and hierarchy; religion; and language. Student experiences placed students in positions of both the oppressor and the oppressed in the various categories. Student complicity with oppressions and subordinations and instances of student resistance to experienced discriminations is described.

Critical-race-antiracist-feminist understandings are used in Chapter 8 to guide explanations provided for why oppressions, subordinations and discriminatory practices are perpetuated and maintained in and through biology education. It is in this chapter that connections with literature and the existing theories emerge. This is done by placing the oppressions and subordinations at the centre of biology education with the oppression of race being fore-grounded. Through this biology education's silence around the power of Whiteness, and as appropriated by Indianness amongst students, in perpetuating oppression is unmasked. Biology education's complicity in determining gendered identities and roles is also revealed. Heterosexuality as the norm in biology education and the silence around homosexuality contributes to the existing oppression and subordination of homosexuality. The specialist language of biology too served to oppress and subordinate by excluding students from not only biology education but also from other education and life opportunities.

In Chapter 9 what it means to teach biology differently is examined. Biology education in the classroom and in teacher education programmes needs to include the voices of all in the classroom – including the 'silent' voices if the focus is on oppressions, subordinations and discriminatory practices. Including all voices not only unveils oppressive social practice it also makes for explosive classroom interactions. Such explosive interactions are to be expected as part of the crises engaged with when eliciting agency directed towards social transformation. Science education research efforts are reviewed – efforts from the remedial fix-it perspective, the inclusive perspective and the socio-cultural-political perspective. Why these perspectives have made no real gains in efforts towards social transformation is linked to the focus of these perspectives in science education being directed towards the access and performance in science. This 'worthwhile' focus provides science education a respectable reason for its continued silence about science and biology education's complicity in the continued perpetuation of existing oppressions, subordinations and discriminatory practice. How this study contributes to a socio-critical biology education towards social justice is discussed.

CHAPTER 2

FROM RACE AND RACISM TO BIOLOGY EDUCATION: oozing through the graze

TO EVERY SCHOOL-GOING CHILD

You are in the process of becoming indoctrinated. We have not yet evolved a system of education that is not a system of indoctrination. We are sorry but, it is the best we can do. What you are being taught is an amalgam of current prejudice and choices in this particular (global) culture ... you are being taught by people who have been able to accommodate a self-perpetuating system. Those of you who are more robust and individual than others will be encouraged to find ways of educating yourself, educating your own judgement, those that stay must remember, always and all the time, that they are being moulded and patterned to fit into the narrow and particular needs of this particular society (Doris Lessing, 1962, p xxiii-xxiv)

What does it mean to create mutual meaning among teachers and students when the discourses of science and education are guided by a discourse that does not include the essences of our lives as gendered, raced, and classed students and teachers? ... what does it mean to teach all students a science that is not oppressive in its content, process, language, or privilege? (Barton, 1997, p143)

2.1 INTRODUCTION

This chapter examines identity as a fluid notion that emerges through difference. It is this that allows for the existence of race as identity and through which has emerged the discriminatory

practice of racism. The variety of attempted explanations for race and racism from the biological through to the civilisational perspective are reviewed. Racism's contribution to a depoliticised education and science education specifically are examined from the perspective as to what meaning this gives to education in general and science education specifically. The need for a meaningful politicised biology education towards social justice from the perspective of race is then explored.

2.2 IDENTITY

Privilege and discrimination are operationalised through difference. Difference itself is constructed through identity. It therefore behoves of any enterprise that seeks to understand privilege and discrimination that the notion of identity be engaged with – so that difference, a political category according to Giroux (1996, 1999), and its role in the creation and maintenance of privilege and discrimination can begin to be known. To problematize the relationship between the individual and the social one needs to examine how the self relates to groups in society or to shared identities – to illuminate society. This can be explored through the relationship between the self and plural identities. According to Sökefeld (1999) there can be no identities without selves. Identity is derived from religion, gender, race, language, locality etc. The various identities always have relevance even if one identity is pushed to the fore at a moment for whatever reason e.g. religious identity that may also be in conflict with other identities of the same person – as with religious identity and sexual identity such as homosexuality.

'*... gender, race, sexuality etc. are the products of a "Ritualize repetition" of normative understandings constructed through relations of power through which individuals are compelled to recognize themselves and perform their identities*' (Duesterberg, 1999, p 758). It is these normative understandings/discourses that operate so powerfully that they provide subject positions through which individuals learn to see themselves as sexed, gendered, raced, religioused, languaged, powerless, etc. and consciously or non-consciously understand themselves as deficient (Duesterberg, 1999). It is these conscious/non-conscious understandings of the deficient that then determines what it is that constitutes the powerful.

For Dolby (2000) identity emerges from the process of interaction between the self and society and this '*sociological subject*' maintains its inner core while it is constantly shaped and transformed by the society that surrounds the self. Dolby accepts that identities are not formed in isolation but always in relation to an other and through the practices of representation. '*Identity is a structured*

representation which only achieves its positive through the narrow eye of the negative. It has to go through the eye of the needle of the other before it can construct itself' as exemplified through '*Whiteness as an identity* (that) *depends on the construction of Blackness and is formed through representation*' (p901). She goes on to share that '*identity is constructed actively only in relation to the other and in large part through the practices of representation and difference then becomes significant as a discursive construction and representation that fluctuates and changes*' (p901). Identities then are constructed in and emerge and through dynamic conversations with others and are always located through the relations of power (Dolby, 2000).

Identity categories and difference that have been established are not '*a condition of human existence*' but an '*enunciation ... that constitutes hierarchies and asymmetries of power*' (Scott, 1995, p5). Thus identity in our lives exists as a theoretical construct created through particular categories at any moment and is not a pre-given naturalized condition (Dolby, 2000). Identity as a concept and categories such as race, gender, ethnicity and class have emerged as prominent ways to think about and describe difference because of specific historical and contemporary structures of power and corresponding practices.

The notion of identity as a multifaceted, dynamic subject-position emerges from identity being recognised as not a static object, but as the result of a creative process. Thus the crafting of selves/identities is an ongoing and a lifelong occupation. Crafting of selves/identities implies a concept of human agency. It is human beings who create, construct, work on and enact their identities. Sometimes they also creatively challenge the limits of the cultural constraints which constitute both what we call selves/identities and the ways those selves/identities can be crafted. Thus we should not speak of the self/identity as a global entity but of selves/identities in the plural (Bianchini, Cavazos and Helms, 2000).

The moral aspect to identity where the sense of self and the moral self are inseparable subjects must also be acknowledged. It is through locating the self in a moral and ethical space that the sense of self is enhanced and who one is, is determined in large part by what matters to the self and where the self's values are positioned in relation to others. To have identity means that the self knows where it is coming from when it comes to questions of value or issues of importance. Identity serves to define the background against which the self knows where it stands on such matters. If values and issues of importance have to be called into question or fall into uncertainty then this will mean

that the self will not know how to react and that the self will cease to know who it is in this ultimately relevant sense (Bianchini, Cavazos and Helms, 2000).

For Bianchini, Cavazos and Helms (2000) then identity is:

> '*a multiple sense of self that is constantly negotiated, socially positioned, constrained by ethnicity, race and gender and morally grounded.*' (p 514)

To speak of identities as isolated, separate constructs makes invisible the '*already-intersectedness*' of identities and also '*masks the already-privileged status of certain identities*' (Kumashiro, 2000, p5). In treating identity as a singular construct, Kumashiro highlights that this allows for only certain identities to count as authentic and valued and for only certain ones to matter when learning about what it means to be of that group. Since identities exist only because of their definition in opposition to the Other, authenticity will require the existence of the non-authentic and the naming of difference can, in activist communities/inclusive curricula, serve less to describe who a group is and more to prescribe who a group ought to be. If students, when learning about the Other see the self in and through the Other, then they will not change how they see themselves (Kumashiro, 2000).

Shared identity does not have the same meaning for everyone who shares that identity – e.g. femininity is not embraced by all in the same way. Shared identity may generate conflict within an individual and ambivalence in relationships with others sharing the same identity e.g. how to reconcile the two understandings of the same identity and how to act towards the other sharing the same identity - homosexuality. A person has to move through a maze of competing and antagonistic identities. Intersectionality and *différance* prevent the person from realizing and enacting the '*pure*' signification of a certain identity because competing significations must be taken into account. One identity subverts the other (Sökefeld, 1999, p423).

The notion of fluid identities is what is contained within the Derridean idea of *différance*. The different identities (plurality of identities) within a person are markers of difference but the difference is not all-embracing; neither are the differences separate nor do they compartmentalize a person – it is this which *différance* describes (Sökefeld, 1999). The different identities of a person are related; it is this that construes the intersectionality of identities – because the different identities are embraced by the same person or the same self and it is this relation that becomes crucial for

their significance. It is this difference that makes *différance* possible. It is the reflexive self that makes it possible for the person to manage the different identities and to distinguish between the self and everything else because of the reflective self's agency – no matter how minimal the agency. The ability to manage the various identities is in itself a display of agency. Identities can be considered as the building blocks for the construction of a personal image of the self. Through the decades difference has been the paradigm for the conceiving of the Other selves (Sökefeld, 1999).

From a Foucaldian perspective there exists important connections between discourses and power within social relations and identity is produced in and through discourse. Thus within any context where multiple discourses circulate individuals occupy a variety of positions from which to speak and act. In this way individuals are simultaneously active knowing subjects of the discourses that circulate and are thus capable of resisting any, several or all of the discourses while at the same time the individuals are objects of the circulating discourses (Duesterberg, 1999). To bring about change, that is '*... the whole set of actions and reactions which are continuously generated in the universe of competitive relations constituting the field*' (Bourdieu in Duesterberg, 1999, p 755), analyses of power should begin at the local level in order to map out the larger discourses and social practices embedded in mechanisms of power in local contexts so that it becomes possible to create counter discourses that legitimise and validate the views of the marginalized. For Foucalt social inequities are located within the discursive relations in life and reform and change in social inequity and identity is possible through changing discursive relations at the local level (Duesterberg, 1999).

How and where do the identities in the school and classroom come from? Students come into the school with identities that have been crafted on the outside within the wider society. Interactions within the school then act to reinforce and perpetuate and/or challenge the identities already crafted from the outside. Identities crafted and forged by the wider society are those that come into being on the basis of race, colour, gender, class, religion and language amongst others. It is these categories that give birth to the notion of difference. These categories operate both individually and plurally in different spaces at different times as determined by what is being experienced. In my work both the students and the teachers entered and functioned in the school community and classrooms as Black, Indian and Coloured. These racial identities being prioritised were those that had been crafted during the apartheid era and were reflective of continuities of the historical present with a deeply entrenched historical past. The continuity was grounded in the belief and doctrine of preserving one's 'own' culture – a dictum that apartheid used for its preservation and which at the same time allowed for the successful conflation and corruption of race and culture.

Plurality of categories operated in delineating the various identities but race is the primary marker of difference. Black identity was in the main located in Africans of 'indigenous' origin. This identity was further categorized on the basis of ethnicity and language as revealed in the presence of Zulu and Xhosa identities at the school. Indians were South Africans of Indian origin who on the basis of religion and language and place of origin in India were known as Muslim, Hindu who were Gujerati, Hindi, Tamil or Telegu and Christian. Persons of mixed origin were Coloured and how they spoke English was also used as a marker to determine this identity. Besides race, class and gender identities also operated to distinguish between the individuals at the school and in the classroom. The poor and middle class distinguished themselves from one another through their possessions and how they spoke. Males and females were distinguished on the basis of what was 'expected' of each sex stereotype role. The existing identities were monitored and reinforced through the overt and covert actions of students and teachers. Attempts to act or exist outside the 'prescribed' identity was frowned upon and also checked by intervention by members of the wider community who included parents, religious figures etc. The few attempts at blurring or marrying of the categories occurred where an individual acted on her/his own and challenged the existing categories and those in positions of privilege and power in the school and wider community.

In the biology classroom the existing categories were deliberately challenged by the provocations that I thrust on to the students. The provocations challenged existing understandings around the notions of race, gender, class, religion and language – understandings that were mine about what it was that constituted discrimination and oppression. I challenged the students through biology. The provocations and challenges to the students were answered by students taking up the challenge for themselves. Students began to challenge their own understandings about identity; they also attempted to unravel and explain their perceptions of me as a woman who did not fit their mould of what it meant to be a raced, gendered, religioused and languaged person. My conscious efforts at challenging existing identities through my person and actions in the biology classroom and in the school had confused the students. It was this confusion that they had to work through and unravel as they worked through their understandings of the various identities that abounded in the biology classroom, the school and the wider community. In the biology classroom the identities became fluid as they were challenged and differences explored; outside the biology classroom the students went back to the identities and the rigid differences used to tell the different identities from one another that existed in the school and wider community. They did this so as not to upset the existing applecart of known identities operating and acceptable to the school. I say this because the student

selves did not create any disruptions around who they were at the school – at least any disruptions that I was aware of or privy to. In my attempt to make sense of the multiplicity of the fluid identities that operated in and through my biology classroom I have chosen to privilege and prioritise race – in keeping with my agenda of race/discrimination.

2.3 RACE AND IDENTITY

Various explanations exist about the construct of race. The explanations are rooted in efforts to legitimate the role of race in determining social organisation from the historical past into the historical present. Challenges to such legitimation have produced their own notions of how race needs to be understood. In this section the construct from the perspective of an ideological race to race as an objective condition and then to race as performance is reviewed. The challenges that have resulted in the notions of race as a Black phenomenon and the development of the notion of dominant Whiteness and dominant Blackness are raised. How Indian race as a dominant construct operates at my school is also discussed.

Race as an ideological concept was a liberal understanding meant to challenge the long-standing biologically based ideas of race that supported and sustained exclusionary practices - in the early part of the twentieth century (Winant, 2000). This conceptualisation considers race as a mere illusion and gives anti-affirmative-action advocates reason to dismiss race in awarding benefits to individuals. Ideological race also assumes that the ways people think about and identify with race categories are a matter of choice and ignores the powerful discursive practices that position some persons as authoritative and privileged; it also fails to account for forms of resistance that produce further marginalization of already marginalized individuals (Duesterberg, 1999).

Another concept of race sees race as an objective condition with clearly definable boundaries that determined group membership (Duesterberg, 1999, p 757). Here the meaning of race is fixed into something objective and quantifiable – as occurred with the social scientific discourse of the nineteenth century. As explained by Gould (1981) scientists of that time often held '*an a priori conviction about racial ranking so powerful that it directed* [their] *tabulations [about the innate intelligence of different racial groups] along preestablished lines* '(p74).

Race is still a significant category of social organization today. Race does matter because it serves as an organizing principle of social relations (Thompson, 1997, p14; Duesterberg, 1999, p 759).

Viewing race as an objective condition allows for the emergence of a homogenous race identity that assumes that all people of a race group are alike regardless of class, gender, sexual orientation, place of origin, religion, language etc. Giroux (1988) has recognized that the assertion of a homogenous community has also been used to promote racist practices of dominant groups.

In apartheid South Africa race was that identity used to legalise social categorisation. Race was organised on the basis of origin together with the physical appearance of persons. Persons of European origin including the British were classified as White. The Japanese and Chinese occupied the position of 'Honorary' Whites. Those who were the result of relationships between Whites and any other race group were categorised as Coloured. Persons of Malaysian, Javanese and Batavian origin were 'Other' Coloured persons. Persons of Indian origin became Indians. All persons of indigenous African origin were classified as Black. Blacks were further categorised on the basis of ethnicity into at least fifteen other groups such as Zulu, Xhosa, Sotho etc. Physically the White had light skins, straight hair, aquiline noses and narrow lips. If at any time the identity of a White person was in doubt the person ran the risk of being re-classified as a Coloured. Reclassification was on the basis of the pencil-test, skin colour and or nose-width (as explained earlier). Adherence to legalised social categorisation was strictly enforced and did lead to persons being reclassified from White. In South Africa race then was not a fixed construct. Its fluidity was located in the classification of the 'Honorary', the 'Other' and the re-classification of White to Coloured. The social categorisations of persons as White, Coloured, Indian and Black, a legacy of apartheid, is still used as a valid set of social categories in the present democratic South Africa.

Duesterberg (1999) proposes a concept of race as performance. For her performance emphasizes the power of discourses about race to determine social positioning and action and, at the same time, considers meanings about race as enacted or performed in particular social and historical contexts. Race as performance allows for individuals to accept responsibility for the meanings they make and the performances they undertake, and for the destabilizing of the discourses that fix identity and support unequal and unjust social and institutional practices (Duesterberg, 1999).

In constructing race as a Black phenomenon, Whites create a protective invisibility around themselves (Brieschke, 1998; McLaren and Torres, 1999; Proweller, 1999; Carter, 2000). The invisibility is partly due to the historical delinking of White from the notion of colour in contrast to the conventional identification of Black as a colour. Proweller recognises (1999) that '*Whiteness is easy to ignore because the conditions are in place for those at/in the centre to forget what has been*

manufactured and secured through its own invisibility and omission' (p 783). This has happened because the focus of inquiry in race discourse has been mainly on the racial 'other' at the expense of those living their lives at/in the racial centre as White (Proweller, 1999); a focus on the victim of racism than the recognition and inclusion of perpetrators of racism (Carter, 2000). Analysis of race identity and discourse has, in schools, continued to pay attention to students of colour in the main while consistently ignoring any examination of how Whiteness is embodied in school policy practice. This was true also for the school where I was located. Here, people of Indian origin were the dominant, privileged and powerful group. This group occupied the position of 'Whiteness' in their relationship with persons of Black African origin at the school. For Proweller (1999) Whiteness refers to *a set of meanings and practices that provide White people with a perspective through which they experience the world. This lived standpoint [being] discursively constructed in relation to ideologies of privilege and domination* (p777).

Race continues to be a critical element in the institutional and organisational life including that of schools. In this instance of identity production Whiteness, like all colours continues to be through institutional arrangements. Institutions have and continue to be designed as if hierarchy, stratification and scarcity were and are inevitable. Schools do not manage race; what they do is they create and enforce racial meanings through which Whiteness grows as a seemingly natural proxy for quality, merit, and advantage, and colour disintegrates to embody deficit. In this way the institutional design of Whiteness, like the production of colours, creates an organisational discourse on race and a personal embodiment of race. This then affects the perceptions of self and others and is what produces the individual's sense of the various race identities and collective experiences of racial tension and even coalitions. Once this process is sufficiently institutionalised and embodied it then escapes notice and is for this reason easily missed within the institutional choreography. What remains clear is the White quality that rises to the top where it appears to remains fixed. It is for these reasons that the focus should become how Whiteness is 'invisibly' created and maintained (Carter, 2000).

Whiteness has been effective in the formation of coalitions that have united people across cultural differences, across class and gender relations and against their best interests in places such as the United States of America where White persons make up the majority group in the country. It would not be possible to write the history of economic, political, legal, health, educational, indeed all institutions, without centring the politics of Whiteness either consciously or unconsciously as a core dynamic. Critical theorists have documented that racial forms and identities are the constitutive

building blocks of the structures of daily lives, imagined and real communities, and cultural processes and products (Apple, 2001; McLaren and Torres, 1999).

Looking at the situation closely reveals that race as a category is applied to non-White peoples. White people are usually not seen and named. They are centred as the human norm. Others are raced; Whites are just people. The challenge then becomes one of seeing Whiteness for the purpose of dislodging it from its position of power, with all of the inequities, oppression, privileges and sufferings in its train and in this way dislodging Whites by undercutting the authority with which they speak and act in this world (Apple, 2001). Whiteness' efforts on tolerance and respect for difference and diversity occurs from a position of paternalism that serves only to (re)centre race privilege leaving Others at the margin – an outcome of the negligence of such projects never questioning how Whiteness has advantaged and at whose expense (Proweller, 1999).

Apartheid South Africa also allowed for coalitions of White persons across the South African spectrum. Whiteness was advantaged and dominated all spheres of daily life even though Whites were a minority group. The shift from apartheid to democracy has meant a shift from the dominance of Whiteness in most spheres. Politically, legally and in most aspects of socio-cultural structural and organisational life Blackness now dominates since it is Black persons who make up the majority of persons in South Africa. Whiteness continues to retain its hold and determines the agenda in the economic sphere including who becomes advantaged through Black economic empowerment projects. This raises questions and challenges about where advantage and dominance truly reside and needs to be elucidated through studies that focus specifically on the advantage and dominance of Blackness in a terrain of White economic power.

The negligence of advantaging Whiteness is what ensures that race is silenced in schools and in education; a negligence that derives from silent social pressures not to name those aspects of education related to race and racism (Carter, 2000). This negligence serves to ensure the absence of conflict that could erupt around difference and in this way also works to domesticate race. 'Tolerance' is useful to Whiteness in that it prevents any challenge and disruption of inequalities based on race. Tolerance's discourse of 'harmony in diversity/unity in diversity' persists in reproducing the systemic inequities in schools and society. In such situations Black students often voluntarily silence themselves by refusing to respond to teachers and students on issues of race. In this way they redirect race discourse away from themselves and then work at managing it on their terms either silently or within their own race groups (Proweller, 1999). Disrupting tolerance and the

unsilencing the silenced will require that for those privileged by race, including both students and teachers, to develop a critical reflective consciousness of privileged race positionality and an understanding of the 'commonsense' ideologies that mask the benefits of occupying positions of race privilege (Proweller, 1999).

The school where I taught had originally been established as a school for Indians only in 1960 – as was in keeping with requirements of apartheid. The school opened its doors to students of the different races in 1984 as part of its and its wider Indian community's resistance to apartheid. In 1994 the opening of the school to all races shifted from resistance to a legislated act – as South Africa moved outside of the apartheid era. Students of mixed origin, Coloureds, although few then enrolled at the school. White students never sought enrolment at the school. This perhaps is grounded in the notion that only those schools formerly designated for White persons offered the 'best' education, had the 'best' standards and did have the most physical resources for both the formal and the sports curriculum and also provided the normative 'Whiteness' required for global success. The teaching and administrative staff at the school were all of Indian origin. The only Black staff were the cleaners.

At the school the Indians based on their historical relationship with the school, their dominance in number, their facility with English as the favoured language with status and on their relative wealth assumed the mantle of invisibility as the privileged, powerful and dominant race group. As a group their invisibility gave them the position of being 'just people' who through just being determined the normative. Anybody that was not Indian was viewed as the inadequate Other that then also became the downtrodden. It was this invisible dominance that silenced and domesticated race at the school and made it possible to 'tolerate' that which was not Indian.

Since the understanding of race continually changes and is constantly challenged, interrupted and reconstructed in and through the actual practices in which people engage and in the discourses that they employ Scheurich and Young (1997) recognise race as a mobile social construct. Race for them thus is located in '*historically and socially situated race-based cultures that are tied both positively (i.e. cultural pride) and negatively (i.e. racism) to skin colour* ' (p 12) They also make clear that both skin colour and '*one*' race exhibit great variations and that the experiences within the race-based group varies also amongst members of the 'homogenised' race group.

Given the present prominence of race in society Carter (2000) believes that it is '*reasonable to conclude that it is very difficult to be socialized in this society without internalising, consciously or unconsciously, negative beliefs about People of Colour and positive beliefs about Whites*' (p 874) or the dominant race group. I now turn to how negative beliefs and emergant oppressions on the basis of race has led to that called racism.

2.4 RACE AND RACISM

Biological, socio-cultural, ideological, structural, institutional racism and civilisational is how racism comes to be to be acted out in various forms in society. Notions of racism as dysconscious, unintentional, benign, a cultural secret and as colour blind is how racism then comes to be operationalised through the various forms of racism. Race is conflated with racism and is also used as an organising principle that serves to strengthen and in this way perpetuate racism as discriminatory practice. This practice is located not in singular racism but in a plurality of racisms.

As part of Bonilla-Silva's (1996) efforts at rethinking racism he traced the history of the notion of racism. He notes that the notion racism was first used in 1945 to describe the principled understanding that one race/ethnic group was condemned by nature to inferiority from birth while another group was destined to superiority from birth. By the late 1960's this understanding had not changed fundamentally and for the social sciences racism was understood as '*any set of beliefs that organic, genetically transmitted differences (whether real or imagined) between human groups are intrinsically associated with the presence or the absence of certain socially relevant abilities or characteristics, hence that such differences are a legitimate basis of invidious distinctions between groups socially defined as races*' (p 465). By 1990 the definition became refined and appeared in a concise form that understood racism as '*a doctrine of racial supremacy, that one race is superior*' (p 465). This idealism according to Bonilla-Silva (1996) has produced '*a schematic view of how racism operates in society - where racism as a set of ideas or beliefs has the potential to lead individuals to develop prejudice, defined as negative attitudes towards an entire group of people, and that the prejudicial attitudes may induce individuals to real actions or discriminations against racial minorities*' (p466). Alternative perspectives on racism include Marxist conceptualisations that prioritise class and see racism as an ideology within the context of class dynamics. Both the institutional and internal colonialist perspective understands racism as that which allows for the dominant/White race to institutionalise and dominate at all levels in society. Winant's (2000) racial formation perspective defines racial formation as the *sociohistorical process by which racial categories are created, inhabited, transformed, and destroyed.* In this view race becomes the

organizing principle of social relationships that shapes the identity of individual actors at the micro level and shapes all spheres of social life at the macro level. This view obscures the social and general character of racialized societies for Bonilla-Silva. Racism for Bonilla-Silva '*only describes the racial ideology of a racialized social system and racism is only part of a larger racial system*' (p467) where a '*racialized social system refers to a society in which economic, political, social, and ideological levels are partially structured by the placement of actors in racial categories or races*' (p 469).

Racism for Thompson (1997) within an institutional/structural and embodied/cultural framework is understood as *a system of privilege and oppression, a network of traditions, legitimating standards, material and institutional arrangements, and ideological apparatuses that, together, serve to perpetuate hierarchical social relations based on race* (p9).

Various perspectives have each contributed to how racism has come to be understood. The ideological perspective has through its theorisations contributed to realisations of the other proposed perspectives such as the sociological, the institutional, the internalised etc. In keeping the various perspectives separate from each other artificial barriers have been erected that serve as a panacea for the actual and real pain caused by the injustices of racism. These artificial barriers serve also to allow for the perpetuation of racism since each perspective on its own makes it possible to excuse racism as benign – there, but not harmful and therefore acceptable.

For me racism, an unjust and painful social reality, is located in race differences based on observed phenotypes used to distinguish between the dominant superior and the subordinated inferior. The demarcation between the dominant superior and the subordinate inferior is not clear-cut and precise – there are various levels as one progresses from **the** dominant superior to the less dominant superior and along such a continuum through to the less subordinated inferior to the **most** subordinated inferior. The fuzzy demarcations along this fluid continuum are determined by economics, politics, ethnicity, gender, culture, religion, language, population number and xenophobia. These are not the only variables that determine postionings along this continuum. The variables themselves will emerge and shift as groups decide on what it is that is to be valued. In racism it is race that works in a variety of combinations with such variables that determines the dominant superior and the subordinated inferior. At times race will be the primary variable determining such social postionings and at other times race will operate equally with other variables in determining who it is that is the dominant superior and the subordinated inferior. Racism thus in

not grounded purely within race differences. While race is prioritised, race works in combination and in concert with a multiplicity of variables to advantage one group and to variously subjugate other groups. It is then that allows for the existence of the various fluid social hierarchies at the same time within the same space.

King (1991) spoke of a '*dysconscious racism*' that she defined as

> '*an uncritical habit of mind including perceptions, attitudes, assumptions and beliefs that justifies inequity and exploitation by accepting the existing order of things as given ... dysconscious racism is a form of racism that tacitly accepts the dominant White norms and privileges. It is not the absence of consciousness (that is, not unconsciousness) but an impaired consciousness or distorted way of thinking about race as compared to, for example, critical consciousness. Uncritical ways of thinking about racial inequity accept certain culturally sanctioned assumptions, myths and beliefs that justify the social and economic advantages White people have as a result of subordinating diverse others*' (p135).

Racist practices do not require intentionality but can still be racist because of the effects of the practice (Dei, 1996; Cole, 1998). In these instances racism exists as a benign racism. The assumption with this understanding is that lack of intention results in the racism causing lesser pain and harm. Racist experience is unjust and will cause harm and pain. Speaking of racism as not intentional and benign in efforts to perhaps justify it as causing lesser pain and harm in effect serves to give to racism a level of acceptability. This justification and the resulting acceptability then begs questioning. Racism shapes meaning through an implicit set of contrasts of which we may be unaware. Meanings framed by racism are not simply personal interpretations. They are preframed for perception by a complex system of social relations e.g. femininity of the untamed sexuality of Black women and the romanticised innocence of White women (Thompson, 1997).

Racism for Cole (1998) includes also seemingly positive characteristics to assert superiority of the dominant group and to justify biological and cultural racism. Racism is a process, which can be intentional or unintentional, whereby social relations between people are structured by the significance of the human biological and/or cultural characteristics in such a way as to define and construct differentiated oppressed, inferior social groups. The oppressed, inferior groups are assumed to have natural, unchanging origin and status. They are seen as being inherently different

and as causing negative consequences for superior groups. For the superior groups they are also seen as possessing *'certain evaluated characteristics'* or '*stereotypes*' that distort and mislead (p 42). The stereotypes, even though they may appear at some point as positive, are in the final analysis negative.

Berlak (1999) regards racism a '*cultural secret*' (p 108) in the sense that it remains largely unfelt, unspoken, and unacknowledged in the public discourse, in the media, and in schools and in university classrooms. For Berlak making visible the cultural secret of racism in classrooms rests on the assumption that teachers – both White and of colour – need to understand and feel at a deep level how racism affects and has affected them and others personally. Without this understanding and feeling teachers will be unable to understand the impact of racism on students and will continue to contribute to the reproduction of racism both within their classrooms and beyond. In apartheid South Africa race together with culture was one of apartheid's assets for the maintenance of racism and race and culture were always openly spoken of as mutually inclusive of one another; resistance to racism in apartheid meant that race continued to be part of the public discourse. Post-apartheid South Africa continues with the legacy of race discourse within the public sphere as part of popular effort towards antiracism. Racism however, continues to be part of the post-apartheid South African experience. This then dispels the notion that racism continues to exist because of the secretiveness surrounding it.

For Bonilla-Silva and Forman (2000) the politics of a colour-blind racism continues to justify the existing racial status quo through liberal, free-market and the pragmatic rhetoric of the dominant racist theorisations that allow for the defence of the existing racism in non-racist ways. Colour-blind racism's defence includes the rhetoric of claims of believing in equality, of discrimination as having ended in the sixties (United States of America) or with apartheid (South Africa), of the status of the oppressed poor being the outcome of their laziness and of affirmative action as nothing more than reverse discrimination. In post-apartheid South Africa colour-blind racism at schools continues to be verbalised through school principals, managers and teachers claiming in the public discourse that they do not see colour but only children.

For as long as racism continues to be theorised as dysconscious, unintentional, benign, a secret, colour-blind etc. racism will continue to be afforded silent legitimation that will then afford it a respectability despite the injustice, pain and harm it brings to bear. This silent legitimation and respectability afforded racism will also work towards its sanitisation in the public sphere through

'lessening' and in this way 'purifying' negative human experiences. This then will ensure for the continued persistence of racism.

Race is often conflated with racism in a variety of ways such as when race is understood as collective identity, a culture-bearing phenomenon that sets groups of people apart from each other and membership in a discrete cultural group invites a certain type of recognition by virtue of its public nature i.e. race equals script (Brieschke, 1998). Another instance of race's conflation with racism occurs when race equals biology – here Whites perpetuate racism through continued emphasis on race as a biological difference. This too provided a basis to apartheid's legalized racism in South Africa – a systemisation that continues to operate in post-apartheid times to determine and differentiate between South Africans on the basis of race. A third way is through the desire for objective truth. Here the idea is that race is '*a fixed, objective phenomenon and identity is an essentialist concept*' (p 55). Here race is conflated with racism in that an objective epistemology decontextualizes the racial experience and deflects conversation away from our own participation in such experience. The desire for a grand narrative that explains race outside of our human interaction is a way of erasing half of the equation in the social construction of race. A fourth way involves withholding recognition through the denial of others' experience or an unwillingness to listen thus withholding recognition desired by diverse groups. A fifth way involves locating '*social categories defining collective identities within the provenance of government agencies*' (p57) in a politics of recognition within and from historically racist White culture. The final way involves the blurring of boundaries in an effort to move beyond a Black and White palette. The challenge is to reflect on and articulate through others how we integrate, reject and modify aspects of cultural heritage as we blur the boundaries. Conflating race with racism results in dialogues where one cannot be spoken of without the other. Thus talking about race invokes racism in ways that will then reveal participation located in politics of recognition and identity.

Racism fails to recognize other standpoints/centres/perspectives; it stigmatises outsider groups as inherently inferior, whether such groups are seen as threatening, unworthy, or unreliable or as benevolent and childlike (Thompson, 1997). The dominant race exists in a paternalistic relationship with the 'childlike' race because the dominant race is more 'civilized' than the childlike race. Racism in insisting on the otherness of outsider groups specifically generates the category of race as an organizing principle of social meaning and then works to naturalize hierarchical relations so that oppressed minorities appear inherently inferior, suspect, or undeserving. Racism is a question of how the privileges of Whiteness or that of the dominant race group come to be identified as

"natural", while Blacks and people of colour that is the people belonging to the subordinate race groups are put on the defensive and required to establish their belongingness to the satisfaction of those in power. Thompson's understanding has applicability in the United States and those parts of the world where White people were and continue to be in the majority and dominant. Her understanding does not reflect the reality of parts of the world such as in Africa or Asia where Whites were the minority and also the civilised, paternalistic and dominant during colonialist rule. In apartheid South Africa the White minority, in their benevolence, set the standards that would enable for the development of the great numbers of noble savages into a civilised people.

The post-apartheid South African landscape provides new insight into the changing nature of dominance. Politically and through it socio-culturally it is the majority Black that dominates in the historical present. Economically it is the White minority that is dominant. This fluidity of dominance blurs the location of power and allows for the coexistence of various racisms from positions of Blackness and Whiteness. This blurring also contributes to racisms' legitimation through various forms that include amongst them the dysconscious, benign, unintentional and colour-blind.

Scheurich and Young (1997) in questioning whether research epistemologies were racially biased provided a category of racism called '*epistemological racism*' (p6) which for them emerges from what they called the '*civilisational level*' (p 6). It is this level that:

> '*encompasses the deepest, most primary assumptions about the nature of reality/ontology, the ways of knowing that reality/epistemology and the disputational contours of right and wrong or morality and values/axiology – in short presumptions about the real, the true and the good*' (p6).

While there exists a '*a powerful social tendency*' (p11) amongst the dominant group to define racism as mainly '*individual*' or as '*limited institutional*' (p11), racism also exists at societal and civilisational levels that society does not engage with. At the individual level overt and covert forms of racism operate – the former being public, conscious and intended act/s and the latter being not explicitly public. Institutional racism within institutions/organisations operates when cultures, standard procedures, rules, habits and symbols of the institution/organisation favour the dominant race and hurt members of Other races. At the social level, societal racism exists when prevailing socio-cultural-historical assumptions, norms, concepts habits, expectations favour the dominant

race. Broad civilisational assumptions that members of a civilisation are not conscious of exist at the civilisational level (Foucalt's archaeological level)[3]. It is these assumptions that are deeply embedded in how the members of a civilisation think and the concepts/categories that they use to name the world/the Real – and which differ from civilisation to civilisation. A basic assumption in the modernism of Euro-American civilisation is civilisational racism within which contemporary dominant research traditions are located. It is from this perspective then that contemporary dominant research epistemologies are racially biased – including the critical tradition. This remains true despite the critical's tradition of not participating in the production of the negative consequences of epistemological racism and consistently opposing racism in its many forms and aspects. For me while this is just one other way of a critical exploration of racism within that terrain that encompasses critical racism, antiracism and critical antiracism does not the location of an epistemological racism at a civilisational level contribute to the continued location of racism outside of everyday experiences that serves to turn racism then into an abstraction. Is it not this abstraction then that justifies and allows for the unacknowledged persistence of racism within the dominant research traditions?

Race, like racism, is not a stable category. Its meaning, its usage, by whom, how it is activated in public discourse and its role in educational and general social policy in the historical present is informed by the historical past. It is misleading to talk of race as an "it". "It" is not a thing, an object that exists outside a person and that can be measured as if it were a simple biological entity. Despite the fact that race is a social construction and a set of social relationships it continues to be spoken of in simplistic ways that then make it possible to ignore the realities of differential power and histories. In this way the existing complexities that are inherent to race can also be legitimately ignored. Although race dynamics have their own histories and are relatively autonomous they continue to participate in, form and are formed by, other relatively autonomous dynamics involving gender, class, religion, language etc. – all of which are implicated in and contribute to the social construction of race. Race dynamics, like the dysconscious, benign, unintentional, secretive and colour-blind forms of racism, also operate in subtle and powerful ways even when they are not on the minds of the actors involved (Apple. 2001).

[3] In various forms the need to preserve the sovereignty of the subject has given a place to the search for a total history in which all differences in society may be reduced to a single form – a coherent type of civilisation at which the 'Real' is constituted – which he later critiqued. Source: Foucalt , M (1972): *The archaeology of knowledge*; Routledge,; New York

Given the present prominence of race in society, Carter (2000) believes that it is *reasonable to conclude that it is very difficult to be socialized in this society without internalising, consciously or unconsciously, negative beliefs about People of Colour and positive beliefs about Whites* (p 874).

For Dei (1996) the centrality of race continues to play a significant role in the rise of racism. According to him:

> *The insistence that race is a socio-political construct has not rendered race or racism obsolete ... cultural racism is on the rise ... the mixing of cultural and biological facts still prevails ... Race is central to all structures , institutions and social discourses in society. Race is used to include, exclude, superiorize and inferiorize peoples. Race does not operate alone but is linked with other issues of social difference ... and therefore a study of racism requires a study of class exploitation, sexism and homophobia* (p258).

The current rise of cultural racism in Euro-America is evident in the political response of Europe, Britain, the United States, Australia etc. to the Muslim Middle East. The events of 11 September 2001 served to justify previously existing cultural racism founded on a fear of the Middle Eastern Muslim 'terrorists' whose intention was the destruction of the free-world democracy practised by Europe and especially the globally powerful United States of America. It has and continues to provide the political validation for the continued rise of cultural racism through the demonisation of the race of Osama bin Laden, Yasser Arafat, and Sadam Hussein and those with links to groups such as Al-Qaeda and Hamas. The rise in racism towards those with Middle Eastern Muslim links, no matter how tenuous, is evident in the relentless persecution of any persons who appear to be linked with Middle Eastern Muslim 'terrorists' – especially by the political machinery of the United States of America. The persecution and prosecution occurs wherever this machinery is able to extend its tentacles across the world. The mixing of the cultural with the biological in determining the Middle Eastern race of a Muslim emerges in persecutions and prosecution based also on just the physical resemblance of persons to those of Middle Eastern origin. The same is also true for the experiences of German-Turks at the hands of the Neo-Nazis in Germany; the Swedish-Lebanese in Sweden; Pakistani's in Britain; Dutch Muslims in Holland etc. Biological identity conflates with cultural identity in current race-based responses by the dominants in their efforts at subjugation.

The current cultural racism of Euro-America is different from the biologically–based racism that is the dominant racism in post-apartheid South Africa and Mugabe's Zimbabwean public political response to Britain from the perspective of biological racism. This serves to highlight that racism must be conceived as different. The difference in the types of racisms will be informed by that which dominates for each space and time not only across nations but also within local spaces where variables such as ethnicity may become the signifier of difference – as for example is the case with the Hutu's and Tutsi's in Rwanda and Zulu's and Xhosa's in South Africa.

For McLaren and Torres (1999) race is a sociological reality and operates as a form of social ontology in that it indicates through '*using culturally various historical categories involving determinants marked on the body through the interplay of perceptual practices and bodily appearance*' (p 49). For them that definition of race as '*a concept that signifies and symbolises socio-political conflicts and interests to different types of human*' (p62) bodies indicates that race is an everyday phenomenon and an ontological category that is socially and historically constructed and implicated in social structures, identities and signification systems. Race thus articulates with power, ethnicity, gender, nation and class. This articulation of race then brings into question the continued use of race as an analytical category when used in isolation from historical and material relations. A shift from such an analytical use of race requires a shift to a plural conceptualisation of racisms and their historical articulations with other ideologies and capitalist social relations.

The plural notion of racisms, as discussed earlier, will allow for the historically specific nature of racism and the variety of meanings given to evaluations of difference and assessments of superiority and inferiority of various groups of people to be captured more accurately. This then has the implication that explanations guided by a critical theory of race will lead to a theoretical and political dead-end – given the analytical trap that surfaces when race is used as an isolated analytical category and which conceals the sets of social conditions experienced by racialised groups that are determined by the interplay of complex social processes – one of which is premised on the articulation of racism to make possible legitimate exclusion. It is the use of race as an analytical category that makes possible claims by the 'Herrnstein's and the Murray's' (1994) of the scientific world that academic performance is outcome of race. It is racism as an ideology that produces race; the task then becomes one of deconstructing race and detaching it from the concept of racism within the context of the plurality of racisms and exclusionary social processes that continue to perpetuate racialised social relations rather than race relations. Racism, for McLaren and Torres (1999) developed out of the systemic slavery of the New World. The dominant

understanding of the civilised paternal White provided the justification for the enslavement of African who by nature was inferior. In enslaving the inferior the civilised were performing a service to the inferior through the paternal care such enslavement would provide to the inferior. The link between slave labour and the success of colonial plantations became silenced through such justification. The systemic slavery on colonial plantations girded the racism of the New World.

Regardless of how racism is defined or from whence it came what is clear is that racism permits for the existence of a dominant hegemonic group and a subordinate oppressed group. Both these groups are significant in any attempt towards social justice – the dominant hegemonic group markers need to be identified and acknowledged for any constructive interaction and engagement with the group towards social justice; and the subordinate oppressed group markers too need to be identified and acknowledged for such constructive interaction and engagement. Such interaction and engagement will make possible for shifts in power – with the dominant hegemonic group relinquishing power and the subordinate oppressed group becoming empowered – in the course towards social justice. How racism exists in different localities cannot be ignored. This recognition is what will allow for the unmasking of the challenges specific to the different localities/contexts. What exists in the United States of America is very different to what exists in South Africa. In the United States of America Whites are the majority dominant group and in South Africa they comprise a minority that dominate mainly at the economic level. The plurality of racisms that exists and the fluidity of the pluralisms that operate at the different localities/contexts and within the localities/contexts themselves must also be recognised. For this reason understandings, whether in the form of theorisations or in the form of actual experience, cannot be exported to explain racism as a homogenous experience as localities/contexts and prevailing conditions differ.

2.5 WHAT COUNTS AS EDUCATION

Classrooms should be sites where students can interrogate experiences that shape their identity (Filax and Shogan, 1999). This is a vital part of the political nature of education. It is through such interrogation of what shapes identity that students can become active agents in changing the course of their own destiny/destinies as privileged or discriminated – from within the classroom to the outer spheres of the wider community and society.

Currently, schools as institutions and the curricula that operate within them are based on theories that suggest how it is that students learn best and what is best to learn. In this way we produce what

Foucalt (1974) describes as fictions that operate as truths. It is these fictions that continue to support the teaching towards the raising of standards (Cotton, 1998, p36). In this way we produce exactly what the fictions describe, and the circle becomes almost impossible to break. Foucalt (1980) describes how this circularity of truth is formed: *'truth is linked in a circular relation with systems of power which produce and sustain it, and to effects of power which it induces and which extend it'* and this form of truth '*was a condition of the formation and development of capitalism*' (p 133).

Giroux (1988; 1998; 1999) recognises that while it is crucial to see schools as social sites in which the class, gender and racial relationships that characterise the dominant society are roughly reproduced, it is equally important to make such an analysis function in the interest of developing alternative pedagogical practices. The first step in developing such practices would be to focus on the relationship between the school culture and the overt and covert dimensions of the curriculum on the one hand, as well as the contradictory, lived experiences that teachers and students bring to school on the other. It is in the relationship between school culture and contradictory lived experiences that teachers and students register the imprints and texture of domination and resistance.

Giroux (1988; 1998; 1999) suggests that for critical teachers working in schools we can make the pedagogical more political by clarifying how the complex dynamics of ideology and power both organise and mediate the various experiences and dimensions of school life ... fundamental (to this) would be the opportunity for students to interrogate how knowledge is constituted as both a historical and a social construction.

Do teachers question discrimination/racism in education is a question that must be asked especially in South Africa. In asking these questions then other questions are raised such as where do they think it exists in their schools, if at all, and how do they understand it to operate. Do teachers see the racisms as residing in students, other staff, themselves, Whites or people of colour? Do teachers recognise the hidden ways in which a dominant hegemonic power operates in the curriculum and in the various aspects of the school environment – by either denying, tokenising and/or distorting people who are not part of the dominant group? Are teachers even aware of and do they recognize the relational aspects of racism to power, class, gender, religion and language relations in education and in the classroom (Kailin, 1999)? There is also a need to question whether the teachers themselves play a role in sharpening /reinforcing/diminishing discriminatory stereotypes. Just having contact with others does not lessen discrimination if the quality of the contact does not

counteract the underlying discriminatory social divisions. Most persons belonging to the dominant group, as may happen with teachers, do not recognize themselves as being discriminatory/racist and believe that discrimination/racism exists somewhere else outside of themselves and to be someone else's problem; existing institutional racisms also evades them. In her study Kailin (1999) asked these questions and found that teachers from the dominant group chose to blame the victim whom they identified as the problematic other when faced with the issue of racism in education. For Kailin (1999) the dysconscious racism of teachers was an outcome of the dominant discourse that existed in education.

Education is political in that it is expected to prepare students to become active citizens. For education to count as education, it must provide for an enlargement and deepening of experience – for enhanced understanding of relations or implications not readily available to uninformed perception. A meaningful education speaks to actual experience while also teaching students to examine their experience in terms that press against the boundaries of convention and of immediate perception. Non-educative schooling allows students to pile up facts and skills, yet fail to speak to their experience or understanding; and miseducation confounds understanding and experience, preparing students for a world that does not exist – a world, for example from which social obstacles and economic barriers have magically been erased (Thompson, 1997).

A politically relevant pedagogy (a renaming of the culturally relevant pedagogy of Ladson-Billings (1994) and Delpitt (1995) amongst others) emphasizes political, historical, social and cultural understandings. It is this pedagogy that for Beauboeuf-Lafontant (1999) is relevant to the political experiences of inequality and disenfranchisement of students. In a politically relevant pedagogy teachers understand the importance of their power and their influence on students' lives. Although such teachers are often unable to influence school-wide policies for their students, politically relevant teachers are invested in their classrooms and to the possibilities they can encourage in their classrooms. They recognise the lack of support for their emancipatory practices and philosophies and therefore operate subversively. They understand their classrooms as sites of resistance and take control not given them in the school power hierarchy. The control translates itself into student-centred classes within what the teachers' perceive to be oppressive, inequitable schools and set themselves up as advocates and 'gate openers' for students. For Beauboeuf-Lafontant (1999) '*A major obstruction to teachers' connection with the content of schooling is that very often public schools silence discussions of political contradictions and the need for social justice*' (p716). Education policy provisions in South Africa provides for student–centred classes. The policy

provisions also provide for politically relevant curricular possibilities through the critical and learning outcomes. Teachers at the school may also influence school policy development since school policy development is seen as that which involves all teachers. Yet in post-apartheid South Africa where the possibilities for legitimated politically relevant pedagogy abounds such pedagogy is rare to non-existent and miseducation dominates. Politically relevant teacher focus remains in the main grounded on employer-employee labour issues. The death knell for a politically relevant pedagogy is spelt out also in the continued persistent labelling of students as culturally different, disadvantaged, English second language persons within English first language aspirations and raced as in African, Coloured, Indian and White. This reveals that the existing culture in schools continues to centre on the experiences, realities and aspirations of the White middle-class and consequently, public schools silence what then become discordant voices and perspectives. It is this silencing that affects the daily experiences of students and forces many of them to pawn their awareness of existing inequities for the persona of a good student (Beauboeuf-Lafontant, 1999). As shared by Fine (as quoted in Beauboeuf-Lafontant, 1999)

> '"*Good students" ... trained themselves to produce two voices. One's "own" voice alternated with an "academic" voice. The latter denied class, gender and race conflict; repeated the words of hard work, success and their "natural" sequence; and stifled any desire to disrupt ... The price of success may have been muting one's own voice*' (p 716)

This analysis highlights the reality of miseducation. Good students accept the instruction not to question social inequality; they learn to align themselves, consciously or not, with the norms of the schools they attend – norms that perpetuate the existing status quo at the school and its ties to social injustice. In this way students are not educated to see schools and themselves as possible sites for fostering social justice.

Power in the classroom and school is manifested in many ways. One of the ways is through controlling the conversation/dialogue/discourse. This can happen in a classroom from the positioning of the teacher and the teacher who talks, the fact that the teacher talks, the way the teacher talks, when the teacher talks, whom is addressed, the message related, the contents presented or discarded, who is dismissed, who is validated – all denote power and control. It is this needs to be made explicit by raising it in the classroom (Fernández-Balboa, 1998).

An education that provides students with the knowledge and dispositions to struggle against the variety of oppressions will ultimately help towards creating a more just and equitable society – on other words an education towards social justice (Gutstein, 2003). Such an education requires taking of differences seriously so that the difference they make and to whom can be seen – though the long-term effects of institutionalised oppression. Difference has to be understood as power-laden social constructs reflecting social position and containing powerful social meanings. In a society where structural inequalities are the norm being Black, female, queer, poor, language 'deficient' etc. means being less than. Thus, this demands examining head-on the existing, prevalent systems of oppression and means being prepared to see, hear and feel the emotions that accompany the variety of oppressions – both institutionalised and internalised (Kohli, 1996). However, as hooks (1994) reminds us this is a scary arena for teachers because it could mean losing control of the classroom:

> *'The unwillingness to approach teaching from a standpoint that includes awareness of race, sex and class is often rooted in the fear that classrooms will be uncontrollable, that emotions and passions will not be contained'* (p39).

Classrooms, however, are not spaces where conflict and emotions are engaged with safely. Educators try to avoid crises and foreclose stuck places in order to maintain control over what students learn and how they behave (Lather, 1991, p138). It would be safe to say that conflict and emotions that trigger crises and stuck places in the classroom are ruled out of existence as soon as they make an appearance through the teacher's authority, the existing school rules and regulations and the school ethos. In South Africa it is the preoccupation with effectiveness, efficiency and performance that continues to be that, which counts as education. However, if we are serious about teaching and educating for democracy and social justice then we need to be concerned with differences in our classrooms and be prepared for the consequences of taking those differences seriously (Kohli, 1996, p12).

2.6 WHAT COUNTS AS SCIENCE EDUCATION

Science as a discipline owes it position of power to its institutionalisation during the eighteenth century by the Royal Society of England and academies in Europe and the United States of America. These academies made science a powerful force in the hegemonic projects of the civilized world. The scientific establishment provided '*objective evidence for the natural inferiority of women, homosexuals, the lower classes, the colonized and the enslaved*' (Norman, 1998, p 367). This objective evidence allowed for these marginalized groups to be mere signs to be interpreted

and incorporated into explanations where the sole aim was the consolidation of the position privilege of the European male at the top of gender, class and race hierarchy as natural and legitimate. Science provided evidence to override any notions about the equality of all human beings (Norman, 1998).

Biology has played a central role in the construction of race. Norman (1998) notes that science's construction of race as biological in the eighteenth century occurred initially through Lineaus' taxonomy. Lineaus, the father of taxonomy, in defining human races taxonomically and gave scientific credibility to racist beliefs thus changing them to scientific facts. In his *Systema naturae* published in1758 (Norman, 1998, p 367) he distinguished between *Homo sapiens afer* and *Homo sapiens europeanus. Homo sapiens afer* who was the Black African was described as being ruled by caprice and *Homo sapiens europeanus*, who was White European, was said to be ruled by custom. This construction of race was further consolidated through the evidence provided by cephalic indices and other quantitative measures - used to validate racial superiority and inferiority; craniometry provided the data for polygenic notion that different races had diverse origins. In this way racial prejudices were expressed through scientific terminology allowing for validation through dispassionate and rational scientific inquiry. Apartheid in the twentieth century in South Africa used this biological construction of race to legalise its policy of racism.

Science according to Norman (1998) also provided the basis and justification for gender stereotyping and discrimination with the female body being described as incomplete and deviant by Munro who was the leading anatomist in the middle of the nineteenth century. This description was obtained through using the male body as the only standard of measure. Anatomists constructed the female physiology to support only the idea that the primary social function of women was reproduction and childbearing. Craniometric data substantiated the intellectual inferiority of women; physical, intellectual and moral weakness and deviance of women, as compared to the physical, intellectual and moral perfection of the upper-class male, provided the groundwork for curtailing women to a domestic existence and for her continued protection and control by men. Patriarchy was further entrenched through the cause of disease that was used to explain female weakness.

Feminist philosophy claims, according to Applebaum (2001), that reason is constructed as male or masculine. Reason or rationality has been developed in ways that exclude women from the public sphere and devalues notions of femininity such as emotion and intuition and the nature of women.

The notion of reason needs to be understood as a set of gendered practices that have assumed a universal status. In modern times reason has been defined in opposition to the feminine in ways that excludes, transcends and dominates the feminine and characterises women and their concerns as irrational and material. In tying reason to masculinity, maleness validates patriarchy and its dominance and hegemony in male-female interactions and in the power afforded to males within a fluid continuum of race.

In the late twentieth and early twenty first century science has retreated from its earlier aggressive pursuit of legitimising particular notions of race, class and gender. It has however, adopted a position of silence on these issues. Does the silence mean that these issues are outside the legitimate scope of science or is the silence part of the continued dominance of a hegemonic Whiteness? The silence extends to the works of the few mainstream scientists such as Gould and Haraway - scientists who have consistently questioned and opposed scientific racism and sexism – their works remain on the margin of legitimate science discourse (Norman, 1998).

In science education only certain groups have been privileged in the curriculum through selective inclusion and exclusion of material and through the teaching of science as a neutral subject. Critiques of science from feminist, antiracist, postcolonial, poststructural and queer perspectives show that real science is defined as the only science that originated in the Western/White world (Harding, 2000; Lee, 2001); only men were considered capable of thinking scientifically (Kumashiro, 2000); science asks only certain questions and is used in ways that primarily benefits certain racial and socio-economic groups in society (Harding, 2000); science has different material and political consequences on different populations, justifying the privileging of certain groups and the marginalisation of others (Harding, 2000; Kumashiro, 2000; Lee, 2001); science normalizes only certain ways of being – such as when it talks about sex/gender in certain terms thus reinforcing the idea that there are only males and females and nothing else although significant numbers of human beings are intersexed ; and progressive educators maintain the privileging of certain groups in society when they require students think scientifically, objectively and rationally (Kumashiro, 2000). This critique reveals science as contributing inherently to the various forms of oppression in today's 'historically-present' global society.

Research in discrimination and science education has reviewed multi/cultural paradigms (Aikenhead (2001), Atwater (1996), Cobern (1998), Costa (1995) Jegede (1999), Krugly-Smolska (1995), Ogunniyi (1995), Pomeroy (1994), Stanley and Brickhouse (2001), Cobern and Loving

(2001); and socio-cultural perspectives (Cobern,1998); multiscience perspective (Ogawa,1998); social constructivism (Cobern, 1998); sociotransformative constructivism (Rodriguez, 1998); antiracist and critical multicultural science education (Hodson, 2000) and feminist science pedagogy (Harding, 2000; Barton, 2003; Mayberry, 1998) – with a view towards an inclusive science education. The research, while recognising gender, class, racial, language, cultural etc. inequalities, remains located within the context of how to improve science education while continuing to ignore/relegate to an invisible status the social discriminatory conditions that produced and perpetuate not only discrimination in science education specifically, education in general but also within the wider community and society. In instances where the research claims a critical focus the domestication of critical enterprise also serves to perpetuate existing discrimination. This occurs through the prime focus being that of including the discriminated without challenging and disrupting the extant roots of discrimination in the discipline of science or its practice and justification of social and other injustices. In South Africa the research in science education advocates that improvement in poor science performance will occur through increased resource provision for those who were most disadvantaged during apartheid. Poor performance is seldom linked to issues of social injustice and discrimination in science education both as a field of study and of practice. In so doing the attempts to improve science education remain located in the realm of reproduction of existing discriminations – for science education, education generally and the discriminated human condition within local, national and global contexts. This is also compounded by the lack of practical discussion of ways classroom settings can be transformed to make learning experience/s more inclusive (hooks, 1994).

The research into the nature of science in science and science education has scope for critical appraisal into where science comes from; what constitutes science; whose science is learned; whose science dominates; and why. This critical aspect however has not become part of any such research that still remains locked within an inquiry approach – even though there is an acknowledgement of the inherent political, social and cultural component of the enterprise of science and science education (Bianchini and Colburn, 2000).

In talking about inclusive science Bianchini, Cavazos and Helms (2000) draw attention to researchers calls for making science courses more attractive and inviting to marginalized students such women, minorities etc; other researchers advocate transformation of science content and pedagogy to address the interests and experience of all students of science; yet others suggest the

use of a female-friendly model/ non-sexist culturally inclusive model/liberatory model/ inclusive practice education model.

The female-friendly model of curricular and pedagogical transformation proposed by Rosser (1995) seeks to highlight and eliminate androcentric and ethnocentric biases in science curriculum and pedagogy. Through developing and using alternative instructional techniques and presenting a holistic and global view of science content the creative and interactive relationships between scientists and their experimental subjects would be revealed; science done by women and people of colour would also be highlighted to illustrate and confirm that alternative forms of research together with interdisciplinary, qualitative and socioculturally situated problems can contribute to success in science. Rosser's model however remains located within the dominant science education research enterprise of improvement through inclusivity. The relationship between the socio-cultural and politico-historical and continued existing inequalities and discrimination in and through science education itself continues to be ignored by Rosser and proponents of various other inclusive models.

McCormick's (1994) non-sexist model works towards restructuring the whole of education to create a gender balanced and culturally inclusive system. The model also looks at a reconstructed science curriculum and instruction that includes the integration of gender, race, ethnicity, social class and age; the creation of interdisciplinary units; accommodation of different learning and thinking styles; and the use of instructional strategies that attended to the needs and values of girls and women.

Barton's (1998) liberatory model of inclusive curriculum and instruction model calls for the construction of a liberatory education as a means to achieve scientific literacy that she describes as authentic, useful and relevant to all students. Liberatory education in science *'is based on the recognition that teachers and students are agents and actors who actively shape and reshape their own understanding of the world and themselves from historically and culturally determined standpoints'* (p ix). Barton (1997) asks '*What is the purpose of teaching science to students, if the result is they understand it, but continue to remain oppressed by it? Can students be taught to understand the content, culture, and practice of science including its hidden agenda*' (p145). Barton's (1998, 2003) model calls for a re-creation of science education where the teacher's role is to assist the students to analyse the role of science in society and their personal lives; create novel and diverse representations of science; and investigate the intersections of and the contradictions between their lives and the traditional portrayals of science so that bridges can be built between science and (marginalized) youth.

For Mayberry (1998) a more democratic and liberatory inclusive science education requires an understanding of the social and political implications embedded within pedagogical approaches. Without such an understanding science teaching strategies will work to sustain existing relations of power in science communities and maintain the specific values, beliefs and behaviours that impede progress towards achieving a more equitable and just society – in which the science community could be more diverse.

Bianchini, Cavazos and Helms (2000) constructed four continua in their own proposal towards an inclusive science curriculum and practice. The first continuum looked at science teachers and scientists' perceptions of their gender and/or ethnic identities as enabling or constraining their career paths; the second looked at the nature of science; the third at perceptions of students' experiences in science education; and in the fourth continuum science teachers and scientists' reports of non-traditional science content and diverse instructional strategies. These continua were then used to call '*for professional developers and science education practitioners to explore the influence of gender and ethnic identities on scientists and science teachers' professional lives; to engage in open and critical conversations about feminist scholarship of science; and to examine inclusive educational practices through the lens of students' interests and experiences*' (p 538). In this way a balance amongst the variety of views could be achieved and the suggested educational practices that emerge can then be used to assist to bring the science education community closer to a goal of a just and equitable science education for all students.

As Bianchini, Cavazos and Helms (2000) state *each model challenges the traditional representation of science as it is enacted in kindergarten through to university classrooms and advocates a transformation of curriculum and instruction to provide teachers and students with opportunities to create new and* ***inclusive*** *representations of science*' (p 518, my emphasis) – within the existing dominant framework of science. This attraction and invitation to science, the so-called transformation of science content and pedagogy and the use of a 'female-friendly' model/ non-sexist culturally inclusive model/liberatory model/ inclusive practice education model advocated by researchers in science remains focused on **inclusivity** in science through science and as such does not even begin to address the socio-historico-cultural-political issues that have given birth to and maintain existing inequities of the historically marginalized.

The domestication of the critical perspective in science education is evident in Taylor and Cobern's (1998) explanation of their view of a critical science education. For them a critical science education *offers the empowering prospect that students will learn to adapt their local cultures to scientific ways of knowing, believing and valuing AND learn to adapt science to their own cultural ways of knowing, believing and valuing* (p 207). Such a critical science education becomes possible through critical science curricula that:

- *Develop a sensitivity to and an appreciation of the natural sciences as a value laden enterprise;*
- *Recognise and acknowledge contributions to the natural sciences by different cultures, religions and societies; and*
- *Identify and deal with biases and inequities implicit in and imported through the natural sciences* (p 207).

This critical enterprise in school science is achievable through an equitable resource distribution at the societal level; through equitable science curricula at the school level; through the learner's voice and sense of agency that is obtained though the use of the learners/local language; through including women in science that is through gender equity and inclusivity (characteristic of the first and second waves of feminism - Barton, 1998); through a socio-cultural/multicultural perspectives; and through a social/critical constructivist approach to science education. Naming the different **inclusive** models and locating them within a critical enterprise has focused attention on including the marginalized as **the** solution to social justice in science education. This focus on the inclusive diverts attention from mainstream science that then remains unaltered and dominant as a depoliticised, neutral and value-free knowledge-form. Inclusivity then serves to become nothing more than a veneer for an unaltered mainstream science and in this way inclusivity also contributes to the domestication of the critical enterprise. What this domestication of the critical perspective does is it silences the real existing social conditions in which the marginalized find themselves and live their lives through ignoring their existing social conditions and their historical present – both through science education and the contemporary social reality. This focus continues to guide science education in South Africa and science education in South Africa thus remains raced, classed, gendered, etc. Any real agency within this domesticated critical enterprise of enculturation into science education of the student and the teacher will ensure that real agency for social transformation remains an elusive delusion.

2.7 WHAT COUNTS AS BIOLOGY EDUCATION

What the literature in science education highlights is that science education researchers fall short in looking to improve science education of disadvantaged persons in science classrooms by focusing on science education only. While being successful in science education is important an exclusive focusing on science education for equity that does not look at the existence of disadvantage, the historical-socio-cultural-political reasons for disadvantage and its continued existence in today's world will not change the existing status quo of the socially privileged and discriminated. In ignoring disadvantage, efforts towards equity in science education will continue to be but a pipe dream – the few that assimilate easily into the world of science education will emerge as 'successful'; the rest will continue to remain at the margins and disadvantaged from science education and society.

Biology does have the space to engage students on more than just 'facts'. Biology education needs to revisit what it engages students with and how it does this. In biology education, for example, ecology provides spaces for engaging with more than just the biophysical. The social, economic and political interactions within the environmental ecosystem provide for possibilities of engaging with empowerment, sustainability, values and social justice in and through education; nutrition provides scope for interrogating issues of food security, poverty and wealth; gaseous exchange can make possible discourse around employment, working conditions and health – these are but only three possibilities amongst the many that biology education provides. In this way biology learning can be related to the lives of the students themselves thus providing for possibilities of meaningful engagement in biology education. The possibilities though have to be unmasked by the teacher with a social justice agenda. The alternative is that which is dominant and prevails – a biology education that remains silent around social justice issues or one that provides lip service to the notion of social justice by including it in its goals and aims or outcomes and then putting social justice to rest. While such a curriculum may be advocated, hard evidence based on empirical investigations are virtually non-existent.

Racial justice, a vision in the 1950's and early 1960's in the United States and elsewhere in the world, has been under attack and together with social justice has been excised from public legitimation. It has been since replaced with a language of cultural deficit and pathology, competitive group interests, individual responsibility, and at best, charity towards the underprivileged (Blum, 1999). Efforts to address racial and other forms of inequality such as

antiracist projects in education have met with tenacious resistance in Britain and in Canada – both by school practitioners and theorists (Solomon and Levine-Rasky, 1996). In post-apartheid South Africa human rights, social justice and transformation are cornerstones of the National Curriculum Statement in efforts to heal, amongst others, the racist divisions of a colonialist pre-apartheid and apartheid South Africa. However just focusing on teachers and schools in efforts to engage with and remove subordinations ignores the dominant hegemony of the existing societal frameworks that shape and maintain the variety of subordinations in society of which the school is but just one part. For South Africa curricular possibilities need to be developed in all Learning Fields and especially in the Life Sciences. Race talk/discourse assumes even greater urgency in biology/Life Sciences the site of racism's validation and entrenchment from the New World of the eighteenth century through modernity and into the historically determined present twenty first century. Race talk assumes an importance also in education in general – with the recognition that just this provides just one of the required myriad of inputs in dealing with issues of subordination as one works towards any notion of social justice.

It is this then that drives a critical investigation into biology education and schooling through race and the various multiple intersecting subordinations. If as Giroux (1996) points out schooling is now the key institution for producing professional technically trained, credentialised workers for whom the demands of citizenship are subject to the change of fortunes of the market place and commercial public sphere then a critical investigation becomes an imperative. In the current scenario/environment in education financial retrenchment and downsizing overshadow issues of social justice, equality and community within the democracy established in a post-apartheid South Africa. Testing and standardization have replaced these considerations and token acknowledgement is given to poverty, race discrimination and class inequalities and how these continue to be reproduced by and affect schools against the backdrop of reduced funding for public schools, the call for privatisation/Section 21 status of schooling and the larger social realities of material power and oppression continue to be ignored. It is this very backdrop to current realities of schooling that drives the need for a critical investigation.

It is a Freirean pedagogy interpreted in a biology classroom that encourages learners to problematise everyday existence, question established policies and practices and theorise possibilities for building a better social world. The critical consciousness being awakened through the biology classroom would, hopefully, also allow for an awakening of a critical attitude *of inward questioning through which ... one begins to see reason behind the facts*' (Freire quoted in Roberts,

1999, p 23). Current biology education specifically and education in general deprive learners who although they are capable of a more critical understanding of how society, their own bodies, their own realities and conditions for living functions because they are not allowed to know. Through a critical lens learners could '*become agents of curiosity, become investigators, become subjects in an ongoing process of quest for the revelation of the "why" of things and facts*' (Freire in Roberts, 1999, p 24).

Postmodernists call for an equivalence among various struggles. McLaren and Farahmnadpur (2001) call for a strategic integration of different yet equally important struggles. Recognising that the legacy of racism, sexism, classism, etc. are far from over I have to find my way of addressing and overcoming the 'isms' of discrimination. I do so by placing race at the centre while recognizing that that race intersects and interacts with all the other 'isms' of discrimination; race in no way subordinates any of the 'isms' of discrimination. By making race the centre of my approach and drawing on the efforts of others, who centre each of the 'isms' in an attempt to address discriminations, the critical perspective can then be used to provide greater insight into the discriminations that abound in the collective work towards social justice. My strategic variable is race and it is framed against other variables such as gender, class, religion, language, etc. that are seen as cursory sites of cooperation as they factor in my analysis in central and distinct ways (Mclaren and Farahmandpur, 2001).

2.8 CONCLUSION

This chapter makes visible the invisibility and domestication of oppression and resulting discriminatory issues and practices. It also draws attention to how the power of invisibility and discrimination has served the interests of an education and specifically a science and biology education designed to maintain the existing status quo. Efforts at transforming science and biology education fail to do so because the focus remains at the level at including the discriminated without critically interrogating discrimination's cloak of invisibility and domestication.

The next chapter reviews the critical perspective that under girds and guides this study. It attempts an explanation for why the critical perspective was my choice in my efforts to gain some visibility in that messy arena of oppression and discrimination and the resulting practices that determine race, gender and class identities.

CHAPTER 3

TOWARDS A CRITICAL BIOLOGY EDUCATION: possibility or delusion

3.1 INTRODUCTION

The previous chapter examined discriminatory issues and practices within education and the wider society. Race and racism emerging through the notion of identity and difference was explored. The contribution of a depoliticised education in general and science education specifically to discriminatory practices and resulting oppressions in the present was acknowledged. These contributions were recognised as being located in the silences in education and science education around discrimination. In science education it was the focus on inclusivity that contributed ironically to the silencing of socio-cultural and politico-historical concerns and engagement with race, racism and related discriminations towards social justice. Through this silencing the existing status quo around issues of identity, difference, race and racism continue to be perpetuated and maintained.

This chapter explores contributions from the critical perspective in education. Critical pedagogy's pragmatic contribution to education and biology education specifically is explored. The pragmatic contribution lies in its questioning of the production of knowledge and of existing social relations and inequalities with a view to transforming society. It allows for theorisations of race from the perspectives of racial formation theory, racial modality, racial identity theory, critical pedagogy of race and critical race pedagogy. Responses to these theorisations in the form of critical antiracist education and a revolutionary working class pedagogy are also discussed. A critique of critical race and antiracist education is offered. Contributions from antiracist science education and feminist science education for a critical science education towards an elimination of oppressions and subordinations are reviewed. A biology education for social justice through recognising, respecting and valuing difference in the biology classroom is then considered.

Cotton (1998) states that any understanding of racism in society and its institutions such as education can only be obtained through using a theoretical framework that explicitly and structurally recognises and accounts for the links between the oppressions, exploitations and inequalities associated with the notions of race, class and gender. This then draws attention to the

variety of oppressions that lend themselves to an understanding of what it is that happens in classrooms and in my classroom specifically. Such an effort may be realised through the use of the critical perspective. A critical perspective is located historically, contextually and ethically and offers insight into the public discourse that has contributed to the new authoritarianism in the last decade. It allows a willingness to analyse the challenges teachers will face when redefining a new mission for education. As Giroux (1996) has recognised critical educational work serves to connect:

> '*the politics of difference with concrete strategies for addressing the relationship between schooling and the economy, citizenship and the politics of meaning, and community and the reality of the heterogeneous student bodies and identities that increasingly inhabit our multicultural, multiracial and multilingual schools. In this instance, the politics of educational reform become part of a politics of pragmatic possibility attentive to both the reduction of injustices and suffering and the need for new alliances; a new politics of connectedness in which the production of knowledge, social identities, and social relations incorporates as a defining principle such categories as justice, equality, struggle and democracy*' (p63).

Pragmatic possibilities offered by critical education through a politicised biology education for the possible transformation of learners' lives are in keeping with the new National Curriculum Statement for South Africa.

3.2 CRITICAL THEORY AND CRITICAL PEDAGOGY

The critical theory of Habermas (Cotton, 1998, p38 – 39) offers the following views of knowledge:

> '*Habermas suggested it is necessary to distinguish three basic forms of our scientific interest in knowing about the world: the empirical-analytical, the hermeneutic-historical, and the critical-emancipatory. We seek to know in order to control social and natural realities (the empirical-analytic interest), to qualitatively interpret and understand such realities (the hermeneutic-historical interest) and to transform our individual and collective consciousness of reality in order to maximise the human potential for freedom and equality (the critical-emancipatory interest)*'.

The empirical-analytical embodies a technical rationality that underpins positivism that enshrines the empirical-analytical sciences as the only source of both secure and privileged knowledge of the world (Milne and Taylor, 1998). Technical rationality dominated the twentieth century and is part of contemporary economic rationalist goals of efficiency and productivity. In the school curriculum technical rationality makes itself present in the implicit objectivism of the science curriculum. Habermas's recognition of the central role of subjectivity in creating and validating science knowledge derived by empirical-analytical means allows for a rejection of the objectivist perspective of the technical view of science according to which science exists as a universe of facts separate from and independent of the knower. It is the knower's task to describe the science facts as they occur in themselves. The hermeneutic-historical has embedded in it a communicative rationality that seeks to understand the meaning-perspectives of actors in social situations but fails to critique the natural and self-sufficient cultural frameworks that shape/distort participant's meaning-perspectives. The critical-emancipatory interest involves a critical rationality that arises from a concern with organising social relations on the basis of communication that is free from the distorting influence of ideologically-oriented interests associated with actions arising from an unchecked and invisible technical rationality. This interest promotes the goal of self-critical reflective knowledge within a critical theory of social action that aims to transform society.

Critical theory is always concerned with issues of power and social justice and with the ways that economies, race, class, gender, ideologies, discourses, education, religion, all social institutions and cultural dynamics – that is the very fabric of lives – interact to construct social systems. Critical epistemology includes an understanding of the relationship between power and thought and power and truth claims; of what values and facts are and how these are connected; and includes a theory of symbolic representation (Carspecken, 1996; Kincheloe and McLaren, 2000). Thus, one of critical epistemology's strengths lies in recognising that presence and perception are not to be taken for granted as truth (Carspecken, 1996).

The primary interest for critical theory lies in subjective and intersubjective social knowledge and the co-creation of this knowledge by human subjects through discourse. It is this that gives validity to the notion that truth claims are never fixed or unchanging; instead truth claims are seen as being created through a community narrative bounded by moral considerations that is grounded in a particular space historically (Lincoln and Guba, 2000).

Human communication is located in one of three categories of truth. These include the truth of only the subject or my world; the truth of all people or the world; and the truth of only those involved in the communication or our world (Carspecken, 1996). This then raises, for human communication, the issue of power as central to any truth/s to be developed since any claim to truth can only be validated by the consent of a group of people around that truth. What critical epistemology is tasked with is to be clear about how power acts to corrupt truth/s and hence knowledge.

Social constructivism is currently a dominant theory within science education which makes a comment about its relation to this study necessary. Some researchers locate social constructivism within the critical perspective. While any discussion on of social constructivism is outside the ambit of this study, the relationship between social constructivism and the critical perspective therefore cannot be ignored. Carspecken (1996) recognises that social constructivism accepts what is already valued as it focuses on what is being influenced. That which is already valued is not questioned or challenged. It is this act of acceptance of that which is valued that then takes away the critical from this perspective. What social constructivism does then, unwittingly perhaps, is to provide the required political correctness for the enterprise it engages with, ignoring relations of power, oppression and subordination within teaching and learning.

Biology and science education remain located within the empirical-analytical paradigm identified by Habermas. Biology education is still intent on the teaching of facts outside of the knower. Recent research in multicultural, indigenous and feminist science education has moved science education into the hermeneutic–historical domain. This research straddles between the empirical-analytical and the hermeneutic-historical and it is in this way that it continues to influence science education. This is also true of science education influenced by constructivist and socio-constructivist understandings. What exists for science education research is understood as also encompassing of biology education research because of biology's location within the domain of science. Current biology education does not raise or encourage any questioning of the objective nature of biology knowledge and it is expected that such valued knowledge is taken as a given. Biology and science education and research in this area committed to emancipation and social justice will require an emphasis on students and teachers becoming critically aware of socio-cultural myths such as objectivism that work together with other social myths that marginalize and delude both students and teachers into accepting a disempowering sense of a lack of agency as learners and knowers of science and as possible agents in the transformation of society (Milne and Taylor, 1998).

Critical pedagogy is linked to the theoretical and practical concerns of critical theory and works to uncover, understand, and transform oppression and domination. Understanding exploitation as embodied in forms of racist and patriarchal social practices should constitute a central focus of critical pedagogy (McLaren and Farahmandpur, 2001). For Fernández-Balboa (1998) critical pedagogy is '*a way of life whose central elements revolve around dignity and freedom and has personal, ethico-moral and political implications that require knowing oneself; reclaiming one's own voice, identity and rights; and acknowledging one's social and political responsibilities*' (p47). Crucial to any critical pedagogy then is critical reflection that will enable us to see how our actions are without real meaning in various instances. Critical reflection is effective when it occupies that space between excessive meditation and redundant thought, when it looks both backward and forward as it connects with the real world and also allows for inward-self-questioning in a constant cycle of coming back to a starting point and purpose.

Critical Pedagogy thus is a way of thinking about, negotiating and transforming the relationship between classroom teaching, the production of knowledge, the institutional structures of the school and the social and material relations of the wider community, society and nation state (McLaren and Torres, 1999). To avoid domestication critical pedagogy needs to establish a project of emancipation centred around the transformation of property relations and the creation of a just system of appropriation and distribution of social wealth. Extra-economic inequalities such as racism and sexism can only be challenged successfully if economic/capitalist dominance is dismantled. Critical educators need to understand how racisms in their present forms emerged from the dominant mode of global production during the seventeenth and eighteenth century colonial plantations of the New World. Critical pedagogy needs to deepen its reach of cultural theory and political economy and expand its participation in socio-empirical analysis to critically address the formation of intellectuals and institutions within the present productions of history. Critical pedagogy requires a revolutionary movement of educators informed by principled ethics of compassion and social justice, a socialist ethos and a language of critique. Critical educators need to renew their commitment to the struggle against exploitation on all fronts – given the current hegemony of a dominant corporate world economy. In emphasizing the class struggle McLaren and Torres (1999) recognise that race and gender antagonisms, amongst others, are located within a theory of agency that acknowledges the importance of cultural politics and social difference. Critical pedagogy needs to acknowledge the specificity of local struggles around the micropolitics of racialised social relations, ethnicity, class, gender and sexual formation. Critical pedagogy must seek a future that is unstable yet concretely locatable in multiple racial formations because multiple

racisms will make possible concomitant multiple challenges. For McClaren and Torres (1999) '... *A central task for critical pedagogy is the construction of what Mohan calls "creative resolutions and contingent alliances"*' (p70). Critical pedagogy encourages self-reflection as a practice of everyday life in which a normative democratic theory of knowledge production and conception is a prominent feature. It needs to re-embrace macro-concepts such as totality, exploitation and patriarchy without defaming a critical understanding of micro-structures of experiential engagement and micro-intimacies of everyday and communal life. Critical pedagogy must assume a position of trans-modernity – a co-realization of an incorporative solidarity or an analectic between the centre/periphery, man/woman, etc. For this to happen the negated, victimized, 'other-face' of modernity must discover itself as innocent.

Critical pedagogy must be made less informative and more performative – a pedagogy grounded in the lived experiences of students. Critical educators need to work towards developing those intellectual qualities that demand a conviction cast in concrete in a concept of justice and fairness that will allow for differences between nations and individuals without, at the same time, allowing for hidden hierarchies, preferences and evaluations - qualities of critical self-reflexivity for McLaren and Torres (1999). For Kumashiro (2000) the role of the critical educator is to, together with students, '*critique and transform*' (p 2) oppressive social structures and ideologies.

For Nieto (1999) a critical education:

- affirms students without trivializing who they are and where they come from;
- challenges hegemonic knowledge;
- complicates pedagogy;
- problematizes a simplistic focus on self-esteem;
- encourages dangerous discourses; and
- cannot effect change by itself.

In an interview with Rizvi (2002), McLaren states that there is no unitary conception of critical pedagogy. For him there are as many critical pedagogies as there are critical educators with major points of intersection and commonality. Various writings about critical pedagogy abound in the academy including postcolonial pedagogy, feminist pedagogy, critical race theory, critical multiculturalism, anti-oppressive education, postmodern pedagogy, border pedagogy, dialogical pedagogy, revolutionary pedagogy, revolutionary critical pedagogy and of course critical pedagogy itself. An important dimension of critical pedagogy is that which emerges from the nature of the

daily interactions between teachers and students. Critical pedagogy itself evolved from the idea of radical pedagogy and has been influenced also by postmodern theory, post-Marxist theory, feminist theory, postcolonial theory, literary theory, popular (Latin American) education, liberation (Latin American) theology, political theology and political-liberatory struggles. There is also the need to distinguish between academic critical pedagogy and the critical pedagogy engaged with by the oppressed groups working under oppressive conditions in urban settings and rural areas throughout the world.

3.3 OPPRESSION AND THE DILEMMA OF A THEORY OF RACE

The critical perspective allows the centring of any of the oppressions – race/gender/class/ language/etc. as a mechanism towards understanding how the variety of oppressions and their concomitant fluidity are positioned and operationalised within classrooms, schools and the wider local society – as all role-players chart their course through the various moments in each of their lives. It is this perspective that has provided the theoretical trappings that help as I make my way through this confusing landscape of the myriad oppressions. Race too has been theorised in different ways by different fields/disciplines.

Race at its most basic level can be defined as a concept that signifies and symbolizes socio-political conflicts and interests in reference to different types of human bodies (Winant, 2000). Thus it becomes possible then to include gender, class etc. which are used to categorize human interests. Winant (2000) notes that at the beginning of the twentieth century, a nearly comprehensive view of race as a concept still located it at the biological level. Shifts in understandings in the early twentieth century motivated the gradual development of a sophisticated social scientific approach to race - here the work of Du Bois and the Chicago School of sociology were instrumental. It was the Chicago School that broke definitively with racial biologism and that asserted that race was socially constructed and not naturally given. Challenges to the notion of race and race theory were an outcome of World War II – this resulted in theories with many limitations – especially the tendency towards reductionism. Ethnicity–based theories saw race as culturally grounded in collective identity; class-based theories saw race as group-based stratification and economic competition; and nation-based theories saw race in geopolitical terms as an outcome of decolonisation in the post-war era. These theories reached or were near to their limits by the end of the twentieth century - due to inclusionist and democratic efforts at reform. This left the world with unresolved racial dilemmas and inadequate theoretical approaches to race at the beginning of the twenty first century. For

Winant (2000) then, in the new century any convincing theory on race needs to address the persistent racial classification, stratification and discrimination. Minimal requirements for any theoretical response on race must include the following three dimensions viz:

- Recognition of the comparative/historical dimension of race;
- To range over and (if possible) to link the micro and macro-aspects of racial signification and racialized social structure; and
- The recognition of the newly pervasive forms of politics in recent times / a racially conscious conception of action/agency

These themes/dimensions have been and continue to be developed in a body of theoretical work by Winant (2000) known as the ***racial formation theory***. This theory, although as yet incomplete and still dealing with lack of consensus, begins to meet requirements towards an account of race. The racial formation approach:

- Views the meaning of race and the content of racial identities as unstable and politically contested;
- Understands racial formation as the intersection/conflict of racial "projects" that combine representational/discursive elements with structural/institutional ones; and
- Sees these intersections as iterative sequences of interpretations (articulations) of the meaning of race that are open to many types of agency, from the individual to the organisational, from the local to the global.

Goldberg (McLaren and Torres, 1999) speaks of a '**racial modality**' which refers to a '*fragile structure of racist exclusions at a space-time conjuncture that is sustained by the power of socio-economic interests and the intersection of discursive field and strategies of representation*' (p 62) – this similar to Winant's idea of racial formation.

In the field of psychology in education Carter (2000) speaks of a ***Racial Identity Theory*** where '*"Racial Identity" refers to one's psychological response to one's own race; it reflects the extent to which one identifies with a particular racial group and how that identification influences perceptions, emotions and behaviours towards people from other groups*' (p875) – a lens and filter for racial and cultural knowledge, experience, behaviour and emotion. The three separate models of racial identity in psychological literature speak of White, Black and People of Colour with each model comprising several distinct racial identity ego statuses that operate as emotional/cognitive schemas that process and interpret information and experiences and guide thought and behaviour.

For Black and People of Colour the racial identity model is made up of five statuses viz.: pre-encounter (Black) or conformity (People of Colour); encounter (Black) or Dissonance (People of Colour); immersion-emersion; internalisation; and internalisation – commitment (Blacks) or integrative awareness (people of Colour). The White racial identity model comprises six racial identity statuses viz.: contact; disintegration; reintegration; pseudo-independence; immersion-emersion; and autonomy. While statuses are similar for each racial group, variations exist because of the social positioning of the racial groups such as the socio-political history that affects the expression of each status. Statuses do not operate independently of each other but together and it is believed that each person has all of the statuses available to him/her in his/her own personality structure. The racial identity ego status variations provide a view of both individual development and group participation; shed light on self-understanding, affect, perceptions, ideas and behaviours towards those who belong to the same or different racial groups. Psychological racial identity constructs highlight that skin colour and physical features are not the only aspects to racial identity but also provide an understanding into culture, gender, social class, ethnicity, religion and other reference group memberships and therefore be used to explore and understand how socio-political systems and institutional practices and policies operate. Racial identity theory reveals that White, as the preferred group, benefit from educational, social, economic and political rewards whereas Black and People of Colour have less access to educational, social, economic and political rewards and benefits. Racial identity models include members of all racial groups in the process of developing a racial consciousness and all racial groups are equally valued – it is this that provides the possibility for the abandoning of doctrines based on racial assimilation and superiority through a Race-Based approach premised on racial identity theory and practice.

Lynn (1999) also distinguishes between a **Critical Pedagogy of Race** and **Critical Race Pedagogy**. According to Lynn a Critical Pedagogy of Race derives from a class racialist perspective and provides a Neo-Marxist analysis of race and racism in late capitalist society. Here class is privileged over race. A Critical Race Pedagogy, on the other hand, could be defined as an analysis of racial, ethnic, and gender subordination in education that relies mostly on perceptions, experiences and counter hegemonic practices of educators of colour. Critical Race Pedagogy is multidimensional in its focus and takes into account all facets of our multilayered identities while arguing that race should be utilized as the primary unit of analysis in critical discussions of schooling. This perhaps needs to be extended to include educators committed to and working towards social justice – not only educators of colour. Lynn's proposed theory also uses identity politics grounded in fixed positions with regard to race and supports a form of authority garnered from membership of the

subordinated Black group. As recognised by Kincheloe (1999) this privilege derived from oppression assumes that only individuals who share a specific identity can speak of particular forms of analysis.

The defining elements of **Critical Race Theory** (Ladson-Billings, 1999) include: first that racism exists and is normal, not aberrant or rare, a fact of daily life of society and the assumptions of White superiority are so ingrained in our political and legal structures so as to almost be unrecognisable. Critical race theory challenges the experience of Whites as the normative standard and grounds its conceptual framework in the distinct experiences of people of colour. This call to context or racial realism insists that the social/experiential context of racial oppression is crucial for understanding racial dynamics. Critical race theory embraces the subjectivity of perspective and openly acknowledges that perceptions of truth, fairness, and justice reflect the mind-set (the shared stereotypes, beliefs and understandings), status, and experience of the knower. Critical race theory notes that colour-blindness makes no sense in a society in which people, on the basis of group membership alone, have historically been, and continue to be treated differently. The danger of colour-blindness is that it allows us to ignore the racial construction of Whiteness and reinforces its privileged and oppressive position. Thus Whiteness remains a normative standard and Blackness remains different, other and marginal.

Secondly, critical race theory uses naming your own reality through storytelling/narrative/autobiography/personal history as a way to engage and contest the negative stereotyping. Thirdly, a central tenet of critical race is a critique of liberalism. This critique highlights the notion of interest convergence in liberalism where Whites promote advances for Blacks only when they also promote White interests. Fourth, critical race theory argues that Whites have been the primary beneficiaries of civil rights legislation.

The usefulness of a Critical Race Theory for Lynn (1999) lies in its providing a framework that comprises a set of basic perspectives, methods and pedagogy through which the structural, cultural and interpersonal aspects of education that continue to marginalize and subordinate students can be identified and analysed. The identification and analysis emerges through questioning the role played by the school, school processes and school structures in maintaining the various subordinations such as those located in race, ethnicity, gender, language, religion etc. Transformational possibilities directed to social justice within these aspects can then be worked towards.

3.4 FROM CRITICAL RACE TO ANTIRACIST EDUCATION

How does **antiracist education** differ from critical race education? According to Ruemper (1996) antiracist education takes a '*more critical and personal view of power relations in society and scrutinizes blatant public forms of oppression and probes systemic biases, stereotypes, discrimination and harassment in social institutions. Antiracist education links race to politics and economics and to power relations in society*' (p323). Since antiracism is distinct because it addresses racism on a personal, individual level as well as a structural level, antiracist education calls on students to look within, to examine their own culture and society and how social structure has shaped their individual attitudes, behaviour, values and beliefs. In this way students are encouraged to examine their own experiences, explore how they compare to others' experiences in the larger society, and develop strategies for deconstructing racism and discrimination in the larger context. Antiracist education does not target racism exclusively; it targets racism within a context of other forms of oppression including gender, class, language, religion etc. It demands that White people and people who hold power examine their own racism and privileged positions so that White/powerful people can learn about being White/powerful since Whiteness/power awareness is a central point in understanding and confronting racism. Antiracist education examines historical relations of domination and subordination and places power at the centre of its interrogation.

Antiracist education praxis engages with the multiracial context (Dei, 1996). A **critical antiracism** gaze makes it possible to uncover embedded racisms, sexism, and classisms. It also helps to detect the academic erasures, exclusions and denials of knowledge and histories of marginalized and disadvantaged groups. For Dei (1996) basic tenets of antiracism include:

- '*exploring ways in which antiracism knowledge can be constructed, produced and disseminated;*
- *highlighting some challenges that globalisation processes provide for education and social change and with that the rationale for engaging in antiracism praxis;*
- *recognising that antiracism has an academic and a political agenda that seeks to rupture the modus operandi of schooling and education which is problematizing and dealing with how schools function to reproduce White dominance*' (p 249 - 250)

For him then antiracism becomes an action-oriented strategy for institutional systemic change that addresses racism and other interlocking systems of social oppression. It is a critical discourse of

race and racism that challenges the continuance of racializing social groups for differential and unequal treatment. Antiracism also explicitly names the issues of race and social difference as issues of power and equity.

However, for antiracist education to achieve the change that it claims to work towards it should not stop at naming. It should look to explicitly taking race, social difference, power and equity and identify various instances of these issues – in the classroom curriculum. It should not hesitate to get all involved in suggesting how these various intersecting issues could begin to be worked with in an effort to reverse the existing oppressions. Getting those involved to provide ways of dealing with existing oppressions is necessary if those involved are to effect any change in their own lives. There is no one way to address existing oppressions and each location must engage in providing suggestions for overcoming their own existing oppressions. If this begins in a classroom and specifically in a biology classroom where positions of power in the classroom at the curricular and interpersonal levels are identified, and what allows for those positions to be maintained are analysed, then the process will also provide possibilities for how the existing power positions may be turned in upon themselves in classroom efforts towards social justice from curricular and interpersonal perspectives.

Such engagements within the biology classroom can lead to change, if so desired, within the biology classroom, the school and the wider community as individuals live out their lives guided by tenets of social justice. Such engagements will be painful – giving up power and associated privileges will not be easily relinquished or rescinded. Strategies that will allow for sustained efforts towards social justice will also need to developed. The means to such efforts and the efforts themselves must come from those directly involved in establishing social justice through and for themselves. Those in positions of privilege and power engaging in such efforts, such as the biology teacher with the biology curriculum and related school processes, will begin to see views of themselves as oppressors. In wanting to reverse the oppressor identity both the oppressor and the oppressed must be involved and willing to relinquish positions of powerful and powerless. Only then can they begin to constructively engage in overcoming the existing oppressions around race, gender, class, language, religion etc. The continued focus on only the oppressed in the biology classroom, how the oppression derives and only the oppressed's involvement in overcoming the existing oppression/s towards social justice will not achieve social justice because of the exclusion of the equally critical component in any and all forms of social oppression viz. the oppressor. Any

success towards achieving social justice must then by necessity include both the oppressed and the oppressor.

A critical theory of race for McLaren and Fischman (1998) leads to both a theoretical and a political dead end when race is used as an isolated analytical category. For this reason they favour an antiracist approach. This antiracist education approach is influenced by a revolutionary multiculturalism. A revolutionary multiculturalism for Mclaren and Fischman (1998) is a counter-hegemonic strategy that assists in the unlearning of racist practices and allows for the development of revolutionary agency capable of contesting dominant arrangements. The envisaged antiracist education as a part of a revolutionary multiculturalism will then also address ways in which global economic restructuring helps to embed racist and patriarchal practices in the politics and practices of everyday life. It will also unmask the ways in which race, class and gender arrangements are mutually constitutive of the capitalist social order.

Subsequent theorisations by Mclaren and Farahmandpur (2001) have led to the development of a revolutionary working-class pedagogy. Tenets of this pedagogy, that foregrounds class, can be used to strengthen the critical race/antiracist pedagogy. With a revolutionary working-class pedagogy language and discourses practiced within classroom settings, such as the biology classroom, are also recognised as being ideologically tainted with the values, beliefs and interests of the socially dominant hegemonic groups so as to conceal the asymmetrical/skewed relations of power. This then makes it important to encourage critical dialogues among teachers and students. The central purpose of such dialogues would be to raise consciousness among students about existing discriminations and oppressions linked to race, gender, class, language, religion etc. Once consciousness has been raised students can be helped to recognize how their subjectivities and social identities are configured in ways that are structurally advantageous to the status quo – even through subject disciplines such as biology/Life Sciences.

For them through a revolutionary working class pedagogy the struggle over the production of meaning would enable marginalized groups to name and then perhaps take the initial steps to transform the sources of their oppression and exploitation. This pedagogy also stresses the importance of acquiring a critical literacy through which reflection, analysis and critical judgements could be made in relation to social, economic and political issues. In this way subordinate groups, are invited to (re)present through classroom interaction and dialogue, their lived reality in relation to objective social structures that shape their lives. Students and teachers are also challenged to

analyse the various meanings underlying their commonsense concepts by drawing on their everyday understandings. It provides the space for teachers, as agents of change, acting as revolutionary intellectuals to critically examine concepts such as freedom and democracy within a transnational capitalism. The classroom space thus becomes a political arena for legitimising the lived experiences of the oppressed social classes without assuming that these experiences are transparent or devoid of racism, sexism or any other discriminatory 'ism'. This pedagogy also demands active participation by teachers and students in the developing of a critical consciousness. It is this that makes this a Freireaen approach in that it argues that revolutionary consciousness is a political act of knowing, an active intervention against the barriers that prevent students from achieving their role as agents of history.

Revolutionary biology educators will need to identify alternative subject positions or counternarratives and countermemories that could be made available to students to contest existing regimes of representation and social practice; they need to identify also historical determinations of domination and oppression as part of the struggle to develop concrete practices of counterrepresentation. These teachers must become theoreticians of their own teaching practice since this is central to the process of raising the political consciousness of students.

The aim of a revolutionary working class pedagogy for McLaren and Farahmandpur (2001) is to make students critically maladaptive to globalisation so that they can become agents of change in the struggles against the various discriminatory practices. Such a pedagogy can then become a critical tool for transforming existing social conditions. However, it will only be effective if there is a commitment to a meta-narrative of social justice both within the classroom and outside of it in the school and in the wider community.

3.5 DILEMMAS OF A CRITICAL RACE–ANTIRACIST EDUCATION: a critique

Various critiques to anti-oppressive education research have been provided. The concerns raised by these critiques are concerns that serve only the interests of the dominant traditional scholarship in education research and in education itself. These self-serving interests have only one purpose and that being the continued hegemony of the dominant groups who now also disguise themselves through labels such as the liberal.

Critical race theory foregrounds race in its efforts at unmasking racism as an oppression. Taylor (2000) has provided a critique to several of the notions on which this theory is based. One concern is around the use of narrative as a methodological format for research in critical race education. This concern is grounded in that demand for verifiability within dominant traditional scholarship. This critique does not question critical race theory itself but only what it is that constitutes valid scholarship. This then raises the question of the notion of a dominant valid universal scholarship which subscribes to apersonal methodologies. Such scholarship chooses to ignore not only the validity of personal experience. It also would deny participants the opportunity of naming their own realities as raced, gendered, classed and etc. persons – even within biology education research where race, gender and etc. have played critical roles in oppression and subordination.

Another critique of critical race theory lies in having to convince Whites and people in power on the basis of race of how racism benefits them because the superiority afforded by the race status has become ingrained into the psyche and is no longer noticed. Many studies point to resistance encountered when racism and its existence is the focus of the study. This however does not provide valid reasons for the shelving of such research. Biology education because of its own collusion with issues of race and racism provides one starting point for the interrogation of such forms of oppression and subordination.

Antiracist education in its unmasking of oppressions and subordinations has foregrounded power. Thompson (1997) provides critiques to antiracist education forwarded from various quarters. One such quarter is traditional liberal education and its perspective on racism. The argument offered by this school resides in the assumption that central to fair democratic relations individuals are treated in terms of merit. Race, gender, class etc. are thus regarded as irrelevant considerations of difference. For liberal education racism can be dealt with as a set of mistaken beliefs, lies, ignorance, hatred or intolerance towards members of particular social groups. These understandings are used by traditional liberal education to validate its claim that it can achieve the same goals as antiracist education in dealing with oppression and subordination. This school also claims that the anti-oppressive focus of an antiracist education serves only to exaggerate or distort the problems that racism poses for knowledge in a democracy and through this undercut any possibilities for a truly colour-blind society. This perspective's focus on merit towards a colour-blind society makes provision for a biology education that can explicitly ignore the issue of race and through this ignore biology's specific role in the validation and entrenchment of racism in both biology's historical past and in the historically determined present.

A second critique to an antiracist education lies in the notion that anti-anything approaches start off on the wrong foot because such approaches, such as an antiracist approach, are negative from the outset, have no vision of any good and define themselves through what is wrong in education. This critique sees such antiracist pedagogy as reactive. Proponents of this critique suggest that what is needed instead is a race-centred education that takes up issues of race within a context of a distinctive cultural heritage or a shared economic future rather than as a political problem. It was these very notions that contributed to apartheid's success in South Africa within education also. Such a focus on race would also serve to take attention away from and give authenticity to biology education's continued non-involvement in entrenching racism.

A third critique of antiracist education is that it puts politics first in that arena where education is not political. However, since power relations are woven into the fabric of our lives, goals and values it is not possible not to start with politics – any more than it is not possible not to start with experiences such as racism. Biology education and the biology classroom provide possibilities for such engagements. Through ignoring race in the biology curriculum, biology education satisfies the requirement of biology as apolitical within that context that regards education as not political. This entrenches further also the understanding of biology as a science that is rational, value-free and neutral and thus places it firmly within the realms of the empirical-analytical.

Antiracist pedagogy is also seen as politically divisive – a fourth critique levelled at an antiracist education. It is seen as politically divisive in that it acts as if racial oppression is disconnected from or is more crucial than other forms of oppression. However, any unilateral account of oppression always runs the risk of replacing a real understanding of the mechanisms of oppression. As a political agenda antiracism is concerned with changing the ways in which race relations are organised to privilege power. Antiracist education has to do with informing how we understand and experience racism. As an educational enterprise then antiracism is concerned both with race-inclusiveness and with inquiry into the ways race-thinking has shaped what counts as knowledge. One of the functions of an antiracist biology education then would be to foreground the issue of race in questions where its relevance might not be immediately apparent.

A further critique of the critical perspective lies in the perspective's underdeveloping the knowledge domains of a discipline such as biology. While interrogating a discipline and the discipline's contribution to social discrimination and oppression in efforts towards social transformation and

justice that which constitutes the discipline cannot be ignored. The requirement then becomes one where the discipline itself is in no way emasculated when being presented in institutions of learning. That knowledge which makes up the discipline must not be denied those engaging with the discipline. It is only through engaging with the knowledge of the discipline itself, getting to know it and then employing the critical perspective will informed learning that can contribute towards sustained social transformation become possible. This is true for all disciplines including biology. That knowledge which makes up biology must first become known before biology can begin to be interrogated for its contributions towards maintaining current existing social injustices such as racism and gendered identities amongst others.

3.6 FEMINIST PEDAGOGY'S CONTRIBUTIONS TO THE DILEMMA OF A CRITICAL EDUCATION

Attempts at unmasking the various oppressions that subordinate have produced the various theorisations from a critical race to an antiracist and working class pedagogy perspective. Each perspective foregrounded an oppression that it chose to work from in its analysis of oppressions. For critical race theory, race was foregrounded; antiracist perspectives foregrounded power; and a revolutionary working class pedagogy chose to foreground class. Within the critical education paradigm feminist pedagogy too has contributed to the theorisations around oppressions and subordinations and does this through foregrounding gender in its enterprise.

Feminist theory for Weiler (1991) not only confirms difference but also challenges all claims to truth while simultaneously seeking to create social transformation in a world of fluid meanings. In education this then makes it possible at the level of practice to challenge dominant approaches to learning and definitions of knowledge by those who were previously silenced or excluded from such discourse. It also allows for challenge at the level of theory where the modernist claims to providing universal truths can be questioned.

From feminist theory emerges a feminist pedagogy that for Mayberry (1998) '*works to uncover, understand, and transform gender, race, and class oppression and domination*' (p 444). Feminist pedagogy is rooted in and expands on Freire's model of education and embodies what we teach and how we teach it; with students and teachers working collectively to interrogate traditional forms of knowledge and social ideologies as well as personal beliefs and identities. Feminist pedagogy considers gender together with class and race with regard to knowledge production and

dissemination –thus expanding on the early Freirean model that had made only passing references to gender. The classroom provides a space for a participatory democracy with both teachers and students engaging in this dialogical experience to challenge structures of oppression, repression and inequality. Teachers and students are challenged to critique the existing unequal social relations in contemporary society and to ask why these conditions exist and what can be done about them. Feminist pedagogy also demands self-reflexivity of both teachers and students.

As with other critical perspectives a feminist position according to Barton (1998) in emphasising the positional or situated nature of knowledge, power and authority and working politically to change oppressive practices and beliefs allows the feminist perspective to move beyond deconstruction into the realm of reconstruction and agency. Conversations in the feminist classroom are therefore overtly political and aimed towards social and educational change and seek explicitly to dismantle systems of oppression. In this way feminist pedagogy too can contribute to that search in the biology classroom that seeks to unmask and challenge oppression and subordination in efforts at transformation.

3.7 CRITICAL SCIENCE EDUCATION.

Antiracist science education and feminist science education from within the critical perspective have influenced science education research. This influence though has not been widespread. Perhaps the difficulty for science education research, grounded in a traditional scholarship within the empirical-analytical perspective, with the critical perspective lies in the critical perspectives insistence on a politically overt agenda that interrogates not only knowledge production but also how the knowledge is disseminated and whose interests are being served. Science education research, which includes biology education research, is mainly concerned with the issue of access to science education. A critical perspective on biology education has as yet to emerge. The critical perspectives influence on science education through science education research is located within the realm of an antiracist approach and feminist science pedagogy.

3.7.1 Antiracist Science Education

An antiracist approach for Hodson (1999, p776) is concerned with revealing, confronting and combating racist attitudes and practices which disadvantage and discriminate against some minority groups and result in an unequal distribution of opportunity, wealth and power that results in

inequality and justice. Questions asked by antiracist education must also be asked of antiracist science education. The questions include why and how members of some ethnic minority groups continue to be underrepresented in positions of power and in higher education, underachieve in school, are overrepresented in crime statistics, tend to have poor health, lower life expectancy and poorer housing conditions. Antiracist education and antiracist science education also asks what can and should be done about these social realities. Key elements/principles of antiracist education for Hodson (1999) include that:

- *it recognizes and directly addresses the social effects of "race" through the curriculum;*
- *it acknowledges that the full social effects of race cannot be understood without recognizing how race intersects with other forms of social oppression based on class, gender and sexual orientation;*
- *it questions White (male) power and privilege and the rationality for this dominance;*
- *it addresses the marginalization of certain voices in society and the discounting of the knowledge, beliefs and experiences of the minority groups;*
- *it recognizes that the personal identity of students plays a crucial part in learning and so acknowledges both the need for a pedagogy that meets the challenges of ethnic diversity in the classroom and the urgency for a more inclusive education system that is responsive to minority concerns;*
- *it challenges the "deficit model" and "blame the victim" explanations of educational failure which locate the problem in the family, home environment or local community and so divert attention away from the institutional structures of schooling and the curriculum as the real cause of problems;*
- *it acknowledges the role of the education system in producing and reproducing inequalities based on differences in gender, sexual preference, religion, class and aims to do something about it; and*
- *it recognizes that education is a political act inseparable from the material and ideological circumstances in which students are positioned* (p777).

In science education these elements for Hodson (1993, 1999) can be addressed through both an explicit antiracist science education and through multicultural perspectives for science education grounded in a global view of science education. Combining both perspectives will make a critical science education possible. The antiracist science education as envisaged by Hodson (1993, 1999) will identify and replace all racially offensive and stereotyped curricular content; will establish

participatory democratic teaching-learning processes where student involvement located in a mutual tolerance, respect and value for all will drive the curriculum; and will draw attention to scientific racism through which science and scientific ways of presenting science knowledge have been used to underpin racism through a study of the notion of race and its misuse in the perpetuation of stereotyping and institutionalisation of injustice and through that the misuse of science for sociopolitical motives. In this way the first four key elements of an antiracist education will be achieved within an antiracist science education.

The second four elements will be addressed in an antiracist science education through multicultural perspectives. Such perspectives would draw from as wide a range of cultures and countries as possible in order to provide a global view of science. Contributions from outside of the west that have contributed to contemporary science practice will need to be recognised. This perspective will also emphasise science as a culturally determined practice. The conventional view about the nature of science as a well-defined, infallible, all-powerful method in the production of knowledge by scientists engaged in an apersonal venture will need to be challenged. Issues of equality, freedom and justice within the context of scientific and technological practice that enriches some while impoverishing many will also need to become part of the science education discourse and the multicultural perspective will make such discourse possible.

Crucial elements to an antiracist science education are the demythologising of science and the politicisation of science education. For Hodson (1999) the science that comprises science education is shrouded in myths that are the outcome of how science is taught by science teachers. It is these myths that continue to perpetuate incorrect views of science and scientists. The myths include the understanding that true and reliable knowledge has to come from direct observation and that science is true and reliable because it starts from observation. The observation allows for science then to produce knowledge by induction. In science experiments are understood as decisive. Science is made up of discrete, generic processes. Scientific inquiry is projected as a simple, algorithmic procedure. Science as a value-free activity also contributes to the notion of science knowledge as true and reliable. Science remains portrayed in the main as western and post-Renaissance and scientists possess scientific attitudes essential to the practice of a true and reliable science. The removal of these myths would allow for the development of a critical scientific literacy that would in turn then make possible engagements with myths located within the nature, history and the complex language of especially school science. The politicisation of science, by providing students with opportunities to challenge socio-economic issues within scientific and related technological

and environmental aspects, together with a critical scientific literacy will make possible an education for political literacy. For Hodson (1999) a political literacy is inherently part of any ideology of education for social reconstruction. Social reconstruction is seen as wide and varied and as including, confronting and eliminating racism, sexism, classism and other forms of discrimination, scapegoating and injustice; a shift away from consumerism and towards a more environmentally sustainable lifestyle. Such reconstruction will work towards social justice. Any such change will also require that teachers too acquire both a critical scientific and political literacy with regard to their own educational practice.

3.7.2 Feminist Science Education

Feminist pedagogy has also contributed to a reconstruction of science education through challenging science education derived from a traditional scholarship. Feminist science pedagogy for Mayberry (1998) has worked to develop a critical analysis of the epistemology of Western science, its privileging of the masculine and its inability to reorient the relation of scientific inquiry to social policy and social development. Feminist science pedagogy has also begun to create sciences that speak from lives of marginalized groups and women specifically.

Bloor (2000) highlights that feminist science pedagogy in the period from the 1980's through to the 1990's was characterised by efforts at including women and other oppressed categories such as class and race within science education. This inclusiveness occurred within the context of science as an objective, true and reliable knowledge form. Barton (1998) has characterised the efforts at inclusiveness as the first and second waves of feminism in science education. The first wave was focused on addressing equity issues through inclusiveness. The second wave focused on gender-inclusive science and women's-ways-of-knowing and drew on works of feminist philosophers of science such as Harding and Keller.

Harding (2000) through her standpoint philosophy challenged the notion of inclusiveness within an objective science. For her science is not objective 'enough' because it ignores the voices and the perspectives of the marginalized groups. The voices and perspectives of the marginalized must be incorporated into new scientific practices so that less partial and distorted beliefs than others can be generated by a new and democratic science. Through her standpoint theory she advocates that all sciences must be local and start from the position of the lives of the community and a conceptual framework from a particular moment in those lives; that the subjects are not dissociated from the

objects of the study; that it is recognised that historic moments produce knowledge; and that subjects are multiple, heterogeneous and contradictory (as opposed to the traditional unitary, coherent and homogenous). The standpoint philosophy is grounded in the notion that individuals must actively work to adopt a standpoint; that a standpoint is a perspective and not an entity with which one is born.

Barton (1998) identifies this as a third wave of feminism in science education that for her emphasizes the situated nature of knowledge, power and authority. It is this that makes possible reconstruction. In science education reconstruction through feminism is located in the recognition that science and the science curriculum exist as political texts and schools as legitmisers of hegemonic ideals. A feminist science pedagogy also recognises and draws its strength from teachers and students as agents and actors who actively and collectively shape and reshape their own understandings of the world from specific standpoints. For Bloor (2000) the challenge lies in how to actualise the standpoint perspective within science education and the science classroom itself. She suggests that a possible solution could lie within multidisciplinary or interdisciplinary approaches to learning.

An antiracist science education with an agenda that is directed explicitly to social reconstruction will work towards social justice. One goal of such a science education will be the elimination of existing oppressions. Feminist science pedagogy has as a goal exposing cultural, social and political contexts within which science has been produced and used to privilege masculine and associated, interconnecting multiple perspectives of power. This exposure is what will allow for developing the critical consciousness required for any social transformation. These theorisations have contributed significantly to understandings around the origin and the continued perpetuation of oppression and subordination in science and science education. Such approaches however, within science education fail to involve the oppressor directly in engaging with and turning in upon itself the perpetrated oppressions. In this way the stature of science and science education as objective is silently retained. Not involving the oppressor in efforts towards social justice within critical antiracist and feminist science pedagogy continues to exclude a crucial component that has a role together with the oppressed towards effecting any significant social change. At best then these efforts become tokenist because they translate into nothing more than yet another attempt at inclusivity of the subordinated and the oppressed. The challenge then lies in involving the oppressor and sustaining this involvement since relinquishing privilege and power will not be a preferred choice.

3.8 BIOLOGY EDUCATION FOR SOCIAL JUSTICE

All forms of discrimination come together in addressing an education for social justice. If education is political then the political stance of educators towards the existence of social justice will intimately affect how students experience all education through the classroom and the school – since it is educators who hold the nexus of institutional power. What then is social justice? Social justice includes access to life choices; power connected to the ways in which individuals can feel powerful /powerless; power connected to feeling in control of decisions that affect the way lives are lived; individual rights; rights to education; rights to individual life choices without being denied access to certain chances through discriminatory practices; and the right to fight practices we perceive as unjust (Cotton, 1998).

For Feagin (2001) '*social justice requires resource equity, fairness and respect for diversity, as well as the eradication of existing forms of social oppression* '(p5). This then requires a redistribution of resources from those who have unjustly gained them to those who justly deserve them. Social justice also demands a means of creating and ensuring processes that will allow for true democratic participation in all decision-making. For Feagin a decisive redistribution of resources and decision-making power is essential to establishing and sustaining social justice and true democracy.

Cotton (1998) recognises that justice often is but should not be confused with or understood as equality. Equality's only concern is results. It is not concerned with how the results were arrived at. Equality's other concern is that all people should be treated the same. Justice differs from equality because it rejects the notion of sameness. For justice each case is considered on its own merits and different persons are treated, if necessary, differently. Unlike equality then social justice accepts and values difference. In a classroom all students are not the same – they are different to each other in a variety of ways. To then treat them all in the same way would be to do the students a grave injustice. A social justice model demands that relevant differences amongst students be recognised, respected and treated fairly. In this way oppression, inequality and exploitation both within and outside the classroom, that is within the school and the wider community, can be worked with. Social justice education for Applebaum (2001) analyses multiple forms of oppression such as classism, racism sexism etc. and helps in understanding the meaning of social difference and systemic oppression in one's personal life and the social system.

Rodriguez's (1998) proposal of multiculturalism as a theory of social justice is based on the understanding that multiculturalism goes beyond advocating just minor curriculum adjustments and professional development workshops since it is premised on the belief that all learners at any grade level must be provided with equitable opportunities for success and therefore hinges on raising teachers consciousness. This means that multiculturalism should be a driving principle in the development and implementation of policies, curriculum and assessment and through this provide learners with opportunities for empowerment. For him this is particularly important in science education for the empowerment of those who have been traditionally underrepresented and underserved in the sciences. His critique of the National Research Council's National Science Education Standards as '*a compendium of half-articulated good intentions*' (p592) can be applied to his proposal of multiculturalism as a theory of social justice since he ignores any interrogation and explanation of the existence of underrepresented and underserved within the socio-historical-political terrain and how this aspect is vital towards any transformative possibility in the lives of students, science students and the wider community.

Gutstein (2003) notes that a central part of teaching for social justice is to work for a society where racism is reduced and eventually eliminated. An important principle of social justice pedagogy then is that students themselves are part of the solution to existing injustice/s – both as youth and as they take their place in the world of adulthood and work. This requires a deep understanding of the conditions of their lives and an understanding of the socio-political dynamics of their world which can begin by teachers posing questions that help students to identify, address and understand these issues. Teachers could ask questions about the high rate of teenage pregnancy in the school community and what this means for the female and the male student-parents. Through addressing such issues students may begin to understand the forces and institutions that shape their lives and their worlds and may begin to ask their own questions of each other and themselves. This process of assisting students to identify, understand, formulate and address questions and develop analyses and explanations of their societies are critical components of teaching for social justice. Through this students may develop a sense of personal and social agency. Developing positive social and cultural identities through validating student language and culture and uncovering and understanding their history is part of the process when teaching towards social justice. It is this that will enable students to work towards equity and social justice.

What would biology education for social justice require? It would demand a recognition, respecting and valuing of relevant differences present in the classroom. The relevant differences would be

those located in oppression and subordination as determined by the players in the classroom. This recognition of difference would also need to be translated into that which will give access to biology to all students in the classroom. The inputs to ensure that all students engage with the knowledge of biology would occur through both students and the teacher. The role of the biology education curriculum in validating and supporting oppressions through race, gender, class, language, religion, etc. would also be an essential part of the biology education discourse. This unmasking of the oppressions and subordinations in and through biology education would then make it possible to work for a society in which these could be possibly reduced. The hope for the elimination of oppressions and subordinations in society remains but a hope.

3.9 CONCLUSION

In this chapter a critical perspective that foregrounds race provides some insight into the various theorisations around racism and related oppression and subordinations. As revealed by the review of science education research in South Africa by Malcolm and Alant (2004) no analyses as yet have been developed of biology education[4] and science education from perspectives of race, class, gender and associated oppressions and subordinations. In bringing such an analysis to the South African context the usefulness of these theorisations for a critical science education both for South Africa and beyond are explored. From this a possible biology education for social justice was then identified. The examination of the various theorisations also provides a basis for formulating strategies towards engaging with that which could work towards establishing social justice within biology education, education, the wider community and society – if social justice is understood as a desired, worthwhile and meaningful goal in the lives of people.

The next chapter looks at the methodological framework in which lie the strategies for exploring my biology classroom. The critical perspective also guides this exploration of my classroom. It allowed me to develop and use a critical self-ethnography in my efforts at getting to know the students and myself from the perspective of the oppressions and the subordinations that also made up the fabric of our lives in and through biology classroom, the school and the wider community.

[4] The slippage in the preceding 3 chapters in the use of the terms science education and biology education warrants further comment. Although I want to advance research, theory and development in biology education much of this has happened in the broader field of science education and I have drawn on this for biology education.

CHAPTER 4

RESEARCHING MY BIOLOGY CLASSROOM: getting to know the students and myself.

4.1 INTRODUCTION

Critical pedagogy contributes to the unmasking of existing oppressions and subordinations. This unmasking is made possible through the use of various critical pedagogical perspectives. These perspectives include amongst them the critical race perspective that foregrounds race in its efforts; an antiracist and a critical antiracist perspective that foregrounds power; a revolutionary working class pedagogy that foregrounds class; and a feminist perspective that foregrounds gender. Critical antiracist and feminist perspectives have also contributed to analyses of oppressions and subordinations in science education. This unmasking and analysis of existing oppressions and subordinations can then be used to inform any efforts towards any education for social justice including a biology education for social justice. These were the concerns highlighted in the previous chapter.

In this chapter the possibilities of naming and challenging of oppressions and subordinations through biology education from a critical perspective is considered. Critical ethnography then is the methodology of choice as directed by the critical perspective. Through this methodology how data can be generated for the production of knowledge around existing oppressions and subordinations, both visible and invisible, through biology education is explored. Reflexivity within this methodology creates opportunities for possible emancipation. Critical ethnography provides the basis for a critical self-ethnography where I as the biology teacher also become visible and subject to scrutiny. The research site and strategies for the generation of data through the biology lessons on cell division, human reproduction, genetics and biological determination and through student interviews are described. The process through which factionalised stories were produced from the generated data is explained.

I located my investigation in one of the three Grade 11 biology classes I taught at Centennial Secondary School. I also teach General science at the school to Grades 8 and 9. It was here that I already met some of the students in this Grade 11 class. Those whom I had not taught previously

knew me as a teacher at the school through contact from other school processes. Thus the students and I were not unfamiliar with one another and with what was acceptable in the biology class. This biology class had in it thirty-four students. Biology, together with accounting and mathematics, was not everybody's favourite subject. The disinterest in the subject was reflected in student performance, which for many students was less than satisfactory. For many students in the class biology was part of the course package that had in it Speech and Drama – the subject of their choice.

Twenty-six of the students in this class were female of which twenty-one were Indian and five were Black. This was according to the race classification that had been used to categorise people in South Africa during apartheid and which still continues to be used in post-apartheid South Africa. Of the eight males four were Indian, two were Black and two were Coloured. The students in this class were between fifteen and twenty years old – the majority of students were seventeen years old. There were twelve Muslims, ten Hindus and twelve Christian students in the class. The class, like the rest of the school, had no White students. Religion was an important part of each student's life.

The Indian and Coloured students came from the area in which the school was located. Two of the Black students came from the school neighbourhood and five travelled from distant apartheid established Black townships as was the case with most Black students at the school. Those that came from the townships lived twenty kilometres or further away from the school and used public transport to get to school and back home. For some of these students it meant that they had to leave home by at least six in the morning and returned home only after five in the afternoon. Students living in the townships had to leave school immediately school was over for the day. If they missed the public school bus that travelled through the area at around three in the afternoon where they paid student fares they would then be required to pay normal bus fares This resulted in minimal contact between these students and the rest of the student body outside of the daily-designated school times from seven forty-five in the morning until two-thirty in the afternoon.

This was a boisterous class even though there were a few students who were 'quiet'. They were given to expressing themselves loudly and appeared to be comfortable with each other. They put this down to Speech and Drama where they had to interact with one another regularly as required by the subject. The students whom I had previously taught were not hesitant to express themselves in the biology class. They were familiar with my encouraging and welcoming communication as part

of the teaching-learning process. It was with these students and in this biology classroom where I attempted to unmask and give voice to oppressions and subordinations.

4.2 CRITICAL RESEARCH AND BIOLOGY EDUCATION

Methodology makes it possible to access knowledge. Practice and the theory do inform one another's arguments in the production or generation of knowledge (Lincoln and Guba, 2000). What methodological theories do is that they provide the principles by which one can design a research project, develop techniques that can be used in the research site/field and for the interpretation of data that is trustworthy. Trustworthiness is achieved through *self-correcting techniques that check the credibility of the data and minimise the distorting effects of personal bias* (Lather, 1986, p270). Such self-correcting techniques lie in the use of a variety of data sources (triangulation) and through the various forms of validity that range from descriptive, interpretive, causal (internal), construct (theoretical), catalytic (Freire's conscientisation), cathartic, and generalizable (external) (Lather, 1986; Maxwell, 1992; Carspecken, 1996; Lincoln and Guba, 2000). Through this then knowledge can be generated.

Any search for knowledge or generation for knowledge must be guided by how does one know what it is that one knows together with the relationship between the knower and the known i.e. the epistemology; what is it that is knowable i.e. the ontology; and how one can get to know i.e. the methodology (Denzin and Lincoln, 2000; Reddy, 2003). What the critical perspective does is that it makes it possible to name and challenge that which is known and has become 'natural' and obvious including issues such as race, class, gender etc. Thus through this perspective a focus on oppressions and subordinations is possible. It is through questioning and challenging the identified natural and obvious oppressions that knowledge about them can continue to be generated. Generating this knowledge can then begin to guide an agenda towards social transformation (Peshkin, 2001).

In my biology class this perspective made it possible for me to question and challenge what appeared as natural and obvious in biology education through the prescribed biology curriculum and perpetuated through biology textbooks that supported the existing biology curriculum. The students too became involved in this questioning and challenging of what made up biology education. In this way the research would attempt to expose those forces that shape and crucially affect the lives of individuals and the group both in and through biology education and through the classroom, the

school and the wider community. This would occur within an agenda where students could, if they chose, gain power and control over their own lives and in this way become agents of change in the bid towards social justice. Student participation in her/his own emancipation would thus be determined by a willingness on the part of the student to be an agent of change for herself/himself (Kincheloe and McLaren, 2000).

As a teacher-researcher I would also need to be vigilant about how my arrogant efforts to 'alleviate' the oppression of others could become invasive (Ropers-Huilman, 1999). I also would need to question when this invasiveness became a violation and whether such violation mattered. I needed to recognise that the student-participants in the biology class would be violated when the meanings they had created for themselves would be interrupted and disturbed by my invasiveness as a researcher. Students were violated in my biology class when their accepted notions of raced, gendered, classed and etc. roles were invaded by my provocations as a biology teacher-researcher. The changes and hurts produced from such violations in the biology classroom could not be ignored and had to also become part of my research engagement whenever they were identified. This had to happen with the knowledge and permission of the student-participant so that ethical issues were also addressed.

Purposefully invasive strategies that at the same time respect the participants when used in research contribute to the catalytic validity of the research (Ropers-Huilman, 1999). Such purposefully invasive strategies were sourced from the biology curriculum itself. The areas of biology that provided for the strategies used in this study included cell division, genetics, human reproduction and biological determinism. This is by no means an exclusive or an exhaustive source. Many such sources, as identified previously, abound in biology and can be used to challenge the 'natural' and obvious whilst at the same time respecting the participants. The question is of how to produce an analysis in explaining the lives of others without violating their reality.

Typical of traditional biology classrooms is discursive closure. Discursive closure allows for power discourses to undermine the multiple meanings of language through establishing only one correct reading that implants one particular hegemonic and ideological message into the reader's consciousness (Kincheloe and McLaren, 2000). I would also therefore need to pay attention to the power dynamics of discursive practice and closure within my biology classroom. In a traditional biology education the focus on the facts of biology does not give space for any discourse around

social conditions that biology itself generates and perpetuates. I would have to guard against such closure in my class.

If it is accepted that there can never be any pure and original interpretation of information then no theory, methodology or discursive form can claim any position of privilege and authority in the production or generation of knowledge. This limitation does not however, prevent new levels of understanding of how lives continue to be lived. The absence of pure and original interpretation will therefore mean that interpretative frames brought into any research has historically situated, constantly changing and developing with respect to the cultural and ideological developments. Understanding the relationship between identity formation and interpretive lenses will then provide an understanding of the origin of assertions and the way in which power has operated to shape these assertions present in any interpretation including interpretations in biology education. Thus the facts of biology education cannot reside in only one particular interpretation, which is in itself a particular construction at a moment in time and space. Interpretation, even in biology education, will require an analysis of how people connect their everyday lives to the cultural representations of their everyday experiences and this involves the unravelling of the various ideological codings embedded within these cultural representations (Kincheloe and McLaren, 2000).

Meeting the requirements of critical research within biology education is possible. This possibility came to be realised through a critical ethnography

4.3 WHY CRITICAL ETHNOGRAPHY

Making sense of human social behaviour for a specific group of humans can be achieved through ethnography that allows for a portrayal of some aspects of the existing culture and also makes possible the influencing of those aspects without controlling it. The choice of the kind of ethnography to be used will depend on the type of research agenda. A non-political agenda is comfortable with a conventional ethnography. A political agenda with a focus on exposing how power is located and works to control social relationships demands a critical ethnography. Critical ethnography does not claim to be better than conventional ethnography. What critical ethnography strives towards is providing insights into questions of social existence otherwise ignored by conventional ethnography.

If the agenda is not explicitly political with the intent of unmasking existing oppressions and subordinations in society then the choice will be a conventional ethnography. Conventional ethnography involves and describes what is, speaks for the subjects, assumes the status quo through affirming assumed meanings when others might exist and seldom reveals the perspective of the research subjects on the researcher.

On the other hand, critical ethnography challenges research, policy and various forms of human activity because it makes it possible to ask what could be; it attempts to connect the 'meanings of the meanings' to broader structures of social power and control; and resists symbolic power by displaying how symbolic power restricts alternative meanings that conceal the deeper levels of social life, create misunderstanding and thwart action (Simon and Deppo, 1986; Thomas, 1993; Kincheloe and McLaren, 2000 ; Triclogus, 2001). I was interested in unmasking and giving voice to the social oppressions and subordinations that were part of my biology classroom and in working towards emancipation if possible. My choice then had to be a critical ethnography.

My interests lay in how teaching-learning processes in biology education continued to also perpetuate social oppressions and subordinations. This interest emerges from my own development and growth in South Africa during apartheid – first as a person living and growing in South Africa and later as a biology teacher. In recent times South Africa has shifted from apartheid to a democracy. What did this mean for the students in my biology class in a post-apartheid South Africa where oppression on the basis of race, gender, language and religion was no longer legally permissible. My experience, like Lather's (1986), directed my desire and need to know. I could begin to get to know by developing an understanding of the world of my biology students in the biology classroom, the school and the wider community.

Critical ethnography not only describes and analyses. It also opens to scrutiny otherwise hidden agendas, power centres and assumptions that inhibit repress and constrain. It requires that commonsense assumptions such as the facts of a traditional biology education be questioned (Roman, 1992; Trueba, 1999). It does this by taking ordinary events, like traditional biology lessons, and reproducing them in ways that exposes broader social processes of control, taming, power imbalance and the symbolic mechanisms that impose one set of preferred meanings or behaviours over others. Through this it reveals how domestication, social entrapment and contentment with social existence occurs. Contentment with social existence needs challenging because in this lies the roots of domestication of oppressions and subordinations. Domestication

also makes possible the excuse of a plea of ignorance, an ignorance that must be further excused since it caused no harm. It also provides for an excuse of non-responsibility for existing social oppressions and subordinations such as racism, classism, sexism, etc. Critical ethnography does not provide the route towards emancipation. Rupturing the domestication of traditional biology education creates then opportunities for students to resist domestication – if they choose to become agents of their own emancipation.

Existing power issues as recognised by Lather (2000) demand also that the critical ethnographic project engaged asks for whom was the research or inquiry conducted. How did the research process engaged with then empower some and silence some; who was empowered and who was silenced? Who decided the research agenda? These questions are crucial to any possible involvement in areas of advocacy and agency. As a researcher I was both alerted and cautioned by Peshkin (2001) who drew my attention to the researcher, who when engaged in a process of selection by sampling, makes choices about who will participate in the research. These choices are bound by the recognition that one cannot research everything and that one should not even attempt to do so. Further, the research products then can only be the outcomes of what decisions have been made about what to sample – based on the researcher's perceptions.

Peshkin (2001) also alerts the researcher to the lenses of perception as being those that include: patterns - being that which occurs routinely and through their regularity give form and content to perception; time – being the framing segments and also history which is critical to understanding the present; emic - being the respect that must be accorded to others by taking them seriously in giving them voice; positionality - being the basis for how one 'sees' and this being done through assuming the lenses of the 'subject' – it is positionality that makes possible the acquisition of the emic voice; ideology - being the stances that frame the researcher's perspectives on the foundational issues of what the research ought to accomplish and also the researcher's role in the research process; themes being the prominent factors in the research; metaphors - being that which directs attention to somewhere and in doing so enabling perception; irony - being the metaphor of opposites that enhances what a thing is and; silence - being directing the ear and eye to that what is not occurring within the research setting and is inferred from the researcher's sense of what s/he thinks ought to be happening. Research purposes act as the criteria when sampling decisions are made around what to include and exclude and what should be placed at the centre and what should be placed at the periphery. What I needed to bear in mind is that through using multiple lenses my perception would be enhanced.

Power positions spoken of by Lather (1986) in research can begin to be addressed by involving the student-participants wherever possible in the research process. I shared with the students my agenda of unmasking existing oppressions and subordinations in the biology classroom; they were privy to lesson transcripts which were also used to guide the student-participant interviews; and those students who were interviewed read through and commented the interview transcripts. In this way I guarded against my own enthusiasms, impositions and objectifications. I let the data speak to me. Iterative readings of the thick data allowed for reflexivity as I thought through the data and its implications. This made it possible for the 'subaltern's' voice to be heard. This empirical analysis made it possible to generate an empirically grounded theory from the context-embedded data. In this way Lather's (1986) requirement of inquiry as a '*fundamentally dialogic and mutually educative enterprise*' (p 268) was obtained.

During this process students had to re-evaluate their understandings of themselves as oppressors, the oppressed and subordinated and the conditions required for an existence that tended towards social justice. I needed to also acknowledge, as part of this enterprise, that recognising conditions for emancipation would not necessarily translate into actual emancipation itself. The provocation of the students during the biology lessons engaged the student in trying to understand her/his world, what shaped that world and what it was that the student needed to engage with to effect any desired change. Such direct student engagement with change allowed for Lather's (1986) catalytic validity through this project.

Biology education and education generally does not begin and end within the confines of a classroom – be it a biology classroom or any other classroom. Biology lessons began to challenge how life as experienced in traditional biology education gave commonsense validation to life even within the school and the wider community. Contradictions began to emerge as students responded to the oppressions and subordinations that were identified from the lessons. Student understandings through processes of socialisation came into conflict with what they verbalised around issues of oppression and subordination; what they believed was in conflict with how they lived their lives. This was painful to both the students and me. The pain came from the knowledge of each of us could be both an oppressor and oppressed person. It is this pain that needs to be unmasked and known before there can even be any efforts towards emancipation.

For Kincheloe and McLaren (2000) a criticalist goal of any critical ethnography, in its various forms, is the attempt '*to free the object of analysis from the tyranny of fixed, unassailable categories and to rethink subjectivity itself as a permanently unclosed, always partial, narrative engagement with text and context*' (p 301). In starting from the position that education is intrinsically political critical ethnography provides for an advocacy for the oppressed. This advocacy may be obtained through various intersecting activities such as: documenting the nature of the oppression; documenting the possible process of empowerment as a journey away from the documented oppression; conscientizing (the catalytic validation) or accelerating the conscientization of the oppressed and the oppressors; a reflective awareness of the rights and obligations of humans without which there is no way to conceptualise empowerment, equity and any struggle towards liberation; sensitising the research community to the implications of research for a quality life through linking intellectual work to real-life conditions; and reaching that level of understanding of the historical, political, social, and economic contexts that support the abuse of power and oppression, the neglect and disregard for human rights and ways of learning about and internalising rights and obligations that work towards social justice. Through such efforts a relationship between the intellectual activity of research and the praxis of the daily life of the researcher may be forged as happened in my biology classroom (Trueba, 1999).

4.4 WHY A CRITICAL SELF-ETHNOGRAPHY

My initial query was around racism in the science classroom – my classroom to be specific. Racism is recognised as a taboo and for this reason it becomes a slippery concept that makes researching it in any classroom a difficult task. The unwillingness to name racism and challenge it lies in an unwillingness to recognise and acknowledge one's self as either the oppressor or colluding with the oppressor consciously or nonconsciously to perpetuate existing oppressions, subordinations and discriminations. I must also confess to my wanting to know where I too was located around this taboo of oppression and subordination. My query within my biology classroom was guided by my experience around events that remained the same in my classroom – both curricular and social. Despite a shift from apartheid to democracy the biology curriculum still remained the same in that race and its contribution to racism remained outside the official biology curriculum at that point in time. Students continued to interact with each other in ways that appeared to me as racist – how they identified each other in terms of apartheid race categories as Black, Coloured and Indian; how they sat in 'own' race groups in the biology classroom; and how they socialised both within and

outside the biology classroom. My task then became one of establishing whether or not racism did exist in my classroom and then illuminating how it occurred and was managed if it did exist.

This study demanded that I also look at my role - that I also interrogate myself. This would be a daunting and intimidating task because a self-study would reveal that which I would prefer not to acknowledge and know about myself. It would be these fears that would guide my selected truths that I would be willing to share with you as the reader and audience. Engaging with the students ensured that I had to deal with the 'Who' I presented in my classroom – while still a selected 'public persona' the selections could not exclude the 'Who' I was in the biology classroom. At the same time any study that focuses on oppression and begins by locating race at its centre is also difficult to research from just on the 'outside' – it would require also my, the researcher's, involvement. Having been socialised within a range of oppressions and privileges as a Black South African middle class woman of Indian origin I was located in a position that made it possible for me to study privilege, power and oppression through a critical self-ethnography. My goal was towards contributing to the beginning of social justice in the lives of the students who passed through my classroom. Naïve or tangible, I believed that this could be worked towards using classroom practice to influence not only that which went on in the classroom but also influence the lives of the students in both the school and the wider community.

Being caught between a rock and a hard place – the ethnographer's dilemma of shaping the research encounter and representing the students that I saw, heard and experienced on their terms while doing this through my own personal, epistemological, ontological and cultural frameworks and from my position of power as both the researcher and the biology teacher. What then shaped my research interests if I was to see myself in the research? Part of me was the outcome of a growing in and through apartheid – first as Black and then as woman. As an Indian I was disadvantaged through the oppressions and subordinations of my life in an apartheid South Africa where I was marginalized through my race by a White-centred society. I was 'advantaged', relative to being Black, within my own group context as an Indian – economically, politically, educationally and culturally. The capital accrued from this 'advantaged' vantage point made visible and stark the disadvantages of my 'advantage' and became my subconscious dilemma. It is this dilemma that has and continues to fuel my interests in discrimination and social justice. It is through this dilemma through which I heard and made sense of students in my class. I did begin with a naïve understanding of racism as that grounded in the Black-White binary of race discriminations. It was both student experiences together with encounters of the epistemology and ontology of racism as a

lens through which I was 'forced' to view discriminations that shattered that naivety. I became sensitive through the research process to a variety of integrated discriminations of race, gender, class, language, religion and power – all playing themselves out in different ways through space and time.

In my work I attempted, like Ladson-Billings (2000, p268), to tell a story about my work, my students and myself. This is located in how I understand myself as a researcher – who I am, what I believe and my experiences – because all these affect and influence the what, the how and the why of my research. My decision to research my classroom was political in an effort to demystify and deconstruct what went on in my classroom of persons that was made up of persons that lived in that continuum of being both the oppressor and the oppressed together with a content that consolidated the existing continuum. Telling my story required that as a teacher-researcher I engaged in systematic self-critical inquiry based on my practice to build theory and in this way to contribute to educational research and also to re-address, what for me were, pedagogical conflicts and challenges. The theory developed could then be used as a guide towards understanding and further developing (and improving) my own practice in teaching towards social justice.

My research in the form of a systematic study of professional action within my biology classroom provided the opportunity for both the students and myself to engage in critical reflection and also created opportunities that allowed a challenging of conventional wisdom of biology teaching and learning. I wanted to expose what went on in my classroom about persons who were both the oppressor and the oppressed and how challenging through biology education could rupture these positions.

Through this the production of knowledge about the teaching and learning within the biology classroom would become possible. Together with students I explored the links between knowledge and action and the contexts shaping knowledge and action both in and outside my classroom. This opportunity to see familiar traditional biology education in new and different ways made it possible to both change and develop biology knowledge and practice in my classroom. Making the familiar of my biology classroom strange and problematic demanded self-awareness on my part of what it was that I was engaging with in the teaching-learning games played in biology in my grade 11 classroom. This self-awareness needed to extend to an acknowledgement of my role in the generation and analysis of my data so that my bias in the research process became evident to all - especially me. This then demanded that I took cognisance of the socio-historical processes that gave

rise to the school and classroom practices that I engaged with – and through this the ideology that governed the process. Only then could I begin to deconstruct my own practice (Triclogus, 2001). This declared self-awareness provides for my reflexivity as a researcher and is essential to the rigour employed in both the gathering and the analysis of my data.

My research allowed me to assume an insider/outsider position as a researcher. My insider position that allowed for trust came from me having worked with the subjects i.e. the students for at least two years previously as their general science and then as their biology teacher. They also knew of me as a teacher in the school, the research site, from the time they came into the school - at least three years previously. Mutual knowledge and trust between the students and myself contributed to the choice of this class for the project. The presence of three race groups in this class, Indian, Black and Coloured also played a role. Other classes had in them only Indian and Black students. The students in this class also demonstrated a range of abilities in biology as a subject and this also influenced the choice I made. As students of the school where I taught they knew how I enacted my beliefs about my position and role as teacher and also how I expressed myself on the variety of issues that were part of the ever-unfolding sagas in our daily existence at the school and it was this that contributed to the trust in our interaction during the research process. I interpreted from those students that shared what shaped their lives with me, both in and outside of the classroom, that trust existed between the students and myself. I was also cognisant of those students who at different times chose to 'close' themselves to what was going on in the classroom – this was true of different students at different times. I also needed to ask whether my insider position played a role in 'colonizing' and 'oppressing' the students in the course of the research. I was explicit on various occasions about my position of privilege – so students were aware of this and thus privilege, I believe, minimised itself. I was also in a position of authority – a position that I was open about and a position I used, at times, to decide how the interaction/s would proceed between students themselves and the students and me.

Reciprocity in my research was arrived at through the lessons where there was full but sensitive disclosure on my part of where I was located on issues around gender, class, race etc. – through the curriculum of biology and as a teacher in the classroom and at the school. This was then enhanced through interviews with individuals and a focused group interview around the research issues that were grounded in notions of gender, race, class, religion, language and power. Both the classroom interactions and the individual and focused group interview allowed for discussions on existing 'false' consciousness around issues of discrimination, which then allowed for the questioning of

taken-for-granted beliefs and authority within the existing culture (Lather, 1986, p266). It was this reciprocity in my research that implied both a give-and-take and a mutual negotiation of meaning and power. In this way reciprocity as a matter of both intent and degree was met within my research design.

4.5 DATA GENERATION

4.5.1 My Research Site - The Classroom

The research design required gathering information to answer the questions: how is racism/discrimination played out in my classroom; in what ways are the classroom practices of the teacher and students discriminatory; and what reinforces such practices and why. This was realised through gathering data in a Grade 11 biology class. In the class there were thirty four students between fifteen and twenty years old. Twenty six were female and eight were male. Twenty-one of the female students were South Africans of Indian origin and five were Black South Africans; eleven were Christian, eight were Muslim and seven were Hindu. Of the eight male students four were South Africans of Indian origin, two were Black South Africans and two were Coloured South African; four were Muslim, three Hindu and one was Christian. Some students responded with scepticism to discrimination as a part of the biology classroom and several shared that this was typical of my searching for problems where none existed! Parents, of those students who volunteered to be interviewed, too were told about the nature of the project and concerns about the political sensitivity of the research was worked through as they were raised by parents.

4.5.2 The Lessons

The data collected and generated was arranged around selected units of the biology syllabus taught in the classroom (see Appendix 3 for relevant excerpts from the Grade 11 syllabus document as prescribed by KwaZulu-Natal Provincial Department of Education and Culture). The required biology content was taught to the students – this being a responsibility to the students that I needed to meet since the students would be examined on the content as prescribed by the syllabus and not on that which was of research interest to me (see Appendix 4 for the content as presented in the study guide text document used by the students). I decided that data would be collected around four units of study in the biology class during the third and fourth term of schooling. This decision was linked to my preparedness for data gathering at this point in time in the research itself. Three of

these four units were part of the prescribed biology curriculum and were units on cell division, reproduction and genetics. Policy determined and dictated the teaching of these units in biology at this time of the school year as it did with when the various units were to be taught to the students. The units were taught over a period of 12 weeks from the 21 August 2000 to the 10 November 2000 with a one-week vacation at the end of September. All lessons taught were audiotaped. At the end of each unit, except for the unit on biological determinism, the students were given a test that tested only the biology content that was taught. Anything outside the content, this being the discourse around oppression and discrimination and biology's contribution in this regard was not examinable – as expected by the formal biology curriculum.

The school timetable worked on a nine-day cycle with each lesson being of an hour's duration. During this cycle of nine days I would meet with the students for six biology lessons. Lessons on cell division took four weeks and were taught between the 21 August and 13 September. Of the 13 lessons on cell division thirty minutes of one lesson was used for testing. The next three weeks, from the 14 September to the 10 of October, were spent on human reproduction. At the end of September the school broke for a week's vacation and on our return we continued with lessons on human reproduction. This unit had in it fourteen lessons. In the first week one of the lessons was used to review the test written on cell division and the last lesson was used for a thirty-minute test on human reproduction. This was followed by a three-week session on genetics from the 11 October to the 7 November. Of the twelve one-hour long lessons the third lesson was used to review the test written on human reproduction. Lesson eleven was used for a test that was set for forty-five minutes. During the last lesson I went through the test, which I had not as yet marked, and then shared with the students that I would be teaching a section outside of the prescribed syllabus. The last three lessons for the fourth term, from 8 to 10 November, focused on biological determinism using extracts from Gould's (1981) *Mismeasure of Man*. The students then went into their final year-end Grade 11 examination that would determine whether or not they progressed to Grade 12.

As I taught each unit I used 'openings' that presented themselves in the prescribed content to raise issues around existing visible oppressions and subordinations. Unit four was a unit I made part of the curriculum titled biological determinism. This unit was introduced to the biology class with the declaration that it was not part of the formal examinable curriculum. Using my position of authority as teacher I gave students no choice about the introductory lesson. The students however, were informed in this introductory lesson that at the end of the lesson they would have the right to choose whether we continued or discontinued with this unit of work that was not part of the examinable

curriculum. This was a silent coercive strategy on my part. Given our difficulties in the classroom and beyond in engaging with discrimination and racism my gut feel was that the greater number of students would wish to engage with this unit. If they chose not to then I would have to analyse and theorise around their unwillingness to engage on issues of racism and race. Students did choose to work with this unit after the introductory lesson.

Each of the units taught lent themselves to questions about existing oppressions and subordinations. Cell division opened itself to engagement around the issue of gender through my questioning the use of terms 'daughter' and 'mother' cell. Students engaged with their understandings of the normative roles ascribed to women as nurturer's and responded to my critique of biology as a subject that served to silently reinforce such normative roles through its language. Reproduction provided the basis to classroom discussions on gender issues, teenage pregnancies, abortions and sexually transmitted diseases including HIV and AIDS. Genetics provided opportunities for linking abortion with ethics and discussions on cloning, racism and homosexuality. Biological determinism engaged with the history of science and its role on the validation of race and racism and its social practice and also on the issue of male/female roles in society.

I wanted to know how the students I worked with, directly or indirectly over a period of four years of secondary schooling, saw themselves – both as biology students when in my classroom and as persons in a world strewn throughout with both visible and not visible race, gender, class, religious, language and power discriminations. I provoked students during the biology lessons by raising questions around that which I considered discriminatory in the biology content because it was through this that existing oppressions and subordinations continued to be perpetuated. It was this that elicited student dis/agreement with the understandings I shared and then provided for further discussion during student interviews. Student reflexivity as part of classroom praxis may have worked to engender possible transformation; in this time it is also possible there may have also been instances where the provocation and resulting debates in the biology classroom served not only to create resistance but to also reproduce existing oppressions and subordinations – both verbalised and silent amongst the students in the class.

4.5.3 The Interviews: From Thick Description To Storytelling

Audiotaped lessons were transcribed and listened to repeatedly to guide the development of an interview schedule. The interview questions were then used to carry out semi-structured interviews

with students from the class. Through the interviews I hoped to be able to engage more deeply with student experiences of racism and related oppressions and subordinations. During each interview the student as a participant was encouraged to share her/his experiences of oppression and subordination in the biology classroom, the school and in the wider community. I had shared with the class my intentions of interviewing students as part of my research and suggested that those students who felt comfortable about being interviewed do so. The ten students who then participated in the interviews did so voluntarily. I got to know who these students were through a response sheet that at the same time provided me with some data about each student. The data provided information about the student's race, gender, religion, parents' occupation and address (see Appendix 1). I obtained parental consent telephonically from each parent for each student interview. Permission for the student to meet with me at the school during the school vacation was also sought and obtained from the parent. Throughout the interview the student was free to say what s/he thought. During the course of the interview '*intruding associations*' (Luttrell, 2000, p513) that I had used to provoke students with during biology lessons emerged. Intruding associations were those parts of the student's life that alerted the student to visible oppressions and subordinations as the student engaged in a reflexive process through the interview. Those oppressions and subordinations that were not visible also emerged. Sometimes, as the student spoke and the non-visible oppressions and subordinations in her/his life became visible to the student, the conflict and confusion that shaped such a realisation also became 'part' of the interview discourse. Each student was also invited to read how her/his thoughts were transcribed into text and free to comment.

Both the classroom interactions during the biology lessons and the subsequent interviews with the students changed our relationship. I was willingly 'forced' into participating in self-revealing and vulnerable ways – my revelations and vulnerability allowed students to share their own inner turmoil in the public space of the classroom, in small groups and in our one-on-one conversations. In this way the research became a part of our everyday 'humdrum' life that we lived through at the school.

I transcribed each of the student interviews. I read through the data repeatedly so that I could begin to identify and generate themes around racism and related oppression and subordinations experienced by the students. I also followed through with a suggestion from a meeting with doctoral student cohorts and supervisors that I try re-presenting the data as stories. This filled me with trepidation because it was outside what I was familiar with. As shared by Clandinin and Connelly (2000) storytelling is a disciplined line of work identified as narrative inquiry and '*in the*

construction of narratives of experience there is a reflexive relationship between living a life story, telling a life story, retelling a life story and reliving a life story' (p 71). When narrative inquiry is that which attempts to make sense of life as it is lived, it tries to figure out the '*taken-for-grantedness*' (p 78) about life as it is lived. This became possible for me as a researcher when I began to challenge the '*taken-for-grantedness*' about life, which then made it possible for me to participate in and also to see how things worked in and beyond my classroom.

In writing each story what I tell as well as the meaning of what is told through each story has been shaped by the relationship between me and the students through: me as teacher at the school known to students for at least 4 years; having taught some of the students as a general science subject teacher in one of the 4 years; contact with the students outside of the general science and biology classroom on the school grounds and during school excursions; when they came to me for counselling; our interactions through school structures such as the prefect body and the representative council of learners. Each story has also been shaped by my agenda as a researcher where through my critical questions biology education was challenged. This provided me with the 'informed' intuition that gave birth to each story that then took on its own life as it wrote 'itself'. I was not able to share the stories with the students who had finished schooling and had left the school by the time the stories were written.

I then shared the stories I wrote with my doctoral student cohort. The question asked by the student cohort was the question of voice. Whose story had I written – the student's or mine? Was the story then true and legitimate? As noted by Lincoln and Guba (2000) voice is a multilayered problem – because of the various things voice has come to mean to different researchers. The reality is that what I have to say matters – it is this that gives me as a researcher voice. What I say expresses and (re)presents selected student experiences through my voice – what you read then you read through multiple voices from a particular time and space in our lives (Clandinin and Connelly, 2000).

I used my power as an author to shape the story and the public perception about the worth of the lives of my students – for this I make no apology. As shared by Stake (2000) '*It is the researcher who eventually decides what will be in the report or story – the cases 'own' story. What results may be the case's own story but the report will be the researcher's dressing of the case's own story ... it is the researcher who ultimately decided on the criteria of representation*' (p 441). The lives of these students need to be known – because these lives are being shaped by biology education. I also

make no apology for recognising and acknowledging that the stories I tell are the 'truth' to fit the need of the moment.

My stories emerged from interviews I conducted with each of the ten students – as solicited by my interest in racism and related oppressions and discriminations. The stories combine a succession of incidents into a unified episode and reflect my attempts at unravelling of and getting some insight into the lives of my students – both in and outside my classroom as both the oppressor and the oppressed (Polkinghorne, 1995). Racism and related oppressions and subordinations, the plot and focus of each of my stories, guided my selection from the myriad utterances during our interviews. My stories then present a 'tightened' and 'ordered' set of student experiences in a meaningful form for me and possibly also for you as the reader. Although my constructions, each story also attempts to be as close as possible to the actual experiences each of the students and does so through being written in the words used by the student in each of the interviews. The story 'title' emerged from what for the student appeared to be her/his significant challenge – emerging from the challenges of a 'disruptive' biology education.

4.6 THE CONSTRUCTION OF A STORY: A "FACTIONALISATION".

What is a story? It is a narrative of an unfolding chain of events, a description of a collection of events and happenings put together coherently by somebody in a particular place at a particular moment in time.

For Barone (1995) a critical story, that is the result of co-authoring, is also an artful practice that requires a convincing dialogue between the writer and the reader. Such an artful practice requires honesty, which can be achieved by the author remaining as close as possible to that experience that comes from careful observation and detailing of the events. This can be achieved through meticulous detailed transcription that then provides thick data from which the story is constructed. Through this the richness and nuances of meaning in everyday life can be captured. In telling itself, a story should not venture far from the lived experiences of the reader as part of it being a convincing dialogue. At the same time a story must not 'tell it all'. It must have in carefully positioned blanks that the reader can begin to fill in with personal meaning. In this way the reader is also engaged through the dilemmas the story poses also for the reader. The story then promotes

'polyvocal, conspiratorial conversations between the writer, the protagonist of the story and the reader' (Barone, 2001, p151)

Stories have been and continue to be categorized as fiction and non-fiction or fact. The binary opposites fact and fiction are close to one another – much closer than scientific rationalism will allow us to acknowledge. In the world of scientific rationalism fictions are akin to falsehoods and facts present the truth without distortion. It is this notion of fiction and fact that Gough (1994) challenges through recognising the human agency present in these binary opposites. For him fiction is an active form in that it is fashioned by a human agent and fact reveals the outcome of a human action in being a reference to the thing done or that, which actually happened i.e. a testimony to experience. Thus fiction and fact contribute to each other. What is important is to recognise that even the stories of fact or non-fiction have been fashioned through a human agency. It is this that leads to a blurring between fact and fiction and makes clear that there can be no factual narrative without distortion. Richardson (2001) too recognises that fact and fiction participate in a delicate balancing act when one attempts to write a 'true ethnography' of experience. While a story or narrative can never tell the absolute truth it can however achieve a degree of critical significance through the writer remaining as close as possible to the actual experience (Clough, 2002).

Stories that give voice to the previously silenced are political. In giving voice it provides for the diversity of experiences that give readers insights into their own lives and practices. Hence the need for carefully positioned blanks in a story. For Barone (1995) then emancipatory educational storysharing makes possible a story that allows for a literary experience that is characterized by the construction of the story by the writer and of the reader's deconstruction and reconstruction in the reading of the story. The emancipatory-minded storyteller uses narratives of struggle (hooks, 1994) to focus on the disempowered and for letting the voice of the subaltern be heard.

Barone (1995) rejects the notion that fiction is associated with falsehood. For him a story in putting the experience in the forefront by remaining true to detail meets the requirement for fidelity and trustworthiness and makes it possible to understand how we live our lives. A story is fictional to the extent that it is fashioned by a human yet remains an artful and honest enterprise. 'Factional' then is the way Barone (2001) has chosen to describe the blurring of the boundary between fact and fiction. This blurring of boundaries between fact and fiction is also acknowledged by Clough (2000) in his recognition that fiction may have a 'privileged access to the real' and that fiction may operate as a 'form of truth'.

Clough (2002), Richardson (2001) and Barone (2001, in his later work) in acknowledging the agency of the human hand in the fashioning of the narrative have opted for the use of the fictional. I, however, choose to refer to the account in my study as "factionalisations". For me, the sharing of the student's experience and life, the student's "fact", using my skill as a writer in fashioning the student's "fact" blurs that boundary between fact and my fictionalisation of the fact. It is this that has made possible the factional accounts of student experiences and lives.

In factionalising the students' lives I was able to bring together the multiple methods of a critical ethnography, narrative method and critical storytelling. This factionalisation provided a space through which knowledge could be generated for an understanding of the oppressions and subordinations that are part of the students' lives. For this reason the stories deserve a space in this research.

I read through the transcript of the interview with Waseela many times. The plot was oppression and subordination. This was what I needed to identify in the transcript and present as a logical, tight and ordered factionalistion of Waseela's life. As I read through the transcript I was struck by Waseela's description of who she was – a thinking person and not a robot (last paragraph of page 5 of transcript).

> W: Obviously I'd opt for the one where we are learning - about racism; we are trying to understand it; because if we can go into the other lesson where we not explaining at all, where we not talking about racism - we just being ignorant, we just taking in whatever knowledge – it's like, it's like - okay - we take in the knowledge, we put it into our heads and we take it out again. That's all we are doing – we like robots. Basically, that's what I call it – robots. You can't just take in knowledge and expect to just spit it out – just spit it out; we are human beings, we have feelings - each one of us; I mean we have feelings and we have to think about all these things, we have to think about others feelings and things like that. Surely, we are not - obviously, this is biology – and people think that there's no feeling in it, There's not supposed to be any feeling. But I think there should be feelings and obviously this goes back to understanding.

This was a reflective response from Waseela who was now also looking at how her schooling had prepared her as a robot. She raised this idea of a robot in the interview several times during the interview (see page 8 and page 9 of transcript). It was this that gave me the idea of the story title. I then used her thoughts that she had verbalised to write the first paragraph of her story.

When I take in knowledge, put it into my head and spit it out again without understanding ... I am choosing to be ignorant. That's what I'm doing. I am behaving like a robot ... not communicating, not thinking, ignoring my feelings and ignoring the feelings of others. That's not learning. Learning happens when I understand and I cannot truly understand if I ignore feelings. I want the space to express my feelings - even in the bio class. If teachers treat me like a robot without feelings and I am not allowed to express my feelings in a class then that's what I'll be when I finish school ... and I too will treat the world like that! **W1**

The second paragraph of my factionalisation of Waseela's life came from excerpts in the transcript on page 2 and page 3 where Waseela reflected on her future role as a learner, a woman and as a mother. The paragraphs from the transcript read as:

W: Ya, because I mean all through the years there's probably students who keep on taking up this knowledge which they going to teach to their children, they going to tell them no, this is the way, this is the way and things like that - and we going to bring up – I don't know, it's obviously going to affect our future, our future leaders, children. They are the ones who need this education and obviously it's education that has to be good biology, and if you going to have all these kind of things where you have to like – sexism – basically for me its sexism, where they representing the woman like the one who has to bring up and has to do everything; where she is the one who has to be independent around her child or something there to look after the child. I don't think that's right.

W: Okay. Now we are in the modern world, that's right, we are in the modern world and women are becoming more independent and things like that there and we still have like sexism – things like - where the women are supposed to be (position of women/roles of women), I'm not trying to be like woman power or anything like that. There is women discrimination and things like that there. Women are oppressed and we still like struggling to actually face up to man, to men, to tell them that you know what we don't have to sit down in the house. We not the only ones, just because we gave birth to this child but ... I mean it takes two to tango ... so that's how produce the baby and things like that there and ...

W: It's, it's okay that's being them, they are being ignorant, they are being ignorant of things like this. Obviously if you want a better world small things need to be tackled first – these things which seem like, you know, Oh! Just let's pass it off, they seem like small things, like small things - but these small things are going to lead to bigger things – bigger catastrophes, bigger problems. I mean if you

like have one statement and a person looks at that statement, and he says okay I'll take that in. Slowly you start developing – I don't know how to explain it to you - you begin to take in that statement. It's like when someone tells you, you are bad – you just pass it off and then slowly you begin to take it in when a person keeps on shoving it at you – it's just like our education system – Now we have the children, and children. And then the children, I mean the pupils - and they going to take in this education and they going to pass it on to their children. We can't just ignore it – and they are being ignorant. And I think it has to be recognized – all these things have to be recognized. You can't just pass it off.

It was these three paragraphs from the transcript that provided the basis for the second paragraph in Waseela's story, which I wrote as:

> I have to question. I have to know why I am learning what I am learning. I will be passing the knowledge I have to my children. I am going to influence the future. I have to question sexism in the biology class. I have to question the sexism in my world. Even biology represents the woman as the one who has to do everything; to bring up and look after the child. That's not right. For a better world it is this kind of thing that needs to be tackled first. You can't pass it off as a small thing in the class. It is these small things that lead to bigger things - bigger catastrophes. **W2**

Paragraph three of Waseela's story W3 came from two paragraphs on page 12 of the interview transcript:

W: Ya. I know like at home… I err… it is kind of talked about … At home, I'm the only girl, and err, I'm the only girl and every one says `Oh! You probably so spoilt' – but the thing is … err… as soon as they say that I try to turn around and try not to cry because I'm not exactly spoilt. My smallest brother is actually spoilt and all my brothers are spoilt by my mother. My mother loves her boys more, my father loves the boys more – my father even admitted to me that he didn't want a girl.

W: Obviously, it made me feel sad and up until now I still cry about it when I think about it. I try to understand but I can't. I try to. Because…and they were supposed to take me out (of school) when I was in std. 5 because he thinks that, you know, girls end up doing things wrong, they get ideas and stuff like that there and they do all the wrong things. So basically, now when I'm working hard – the only two people I think about is my parents – my mother, my father, about them. And I work hard for them – to show them, you know, girls are not like that. Basically, I try for woman power to, and I tell

my mother all the time, you know. In home economics too – my teacher, I love my teacher – Mrs U. R. – she tells us, she teaches us `Oh! Is it right that boys must sit down when they come home. When your mother…when you are parents, when you become parents you make sure that you treat both your boys and your girls equally – they must both do equal work. They both children'. You can't treat me as though I have all the responsibility on me and expect my brothers to just relax. I don't think that's right. I know my smaller brother – he doesn't work. He's basically – there is only one years difference – basically we about the same – just that our genders are different – so more responsibilities are put on me and less on him. And then he has become rather irresponsible – because my mother is always doing stuff for him.

At home my mother loves her boys more. My father loves his boys more. He even admitted to me he didn't want a girl. I still cry when I think about that. I try to understand but I can't. They were supposed to stop me from going to school when I was in Grade 7. It was because, you know, girls end up doing the wrong things according to my father. They get ideas and stuff like that there - things that should not happen. I know at one time when I was small I used to wish I was a boy. Because boys had all the fun. Girls have to be tidy and clean up and do things like that. **W3**

This was how I factionalised what Waseela had shared in the interview with me as her story. **W4** came from a paragraph in the transcript on page11; **W5** from page 12 of the transcript; **W6** from page 7 of the transcript; **W7** from page 12 on the transcript; **W8** from page 8 on the transcript; **W9** from pages 4, 6 and 7; **W10** from page 20 of the transcript; **W11** from page 5 of the transcript; **W12** from page 13 of the transcript; **W13** from page 15 of the transcript; **W14** from page 17 of the transcript; **W 15** from page 17 of the transcript; and **W16** from pages 9 and 10 of the interview transcript.

Each paragraph of Waseela's story was given a code. The code was made up from her initial W and the paragraph number in the story. Waseela's story had 16 paragraphs the paragraphs carried the codes from W1 for paragraph 1 to W16 for paragraph 16. This coding system was used for each story where the student's initial and the paragraph number made up the code; for the lesson stories initials of the lesson title together with the paragraph number made up the code. The codes were

used to provide a cross-reference between the stories and the initial analysis in the generation of knowledge around oppressions and subordinations.

CHAPTER 5

VOICES FROM MY CLASSROOM:
student stories

5.1 INTRODUCTION

In the last chapter the link between critical research and biology education in exposing existing oppressions and subordinations was explored. The need for a suitable methodology guided by a critical framework was then identified as being a critical ethnography. Through this methodology existing oppressions and subordinations, both visible and not visible, could be named and challenged and through this knowledge generated. A critical self-ethnography served to unmask me as the biology teacher situated within this project. How the methodology allowed for data generation at the selected research site through selected biology lessons and student interviews was described. The use of storytelling for the (re)writing of the generated data in the form of factionalised stories was also explained.

In this chapter the factionalised stories of the ten students who voluntarily participated in interviews is presented. Through these factionalisations I share with you the lives of the students as seen through my eyes and my biases. As you read through each story, fashioned by me, you are invited to get to know each student through the experiences that fashioned each life. Any shortcomings in the (re)presentations are all mine and not the students at all. It is I, after all, who has crafted these 'stories'. Each student is introduced to you through a brief profile in the table on the next page. The student stories then follow in alphabetical order according to the names of the students. Additional text and images from students in the class, other than those interviewed, is placed betwixt the student stories. These texts and images serve to provide glimpses of the student experiences within the biology class – glimpses of how the students saw me and what it was that was taking place or not taking place in biology education.

NAME OF STUDENT[5]	AGE	RACE	GENDER	RELIGION	FATHER KNOWN/ UNKNOWN	PLACE OF RESIDENCE	ENGLISH FIRST OR SECOND LANGUAGE	PERFROMANCE IN BIOLOGY
Anneline	18	Indian	Female	Christian	Known	School Neighbourhood	First	Poor
Ronald Arthur	18	Indian	Male	Christian	Known	School Neighbourhood	First	Poor
Chreestheena	17	Indian	Female	Christian	Known	School Neighbourhood	First	Poor
Jameel	16	Coloured	Male	Islam	Known	School Neighbourhood	First	Fair
Kaiser Mbeki	18	Black	Male	Christian	Unknown	Township	Second	Satisfactory
Nelisiwe Faith	17	Black	Female	Christian	Unknown	Township	Second	Fair
Nolwande	17	Black	Female	Christian	Known	Township	Second	Satisfactory
Pretty	15	Black	Female	Christian	Unknown	Township	Second	Good
Sandile Wonderboy	18	Black	Male	Christian	Known	Township	Second	Good
Waseela	16	Indian	Female	Islam	Known	School Neighbourhood	First	Very Good

Table 1: Profile of students that volunteered to be interviewed.

[5] Names of all students have been changed to maintain their confidentiality

Zeenat Bayat Grade 11.B 20.11.200

5.2 Only people who do well are important. I never did well ...

Anneline's story

I was shocked. Very shocked. I told my father about it. Why me. I never did well in bio. Only people who do well are important enough to be interviewed. Why did she pick me to interview. That's what I did think. I never ever performed well in bio in my life. That's why I repeated grade 10 – because of bio. It does make me feel nice that you called me. I probably ... am important. **AN1**

When we did cell division you spoke about male and female roles hidden in the language. You did that to make the lesson interesting, easier to understand. It's mothers and their daughters who produce and look after and help to grow. You won't come across father and son cells – because in real life they can't produce and things like that. It's the female's job to do that. Females show more responsibility, know how to care. Even at church the pastor always speaks of how much his wife does for him. Everywhere it's what my mother does. So the language used in cell division, mother cell and daughter cell, it's appropriate. Yes, it's appropriate. Not sexist. **AN2**

The male is more powerful and the female is more responsible. That's why he's never disgraced if he makes a girl pregnant – a girl he's not married to. I mean that guy in Grade 11 he was totally cool about the whole thing. On the day she was having the baby he was sitting with a cell-phone in the math class – phoning to check if she was having contractions, if the baby was born and things like that. The guys call him daddy and he's totally cool about the whole thing. **AN3**

This power thing with the boys – it's there when they talk about sex. It's not a shock but what they say is disgusting. I lose my appetite when I hear them say things like it's nice to break a girl's virginity cause then she'll follow you, it's better. They're so poisoned and they know whom to target. But when the girl's pregnant its like oh shit, now I'm stuck with this mistake. They're not interested; they just want to enjoy life. **AN4**

The female – now that's a different story. Maybe it's because she's more sensitive. I know if that happened to me I'd be totally disgraced. On Sunday the pastor said at his sermon that nowadays for parents, when their children fall pregnant, it's just a mistake. But in the old days it was a big thing. For me too it would be a big thing, a disgrace. But now it's like nothing. **AN5**

[Biology Essay]

I think we should. Our Biology teacher is a very nice person but from last year to now there's a dramatic change. My marks have totally decreased from standard 8. I have been getting a higher grade pass but now I dont even get a standard grade pass.

Dont get me wrong I like Miss Patel because of her caring Nature. But when it comes to Biology I dont understand. Maybe its because she believes passing should come hard not easy. For example last year Mr Padyachy took us for Biology. That was my best year of Biology, he encouraged to pass. He gaves us assignment projects and group work. I respect mams choice of our subject being totally by tests but by this process of passing.

I'm sorry if those words hurt you in every way. But most students wont be so sincere. And I am.

THANK YOU

Zeenat B.

We need to talk about this in bio – the boys must learn about responsibility. They need to be taught these things. They need to learn what's going on – just like us. In biology we learn about the reproductive system. But if you bring up teenage pregnancy, even if it's related to what we doing, then we'll be talking about responsibilities, feelings, religion, parent's feelings and everything that goes with that. I suppose we should discuss this during our guidance lessons. But there is a place for this kind of learning in biology. **AN6**

In biology we can learn about each other – about the different races. This is a multiracial country. How do the different races react to pregnancy outside of marriage? With the Blacks it happens all the time. They used to things like that. I'm totally, totally against it. They allow it to happen. It's so like shocking. It's nice to know about their culture and religion and the way they go about things. I mean their culture is very, very complicated. It's not bio but it's something that I did learn in the bio class. What if someday you end up in a place with only Blacks. If I don't know what's going on in their culture then I'm going to be stuck. It's nice to talk about these things because everything is linked and all these types of things will come up when you have a discussion –even in the bio class. **AN7**

Abortion. I don't think we should be talking about that at all in the bio class. Maybe in the guidance or right living class. I kept quiet when we spoke about it during bio. My aunt had an abortion. We didn't know if she wanted to or not have the baby. No one was against it. She's a Christian and she's 45. she thought about it and decided she's too old and also it's expensive to have kids. She didn't have the finance. It was difficult for her. A lot of people criticized her. A lot of people fasted and prayed for her. And it was a boy. She doesn't have any boys. That's why I just kept very quiet. I was really affected by it. Abortion – it will lead to religion and feelings and whatnot. We shouldn't be talking about that. In bio we should only speak about the process and what happens. Not how it affects a person and stuff like that. **AN8**

Nolwande said Black township girls get AIDS. That's true. She knows what goes on in the township – she's there. They have sex everywhere. And they don't have the knowledge about AIDS. We need people to go to the townships and tell them about it. This one guy where I live said they're going to die like ants because they don't have any knowledge about it. If you look at the shacks behind where I live and in the park there – you see them doing it on the seesaw, the sliding board, under the sliding board, everywhere. And it's the township boys that spread it. Even on TV it's only Blacks who are actually coming on and saying they are HIV positive. There was this one

Indian couple and this one White woman – but the rest, it was only Blacks. To say that it's Black township girls is not offensive because it's the truth. Even though the statement is racist and sexist, it's the truth. **AN9**

We must talk about what AIDS does to the body in the bio class – the infections and things like that. That's more interesting than abortion. And if somebody has had a personal experience with AIDS and wants to share we must allow that. I mean that's what we can do in return when somebody is hurting. We can sympathise. It will also make us more aware of AIDS. Just like I learnt from Ann at youth counsel at church. Ann has AIDS. She's a White lady. Her partner didn't tell her he was infected and she got it from sleeping with him. She was so angry with him she went to the hospice with a gun – she wanted to kill him. His body was covered in sores and he was ready to die – she left. Now she's taking the same drugs as that basketball player Michael Johnson to get better. She's now married to another guy who knows she has AIDS. But when she wants to visit her family she has to phone them first. It's important to talk about this in the bio class – what happens to the body, the anger, how you feel … **AN10**

How you feel … its okay if you talking about AIDS. But not about abortion. That's going to lead to religion. And that can be offensive in the classroom. That has happened in the English class. The discussion led to religion and before you knew it there was a big fight. It was like a fishmarket. Then it became you roti ou and things like that. Religion is a very difficult topic in the classroom. Best to avoid it. **AN11**

Why is it that light skin is prettier? My aunty used to call me a nigger. She, her children and her grandchild are fair. She even said when the grandchild was due that if the baby was Black she would put the baby in a bin. Her son-in-law is dark. My aunty judged me. She teases me but I get very offended. Even at school – this friend said our baby is fair but you must see the neighbours. It is absolutely dark, dark, dark and ugly. If genetics will allow people to design their babies then they will go for lighter skinned babies. If it's going to happen then we need to know about it. It will be interesting but I don't know if we should discuss this in the bio class. If we do racism is going to come into it. It's okay to get to know another culture but when it comes to racism … **AN12**

The Blacks in our class are very timid and they just keep quiet. They are overruled by the Indians in the class. One of the new guys in our grade 12 class said the other day that the Blacks must go and build their shack outside. It did offend them even though they laughed. They are intimidated. They

either laugh or just keep quiet and like they not interested in what is being said. So it's safer not to talk about things like this in the bio class, in any class. **AN13**

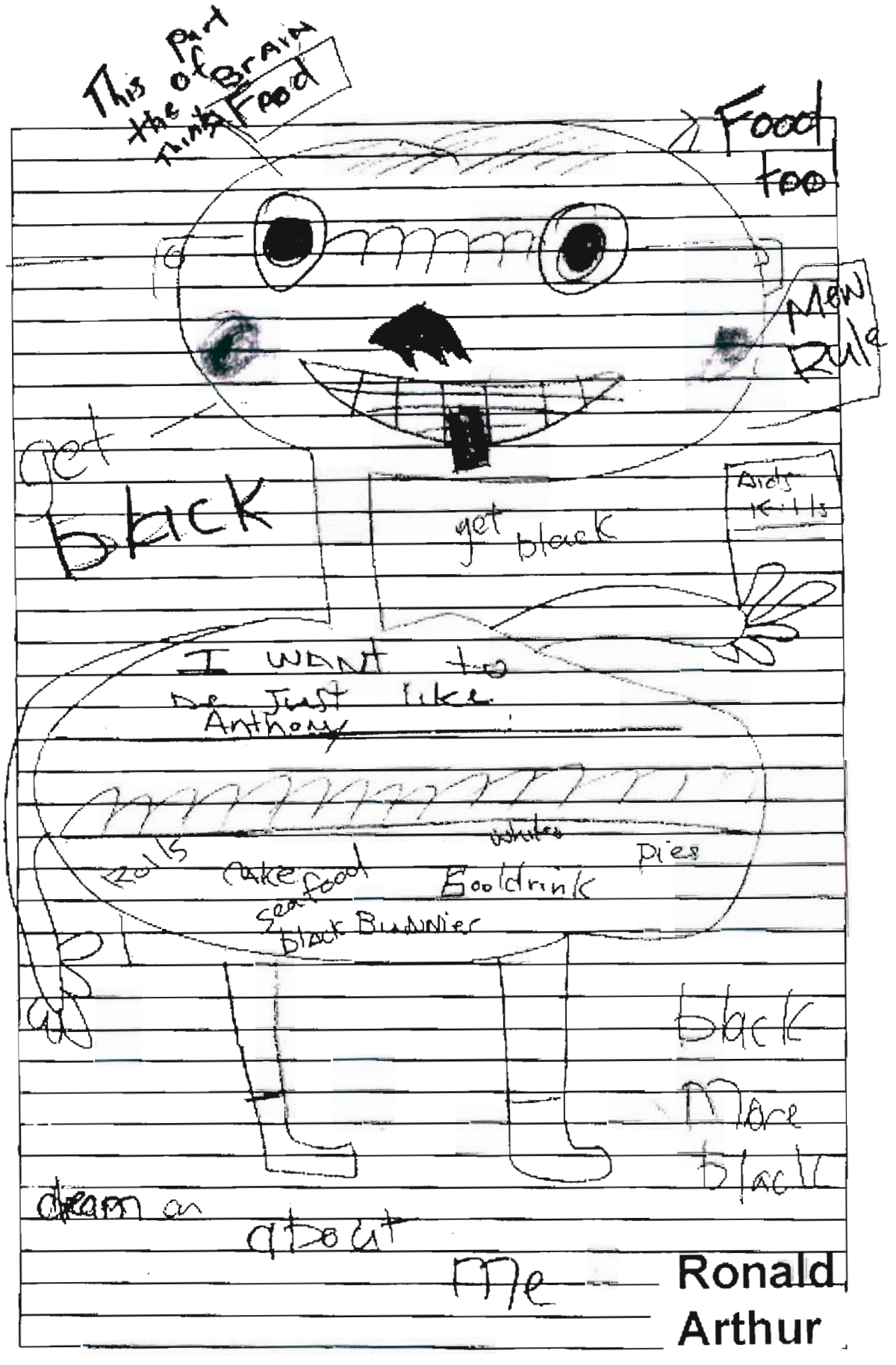
I realize that we will talk about abortion in the bio class when we dealing with the transmission of disease – through genes and things like that. But relationships, honesty, feelings … it's interesting to know but it's not part of biology. I'm confused. It's okay to speak about feelings when we speak about AIDS so why can't we do the same with abortion. When we spoke about this in class we were very alert and learnt about the whole thing. We shouldn't just stick to the facts. We should talk about our feelings and what we think. I am getting confused! **AN14**

Even homosexuality. I don't know if we should talk about it in bio. I know people in my class like this. Everytime we see this one person they start talking about it. People in the class. They talk like mad things. I don't know if we should talk in the bio class about this. If the topic comes up people will speak about it. I don't know if we should. It's not a part of biology and religion will come in. I don't know if I'm against it or not against it – there's positive things and negative things about it. I knew this guy Daniel who was like that. He was killed and his two killers got away scot-free because they said he was coming onto them. And the pastor was talking about homosexuality and TV and he was totally angry. It's not part of biology. **AN15**

Just like we should not talk about racism and racist understandings in the bio class. It will lead to a major row in the class. It won't serve any purpose to have such discussions in the class. We can just answer the questions when it does come up. But not have lessons on it. If does lead to a discussion it will only be because the Blacks in the class will want to prove a point. It will take us nowhere. Even that work by Gould – how do we know that he was not lying. It's just written on paper. But we are all equal. We need to talk about that. We need to let people know we are all equal. It can be done if there is order in the class. Not like what happened in the English class. The teacher had no order, no control. Chaos! Total chaos! With control and discipline people get their point through and then the topic is closed. That way when you walked out of the class you had learnt about it. That's what happened in the biology class. We had order and we learnt about sensitive issues – religion, racism, sexism, homosexuality, abortion … That is where we should talk about it – in the biology class. That's where science leads us too. Science puts it in such a way that you speak about yourself and eventually you get into feelings and racism and … everything. Everything is linked. That's where we should talk about it. Biology is not just facts. It should provide more understanding. **AN16**

But the language of biology! It makes biology very, very difficult to understand. When I study biology I like go mad. Why can't they use simple words. Is it because they want to make bio sound intelligent? Just like the language of maths – take logs … math also wants to sound intelligent! So complicated. **AN17**

Just like the relationships in my class. Some are so complicated. Some people are so staunch about their religion they actually fight. Why do people react that way? Why can't we talk about it – why can't I just tell you about my religion without getting into a fight. Even in this school. Very rarely you'll see a Black in an Indian group …very rarely. It's true … it happens. The Coloureds stay in their group, the Blacks in theirs and the Indians in their own group. It's all so complicated. Why did you pick me … **AN18**



Ronald Arthur

5.3 Roses Are Red, Violets Are Blue, Who Is More Black? *Me Or YOU!*

... and so begins Arthur's story

I was not accepted for so long in primary school. The standard one teacher ... she broke everything in me. She crushed me. It was 1991. I used to be a quiet child at school. The school was raising funds for Valley View, Place of Safety. My mum gave me three Rands to buy this hot dog. Somebody told my teacher, Mrs Arthur, that I had ten Rands! Mrs Arthur thought I had stolen the ten Rands. She made me take off my socks and shoes in front of the pupils. She did not find ten Rands on me – only three Rands. She decided that this was change from the ten Rands that I had stolen! This became a major thing. It will always stay with me. **A1**

We shared the same name – Mrs Arthur and I. This too became a bane in my life back then. One day somebody wrote a swear word in front of the classroom – Arthur's puss. Even I did not know what that meant when I was in standard one. Mrs Arthur came into the class and in front of everyone she said to me:" *You are the only one who knows how to spell Arthur*." Everyone just looked so .... She took a lot of confidence out of me. She was like a sergeant-major. **A2**

This was the beginning. The beginning of not being accepted.... There were many incidents that year. Like when she did not let me hand out my chocolates to my classmates on my birthday. That for me was a special event – more important than even the gifts I received. My mum would save to buy them chocolates. She even saved to buy the teacher a slab! And Mrs Arthur – what did she do? She gave them to another pupil to hand out. My sweets! Another insult, another stripping away of my confidence. **A3**

What has education given me? As I think back on it, I now see that schooling stopped for me in standard four. Schooling stopped for me when I was faced with multiplication. Mathematics stopped for me when I was faced with multiplication. Books left my life. Enter the gangs. **A4**

I started by joining small gangs. I learnt that I was a thug from the Westside and part of the gangland. I was a serious, quiet member of the gang. I smoked. I was important. It gave me

Roses
Are
Red, Violets
Are blue, who
is more black
me or
You!

confidence. It was now safe to leave the bosom of my family and venture forth. When I got to high school I was a rascal – with a *schooling problem!* **A5**

Did I tell you that I was teased in primary school? Did I tell you that this followed me into high school? I was called *Blackie* and *this* and *that*. When I was teased about being Black it bothered me for about five minutes. It bothered me that I can't change being Black. I have to live with it no matter what. Long ago there was a guy – in primary school – who used to tease me horribly. I finally responded, as a way of dealing with his nastiness, by saying that if we ever went into Kwa-Mashu together I wouldn't be the one to get robbed .... This too took away some of my confidence. The gangs helped give back some of my confidence. **A6**

My schooling problem! In standard six I had a schooling problem, in standard seven I had a schooling problem and in standards eight and nine. I lost so much of schoolwork. I was slow. I wasn't a booky person. I did not read. The only times I picked up a book was to study for exams. But I did not understand the ideas in the books! I did not understand the language. Language is the root problem to all my struggles. But I did con my biology teacher! She had no idea that I could not read – she accepted that because I spoke well I could read. What a hoot! The language is so hard – even Afrikaans is easier. The language of biology ... now that **is** a foreign language to me! **A7**

Talking of biology ... in standard nine we spoke through issues of identity, gender, sexuality, racism, power amongst others in class. Hey, when we did cell division we looked at the language that biologists used. Did you ever think about what using language like mother cell and daughter cell could begin to mean? I mean in English and in poetry I look at the teacher's point of view, my point of view, other pupils' point of view and the poet's point of view. I do this through the language used. Why don't I do this in biology? **A8**

Mother cell, daughter cell – an issue of sexism! Mother – for many people as soon as they think 'mother' they think of caring and supporting and reproducing. For me mother means taking care of – I don't have a problem with that. Now daughter – **that** would be a gender issue! But if we talk about this it would mean that we would have to change it ... and people are so afraid of change. And the male species ... they are so afraid of change. When change is coming, before it can even get there, as soon as it starts growing or just putting down its roots they take it all out. They're too scared to change. It's the same thing as racism – it's one way only. It is because people want power ... males want power. **A9**

As for sex education! It is so separated from everyday life. An academic sex education in the classroom and teenage pregnancies in real life. For a long time we've been having teenage pregnancies and abortions. We do not discuss this at home. We do not discuss this in class. So when do we discuss it? When the person is already pregnant! If we talk everyday situations I get to learn about different understandings from different persons – Nozhipo, Sandile and a Zulu understanding. Naseema and an understanding from a South African of Indian origin. I hear them both – I take the good and leave the bad. Biology too is about different viewpoints – just like poetry. If we can do this in English why can't we do this in biology? **A10**

Do you know that when we were exploring sexually transmitted diseases, HIV and AIDS someone in the class said '*Black township girls get AIDS*'. Is that racist, sexist? Not racist – racism is politically inclined. It's not supposed to be part of biology. Anyway Springtown girls get AIDS, Asherville people get AIDS and Kwa-Mashu girls get AIDS. As long as somebody is getting infected with the deadly disease it should be brought up. It should be spoken of. Sexist? – sexism does get into biology. But then again females should be more aware of AIDS and HIV and teenage pregnancies than boys. I'll tell you why. It's not a sexist comment – at the end of the day if someone is pregnant it's not the male. The male can run away to South America or God knows where. The girl will be stuck with that baby. At the end of the day it's her body that's going to be infected … or affected by the chid. **A11**

Me – I think I have racist and sexist perceptions. We brought up with racist and sexist perceptions but the thing is how you act out those perceptions … you can be brought up with something but that doesn't mean you going to do it … doesn't mean if you going to go into a garage you going to become a car! Then there's this other thing. I mean I am of Indian origin – but I'm actually brought up in a basically White society. I don't tell people this. When we go out you find like three or four Indians, it's not an Indian thing. It's basically a White, Coloured thing. **A12**

Gladys started crying on that Monday when we were talking about HIV and AIDS. We all were concerned and when the teacher asked her why she was crying she said her friend had died on Sunday from AIDS. She refused to talk that day – we let her be. Two days later Gladys started talking about what happened to her friend. But if Gladys or anybody wants to talk about their feelings, their experiences in the biology class they must be strong enough to take the comments from other pupils. There must be place in the biology class to talk about how one is feeling. But …

only if the person is strong enough to take the comments must the person be given the space to share. For this the person must build up a lot of courage first – they mustn't when society knocks them with something … get all shaky and cry. **A13**

That teacher also spoke about how genes can transfer diseases from parent to offspring. Why doesn't she just say child like we do? The language of biology – it is a foreign language. Disease transfer – from parent to child? Does that make abortion okay? Abortion is not even supposed to be legal. If we going to talk about it then we must talk about it as something we don't do – like marijuana and cocaine – something that's illegal. Abortion basically boils down to killing a baby. Why then can't I go up to somebody and shoot them and walk on the street with an innocent face? Is it not the same thing? But we have to talk about abortion because it is part of a general lifestyle. Where? In the biology class because it is part of the biology zone. **A14**

Talking of biology – there should be two kinds. One for those people who want to be doctors or study the cell and that kind of thing. Textbook biology and facts. Then there should be biology for the lots of people who are not keen on learning about the cell … that kind of thing – people who will be in cash sales. People like me. Learning about teenage pregnancies, what it means to be father is going to help me more … than learning about the division of cells! Biology issues dealing with everyday lives – my kind of life. Social biology for the majority. **A15**

Jameel said that if designer babies became a reality – what with the new technology and gene transfer – people will actually choose to go for lighter skinned babies. You know, given a choice people would probably go for lighter skinned babies. Light-skin is so-called right. The thing is with people – people have been programmed that the White man is right. They've gone past apartheid – yet in the year 2001 they still think that light skin is better. **A16**

Now that I think about it all these issues such as abortion, pro-abortion, anti-abortion, genetics, sexuality, racism … all these should be part of biology education. It will give people an idea of what their options are. It can teach about options as well as democracy. It can teach about justice – dealing with light-skinned and dark-skinned, HIV. It can provide a basis for understanding justice. It can teach about political issues. **A17**

Homosexuality! It's shameful. It's against God's law. There is no place for homosexuals in this world, in my world. It's wrong. When I questioned the teacher in the biology class about this she

was evasive. All I wanted to tell her and the class is that if homosexuality is not a result of gene transfer then it is unnatural – my church has taught me so. But boy was she difficult! The more she evaded the question about whether it was wrong or right the more I insisted that I wanted an answer. We both got angry. We yelled at each other! Some of the others in class told me to shut up – like Naseema the loudmouth. Even Anneline, who usually is quiet, joined Naseema. But there were those who were quiet and said nothing! I remember that lesson! Homosexuality exists and it has to be part of the biology programme. Nobody else wants to talk about it. But it's still wrong. **A18**

My music teacher is bisexual. But he's just a person offering a service and I am paying him for what he is teaching me. It's his expertise in music that interests me which is why I chose him as my teacher – not his sexuality. That crazy teacher – she asked how I would react of I suddenly found myself attracted to another male. I laughed. How would I feel? I don't know. I don't know what I would do. I've never given it any thought … until now … **A19**

Come to think of it race and racism is an essential part of learning in biology. For years racism has been justified on the basis of science. Have you ever read S J Gould's *Mismeasure of Man*? Gould uses pictures too. I found out that science used the volume of craniums, physical features and so many other things to discriminate between humans. Science used this to put Germans way at the top and Hottentots way at the bottom. Gould shows how science manipulated the evidence to suit racist understandings. For this reason racism must be discussed in biology. Why are we not discussing this biology that is relevant? It is this information that is gonna help me go forward in the world. I believe that if you don't learn about racism you become a racist. If you learn about it you are able to identify with people … whether they are Black, White, green or whatever. Because this information hasn't been around … that's why we've been living in turmoil for so long. Again it all boils down to power! **A20**

Talking of power – the African government at the moment … are they failing? When the White government ruled South Africa they did not look after the majority. Money wasn't spent on them. The Whites had an elite view and had all the money spent on them. Now with this new democracy or whatever there's more people to look after and the money is not enough to take care of even the White people. And jobs have become fewer and everyone (White?) is saying 'Oh, I'm unemployed'. The White government was so successful. **A21**

Coming back to racism and the hierarchy that puts the White male at the top and the Black female at the bottom. This was instilled in primary school. We don't need to spend more than fifteen to twenty minutes on this in the biology class. I mean I know from primary school that I am equal to the child I am sitting next to – no matter how inferior I feel on the inside. Whether you come from a squatter camp or a mansion you are equal next to one another in the classroom. Even if you meet one another on the street you are equal. The only time you not equal is when it comes to finance. And this hierarchy thing that's racist – we must talk about it in biology. If you don't talk about it … it's like disabling the brain. It's being disabled. **A22**

Hierarchy. Who said this is not present in the classroom. Look at teachers. They believe that by getting close to a pupil they will let their guard down. So they don't communicate with pupils. It's not that pupils don't want to communicate with teachers. Teachers don't have a social tracking – they don't want to communicate on social issues. You go into a class, the teacher teaches you math, you go out. There is no communication. Teachers and pupils don't communicate. Teachers don't communicate to guard their power. I'm questioning why in the math class the teacher screams from the time you get in and the class is never quiet whereas in the Afrikaans and bio class the class comes in and settles down. Why is it that a teacher that doesn't scream gets the class to be quiet, to do her work – from a class that is usually noisy. Some teachers relate to pupils. With others – school is a military camp! **A23**

Do you like the picture I drew? It's at the very front. The one that says on it *Get Black; Black, More Black; Men Rule; I want to be just like Arthur.* You know how everyone teases me – Blackie this and Blackie that. I told you this already didn't I? But they are Indian just like me. I have to live the fact that I am Black – the Blackest kid around. Still it hurts when they call me that. Makes me feel inferior inside. I thought I'd just share that with you in the picture. That's a picture of my biology teacher – the same one who believed I could read! **A24**

She called me yesterday. Said she wanted to speak to me. Wanted to speak to me even though I had failed. I was shocked. I was shocked that … err … that there's somebody who values your opinion – even though you've failed. It makes me feel a little bit more confident. But then again she's always asked for our opinions. Asking me for my opinion made me feel I was a person of worth … because there are so many things that make me feel that I am not part of this world, that I have no worth – like failing. **A25**

I failed at the end of the year. I failed standard nine. I was hoping to do matric next year. It was such a downer. But failing is something I have to live with now. That's what happened. I've lost a lot of confidence – in speaking and in a lot of things that I did. But give me a few months and I'll bounce back. I … I always do. I now need to find a job. Failing … it has closed an avenue in my life but another will open. I've spent eleven years of my life at school and it has not prepared me for life. Schooling stopped for me in standard four. It hasn't given me anything. **A26**

Kribashnee Reddiar Std 9B 18 November 2000

Biology Essay Based on which levels of teachings do I prefer

I would certainly prefer the teachings of Mrs F. Patel rather than the textbook. She expresses herself in the most simplest form which will definitely make the students of ***Centennial*** Secondary understand what has been taught. Someone you would be able to trust with your problems, someone who is caring and will not think about her needs before others, but put others first. Research is done in class which is taped. Information produced is amazing. We learn different things everyday. Topics relating to the enviroment, nature itself and humans in particular. Their relationship with nature and its surroundings. Pupils are interviewed in class. Important facts are shared. Emotions are brought in and dealt with. We as pupils are proud to have Mrs F. Patel as one of our teachers. Our lessons are lively and not dull, and boring. The textbook has efficient information but not to the standards of us pupils. The textbook is complicated with certain information that is insufficient. Whereas Mrs F. Patels knowledge of nature is understandable, interesting and the basics are being taught. Relatively facts are being introduced. Mrs F Patel is strict at times but she knows one day we will benefit from this. Its all done in good intentions. We all learn from our mistakes. Mrs F Patel gives us the strength and courage to strive towards our goals, which can be achieved successfully. Biology is one of the best subjects. It can be confusing at times but you eventually learn the skills. Mrs F. Patel advances our knowledge accurately.

5.4 My Name Is CHRISTINA ...

Just Call Me Chrissie!

Chreestheena's story

Be careful ...you're hurting my brain. The words in biology – they're brain teasing and brain twisting! I'm ready for grade 12 now and bio and maths are my problem. If I want to write for an exemption I can do only one of those on the standard grade. So I dropped maths to standard grade. Now bio is a problem – because of all the words which confuse. It doesn't really allow you to perform how you would want to perform in the subject ... its just got too many high words and sometimes the words are so similar that you just get confused. The whole confusion takes place because of the language and if you can't get the language right you feel ... you feel like you not intelligent; like you a bit stupid. It gets to a person. And now because of bio I have to write for a senior certificate... ***C1***

Discussing issues from real life, bringing reality into it makes it easier for a person to understand. Learning about mitosis and meiosis and looking at issues of female identity helps you understand the topic better. You don't forget or get confused. Its not just boring stuff from the textbook anymore. The fact that science brings in mother cells and daughter cells ... just like in the real world. It is mothers that are reproducing and then the daughters. I mean this is part of female identity. That's how the world works. That's not sexist. Fathers don't reproduce... ***C2***

It's also the mothers who take more care of children. That's changing nowadays. It shouldn't only be the female anymore. Females shouldn't carry on being ruled, have the inferior role. Women shouldn't be criticised all the time. Everybody's equal. We need to discuss this in biology. Why does the female always take the rap for everything? Take for instance teenage pregnancies. I don't understand – especially with Indians. They're ready to blame the female. But the male – he's a man so we must understand. ***C3***

We should be having more discussions. It doesn't mean that because you're a teacher you know everything. When you get different viewpoints from different people you learn different sorts of things. It's nice for us to know about different cultures. We don't know what's happening in the Black culture and they don't know what's happening in ours. We're living on this earth for so long and we don't know what's going on with them. It's good it comes out in the bio lessons because we get to learn about them and they get to learn about us. We can learn from Nolwande about accepting

and supporting babies born to unmarried girls in her culture and she can learn about us and our shame and disgrace. ***C4***

Abortion too is part of biology. Doesn't matter whether the abortion is the result of an unwanted teenage pregnancy or the genetic transmission of a disease from the parent to the child. Abortion is done scientifically. There's surgery and medication and stuff like that. There's a lot of that going on lately. And when you're talking about abortion feelings are bound to come into it ... whether you like it or not. And we are not robots in a classroom where we just have to stick to the facts and not let out any feelings or emotions. Learners have a right to express their feeling and emotions on a subject. And as we express our feelings and emotions we end up having better solutions. We learn better that way about how to improve a situation. It encourages learning. You learn from others about things you didn't know, things that didn't strike you. But that doesn't mean we must talk about whether or not one tells one's partner about an abortion. That's to do with relationships and honesty in the relationship. That's not part of biology. You could talk about it but it's not part of biology. ***C5***

It is the truth that Black township girls get AIDS. Nolwande said that. She comes from a Black township and she knows what is happening there. It is a fact. If you do a survey you'll find that most of the Blacks get AIDS instead of Indians. It's because Blacks are not so strict with their children. In the Indian communities our parents are very strict and decide what we can do and can't do. With Blacks they are allowed their freedom. I mean with us if we have a baby before we marry it's a total disaster. With the Blacks it's allowed. Their parents are lenient with them. Another reason for AIDS is that most of them in the township are so poor they become prostitutes to get extra money. They are school dropouts who don't have the intellect to go out there and get jobs; they don't qualify for certain jobs. The best way to make big money is prostitution. That's what leads to AIDS. ***C6***

We need to talk about AIDS in the bio class. It is a sexually transmitted disease; science tells us about how a disease comes about and how to cure it. And when you talk about AIDS the talk will automatically go to the community where it is – the Blacks. You can't shove that under the carpet. You'll hear about the girl's. Not the boys. That's because the boy is a male and for males it doesn't matter. Not like with girls. If its girls then it's a big thing. But we shouldn't talk about poverty and prostitution in the bio class – that's for some other subject - maybe right living or guidance. ***C7***

HIV and AIDS. It will be the same like with discussions on abortion. Feelings will be expressed in the class especially if somebody has had a personal experience of the disease. The personal experience will provide a much better knowledge of the disease. This will let other people in the class learn about the disease. This is better than even the radio or the TV that has no effect - because nobody feels it is going to happen to them. But they'll listen to somebody close or a friend's point of view in the class; they'll take note of that. And that's why it's appropriate to express such feelings in the bio class. ***C8***

Reproduction in biology also makes it possible for us to talk about homosexuality. We can't do it in guidance because there's no guidance anymore. It has to do with the body so we should talk about it in bio. People don't know much about it. They come from backgrounds where parents and families don't talk about it. But people need to know about subjects like this. If a topic like this comes up feelings will arise. You can't just stick to the facts and throw feelings away. It's a package deal. I think everything should be discussed. This way people will have a broader knowledge and be aware of what's going on. They will learn from other's experiences and they will be aware of the facts, of the advantages and the disadvantages. ***C9***

To tell you the truth I don't think it should be encouraged. I mean God created Adam and Eve not Adam and Steve. I guess I was brought up that way. It's like that especially with our Indians. If I had to bring home the same partner … my mother would rather see me dead. It's against our religion. It's mocking God. In a discussion like this in the class religion is bound to come up. It's okay if religion is allowed in the bio class in this case because it will give a full view of the situation. All points of view will be expressed. I think that's okay. Religion is okay if we respect each other's views and we not offensive to any religion. It's not right to pick on other religions. ***C10***

But we mustn't allow feelings about light skin and dark skin to be expressed in the bio class. We should talk only about the genetic process, not about the feelings. If feelings are expressed it will lead to a whole big argument. And the Black pupils will get offended, some will feel bad because light skinned people do get favoured and everything. When we're doing genetics and discussing designer babies – it's true - the normal human person will go for a lighter skinned baby. It shouldn't really be like that but that's what they would do. I guess that's because of the apartheid system we had where the White people got everything and the Blacks and other cultures were low. It's always the lighter skinned peoples that are favoured in this world; the darker skinned people – it's like they

are dirty. It's safer not to express these feelings in the bio class. This way feelings won't get hurt. **C11**

Racists – you get one or two of those who don't get on with the Blacks in the class. Most of the Blacks they get on with the Indians. The Indian community and the townships – it's like two different worlds come together … in our class. We did get on. We spoke to each other even though some people were like racist. In the school though it was Indians for the Indians and the Blacks stick with the Blacks. Like when we're having a competition and a Black person comes and stands next to you … you just move away. **C12**

Biological determinism and race categorization – now that we should talk about. It should be in our syllabus. It will make us less confused about Whites being dominant. It deals with science from the past – one that was racist, one where people actually manipulated things. A fact of life that did take place. It should be taught. The more you talk about it the better. Things have really turned around nowadays. It will better people's knowledge and get rid of the old ways. **C13**

The old ways were where Whites had everything and knew everything. In the old days the Blacks were very poor, didn't have homes and were brought up in the bush. They didn't have to pay rent and lights and water there. That's why they have more of an intellect when it comes to the bush. They had a carefree life and didn't have to bother with studying. Whites wanted to better themselves. They had better opportunities. That's why they studied. That was their way of living. But these days it's Black men with top jobs driving the best cars. Why, we don't even have a wheelbarrow to speak of! This should be taught. People would then realise that Blacks are not stupid. They are becoming more intelligent. It will better people's knowledge about them. If you visit a Black home nowadays … ours is a shack compared to theirs. It will help us become less racist. Blacks are climbing up the ladder but we Indians don't get a chance to improve ourselves. That's not fair. This must be brought up in the bio class because science is now saying it's not like that anymore. Actually these days if you not Black you don't get the opportunity … so the discussion is relevant to the bio class. Since we are all equal. **C14**

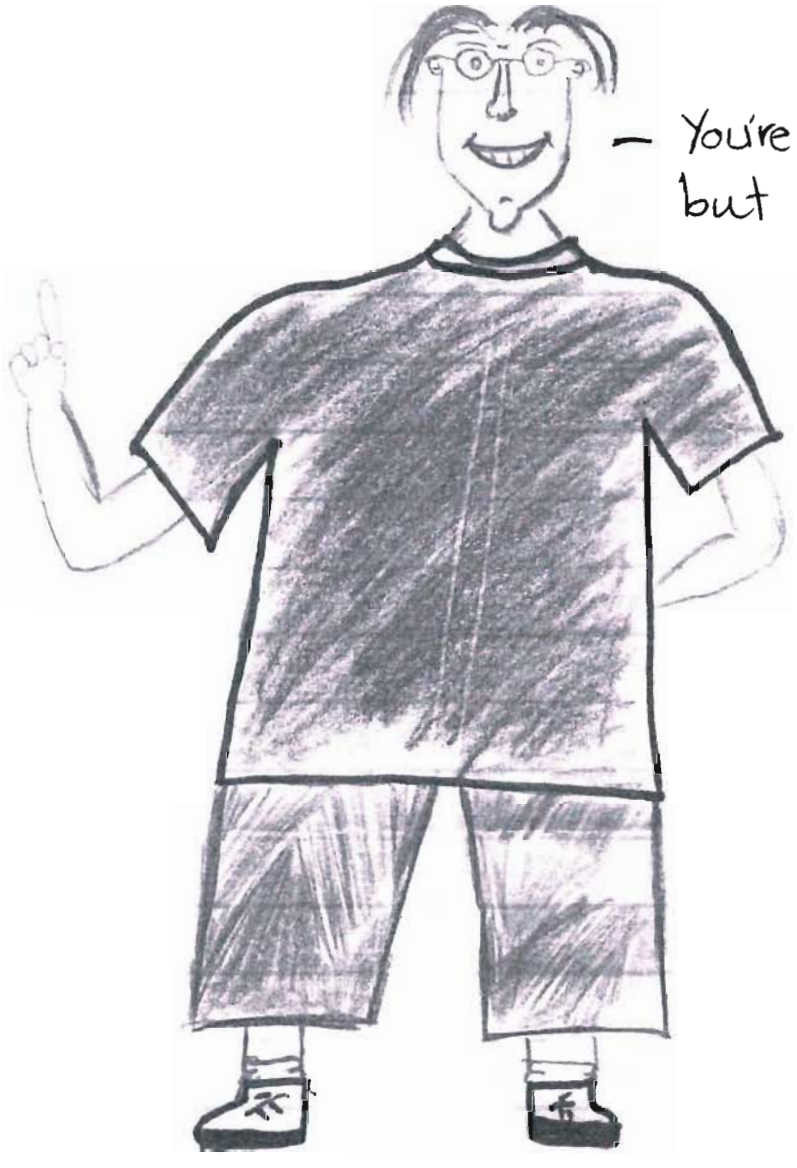
Science comes to life when you get a chance to express your views and your feelings, when you learn from other students. You stay awake. Everything is not done robotically. It teaches better values. It helps you to be a better person in your community. It makes you a better leader in your

community. It teaches you lot more than just facts. It lets you pick out what you want to – what you feel is right for you and what you think is wrong for you. ***C15***

It's frustrating when you can't air your view and there's nothing you can do to change a situation. It's because most teachers have the upper hand in everything. This is not only for the subject – it's for everything. Even if you go to the office to the principal, bring your parents or write a letter you are the one who is made out to be complaining. You become the liar. It becomes worse for you. You then get penalised for every slip up you make. Sometimes when you're pushed you'll say something that you meant but didn't actually need to say it in that way. It's best to rather keep quiet and take it as you go along. But it's still not fair especially when the teachers have their favourites … ***C16***

My name is spelt Chreestheena but it's pronounced as Christina. You've taught me from Grade 9. I tried to tell you then and you didn't listen. Maybe you couldn't hear me. I was much softer then. If you can't get my name right then just call me Chrissie. After all these years … just call me Chrissie. ***C17***

MZ. F. PATEL.



— You're all lovely children but just damn Lazy.

A TEACHER WHO SOMETIMES CAN BE A LITTLE STRANGE. BUT A GOOD PERSON.

DONE BY.

Naeem Jamal

18/11/2000.

5.5 I Hate Biology !!!

But ... I Did Enjoy It When It Allowed Me To Explore Everyday Issues.

Jameel's story

I hate biology. I hate mathematics. I only did them because they were offered with the speech and drama course. I want to be a make-up artist when I finish school. There probably are lots of people who have been forced to take biology. If we had done just straight textbook biology I would have hated it even more than when I started out. I didn't do so well in biology last year but I did enjoy it because we discussed everyday issues. We experience racism, discrimination, sexism, religion ... in our everyday lives. Biology gave me a chance to explore these everyday issues. I did enjoy this more than just the plain factual biology that I have also been taught. **J1**

Take the language used in biology – mother cell, daughter cell. The female is always spoken about and men are left out. This gets us thinking about how women are always spoken about. This is a sensitive issue to many people and one that is not often spoken about. It gave us a chance to discuss that women aren't given a point of view most of the time. We then started talking politics – I don't know if this is part of biology but it made a difference to my understanding. It gave us a chance to express ourselves which we don't do in other lessons, talk about what we feel about gender. It gave us a chance to share our views rather than keep it inside ourselves. That way we learnt more about each other and learnt to respect each other even if we disagreed with each other. **J2**

Sexism has a place in the biology class. Discussions on sexism will be educational and informative. As we work through the section on reproduction guys can be made more aware of their role if a girl gets pregnant. A lot of guys in this school have this egotistical idea that if a girl is pregnant it's her fault. If she's willing to have sex then it's not the guy's problem. Discussions can work towards changing those understandings. Teenage pregnancy doesn't affect the guy the way it affects the girl. It's the girl who is embarrassed and ashamed; it's the girl and her family that gets disgraced. The embarrassment and disgrace is so great that even my close friend, whom everybody liked and respected, couldn't tell me she was pregnant. She came up with all kinds of excuses like she was going to another school, couldn't speak to me on the phone or that I couldn't visit her. Everything but tell me the truth that she was pregnant. **J3**

Naeem Jamal 18/11/2000.

Gr: 11b.

Students often wonder why they do conventional bio, rather than doing biology on a higher level. What I mean by this is that, that we should not do school biology but study this subject into more intracat detail. To find ~~out~~ out more about how scientist has experimented and explored futher into the world of science. The normal school biology is good and fun but students loose interest quickly and becomes boring.
A new type of biology would be more interesting, because of the fact that we will not only learn about biology but also about the history behind it.

Thank you.

A girl could get pregnant because she sees it as her only way out of an abusive home situation. A way to get away from home. My sister became pregnant when she was fifteen. The physical abuse amongst other members of the family really affected her. She failed at school that year; she did miserably. Pregnancy was the only way she could get away from home, away from everybody. If a girl gets pregnant it's not just because she's willing to have sex. So many people hate to speak about things like this. **J4**

Talking about teenage pregnancy will let us learn the female points of view. It will tell us that a lot of the female's points of view were right. It will also let us learn about the different religious points of view. The Muslim understanding that puts the girl into exile, never to be heard, never to be seen, kept at home. The Zulu way that says it's acceptable – that makes us think about which is right, which isn't. Sometimes we could talk about these in biology. When we talked about these different understandings it made the subject fun; we learnt biology, we learnt more about other people, other cultures and other experiences. It was an interesting and good time for us. **J5**

Another sensitive issue is abortion. It involves the destruction of life. Children are a gift from God. Yet sometimes depending on the occasion it could be okay – like when a female will be disgraced and put into exile. Speaking about it gave us the chance to learn about Zulu culture, other people's points of view. Speaking about abortion could upset too many people. We should not talk about it. But then again by speaking about it people could overcome their feelings and maybe even express themselves. **J6**

Reproduction made it possible for us to talk about HIV and AIDS. Saying that it's Black township girl that get AIDS is like saying Black girls are cheap. I disagree with that. Everybody gets AIDS. Again all the blame is being put on females. The guys are just left out of it. I would have expected a guy to have said that – not Nolwande. A female discriminating against females. That's so confusing. Maybe she said that because it's true about many girls in the township. Otherwise I couldn't understand it. **J7**

In other classrooms we don't get a chance to talk about our own personal experience with AIDS. It's not part of biology but it needs to be spoken about. Everybody was willing to listen to Gladys and know more about her friend. By listening to Gladys about her friend we became more aware of HIV and AIDS and learnt. We learnt more than just about how HIV is transmitted. It made us think more seriously about HIV and AIDS. That was an important part of my learning. I used to go home

and share this with my mother. She seemed surprised that we were speaking about these things. She didn't tell me what she thought about that – whether it was good or bad. One of her closest friend's has AIDS and she still hasn't told her son. I don't think she knows how to. Yes talking about HIV AND AIDS has a place in biology. **J8**

Designer babies – now that's interesting. We can talk about why lighter eyes, lighter hair and lighter skin are thought of as better. Why people like that are treated differently. Why a lot of people say if I ever have children one day I want to have fair children. It's also true that if people can design their babies they will want to have light-skin babies. Through genetics we can look at the subject of discrimination. I'm not too sure whether that's part of biology. Yet biology provided the space for such discussions. **J9**

Genetics also made possible debates on abortion. Like when we looked at the transfer of a disease by a gene and whether the solution was an abortion. The debates gave us a chance to talk about it ourselves. We don't always get to do that. So many people in the class are shy and quiet like I was, always afraid to give my opinion. At the end of the day I did – loosened up and got involved myself. I found the courage to express myself. This got us closer to others in the class. It even made it possible for us to carry on talking about the topic outside the biology class – on our way to the next lesson. **J10**

It's the questions that come from curiosity that lead to useful discussions. Questions like whether homosexuality is the result of a gene transfer. I myself was curious about that. That discussion was informative. I'm glad we spoke about that. Homosexuality is not spoken about elsewhere. The only time it is spoken about is when we see a homosexual. We needed to know that it's not due to a gene transfer. That it is an individual's decision, your own decision – you choose to go in that direction. **J11**

What we shouldn't talk about are old understandings like Whites being the dominant race and Blacks being stupid. If we do a lot of Black people might think that it is true. Everybody knows about that because of the messages over the years. Such a discussion could lead to further discrimination. Intelligence in the bush and academic cleverness – that's determined by opportunity. Everybody is equal. The White man is definitely not cleverer than any other person. It's opportunity that determines that. Any discussion should only be about all being equal to work through the discrimination there is about some people being cleverer. Nothing else. **J12**

In the past the proof was always about Whites being superior. Now there is information to show that's a lie – like that by Gould. Maybe this is never spoken about so that Blacks will continue to believe what was said in the past. And maybe the White man will be ashamed to learn that he very close to the Black person and for him it would be wrong to discuss something like this that says he is not superior. Gould's ideas are part of learning in the classroom. A learning that will make us feel better about ourselves. There are times when I feel that there are others that are better and that I am inferior to other races. **J13**

As a Coloured I often feel I don't know anything about Coloureds. Where do Coloureds come from. It's always been like that there is nothing to speak about when it comes to Coloureds. They have never achieved anything. But by speaking about what Gould has shown we get to know we are all the same. And that makes me feel better about myself. **J14**

What is the truth? We all want to know. Is it the biological point of view or the religious point of view? There's always conflict between those two. So many facts are brought up in class against science, against biology. What is the truth? We should discuss these views in the classroom. Not only the biological view. **J15**

The language of biology is also very confusing. It just isn't easy to work with. There are so many terms to remember. Is that because scientists believe they are more educated and that you need to be very intelligent to understand information in science? That's discriminatory. If I had my own way I'd make it less sophisticated. Sophisticated language to learn factual information. Maybe we are being brainwashed in biology. This also makes me hate biology. **J16**

We got along well in my class. But the Black people still stick together, the Indians together and the Coloureds together. Maybe that's because of the way we were brought up or the way we are. I get along with every race in this class and in the school. But I don't get along with the Coloureds. In the school there isn't a large conflict. There are some people who don't want to be your friend because of your race. I know a few people like that in my new class. I try my best but they are so difficult sometimes. My bio class was different. We made jokes about each other, about races, cultures … but we understood. We disagreed on a lot of issues but that didn't affect our interactions. **J17**

In school teachers and students sometimes got into conflict. That was because of school rules that students didn't agree with. There are teachers that students feel comfortable with. There are teachers that students don't feel comfortable with – this is when there are conflicts. **J18**

We don't normally get a chance to discuss racism, sexism, gender, language, townships – we need to discuss these. Biology provided the place for such discussions – even though at times it was not strictly biology. It made biology more interesting … less hateful. **J19**

ESSAY FOR : PATEL

FROM : You'll Find Out Soon!

(First things first).

Ten Things I "HATE" ABOUT YOU

1. The way you talk
2. The way you walk
3. The way you teach
4. Your laugh
5. Your character
6. Your Aids T shirts you wear
7. The way you abuse "Zulu" when trying to speak it.
8. The way you shout in class
9. You know the rest
10. Fill in the gaps - - - - - - - -

*(change of mind)

Ten Things I "LOVE" ABOUT PATEL

1. Your understanding nature.
2. The ma's and kidoo's you call us.
3. Your quick way of teaching (sharp-sharp)
4. Your love for other cultures and race's.
5. Your caring self
6. Your car (feel like stealing it someday). *(BE CAREFUL)
7. Your communication skills
8. Your love for your "FAT" (You make me laugh)
9. Caring your whole kitchen to school in a basket
10. And more, (especially when you brought those people from over sea's) *(man I loved you more then)

P.T.O.

5.6 Biology And Racism ...

I Thought You Were Just Joking!

Kaiser Mbeki's story

Biology and racism ... I thought you were just joking. I thought biology was just about the study of nature. When you brought that book by Gould I was shocked. I was so quiet in that lesson. I learnt then that biology is racist and political. We need to learn about the wrong things that arise from biology and correct them so that the next generation can learn what is right. Teachers can't keep on teaching the same thing over and over when it is wrong. We need to know about biology and apartheid ... we need to know the truth. **K1**

Why were humans compared to animals; Blacks compared to apes? That the White man's skull looked like a humans and the Black man's skull looked like that of an ape; that the White man's skull had more brain space. You start to think of it in that sense. That the White man with the bigger brain is cleverer and the Black man with the smaller brain isn't as clever as the White. Many Black people today live a White lifestyle but the White man is still cleverer in the outside world. Even I accept that. **K2**

The outside world. That's the world outside of the bush. The bush is where the Black man was first spotted. That's where the Blacks came from. That's why Blacks are cleverer in the bush, in hunting and things done in the bush. The Whites in the outside world were more into books and inventing things. When others went into the outside world they were not given a chance by the Whites. That's how Whites have been brainwashed into being dominant and Blacks into being stupid. **K3**

Look at the world around you. Black people are still in the back of the vans; Black people are still working in the gardens; Black people are still the maids. For many years Black people were forced to believe that they could not do things that Whites were capable of. It resulted from years ago and today Black people still believe they are not as clever as Whites. Even today Whites and Indians believe that Blacks are not intelligent. I know this from reactions I've got both in and outside the class. **K4**

That's why people still want to have lighter skins. Think of the ads – there's this Black lady that advertises that PONDS lighter skin thing. For many people it's the lighter skin that is more acceptable. The Whites were always at the top – they always had all the answers. The Blacks were

You are a lady of companion and you have a very caring and understanding nature. Although you can be daring, I compare you to the generations characte known as Ntsiki, thats when you are angry and untauchable.

They say that there are always 2 sides to a person the good side and the bad both are controlable but Patel's bad side can be your nightmare. But she is a loving lady (I keep saying that) I know and it's because it's true. When you brought those people from overseas you really showed us that you love us (I mean meating people from overseas) It was overwhelming and I appreciated it.

Anyway I dont thinkk I have got anything to say but that I thank you for being a part of my life ~~the~~ for the year "2000" It was nice knowing even more than just hearing about this Patel teacher whom everybody is scared of.

THANK
YOU,
THANK
YOU,
THANK
YOU!

Enjoy you stay /holiday that's for the whole six MONTHS! (ANT YOU TAKE ME OVERSEAS WITH YOU (JUST JOKING)

<Mbeki>

MANY HUGS + KISSES FOR THE YEAR (2001.)

the slaves. That's why we want to be like the Whites. Wealthy. Powerful. With lighter skins, big houses, expensive cars and nuclear families – the White look and White lifestyles. Many people are adopting this lifestyle because for them this is the right lifestyle. So if people get a chance to design their babies they are going to go for light-skin babies. That's part of genetics; that's part of biology. **K5**

We need to talk about these things in the classroom. Of course the Black point of view will differ from the Indian point of view. We have different backgrounds; we are taught differently at home. But even in an Indian dominated school like this we can together learn about the differences between us so that we can understand each other better, relate better and communicate well – even outside the classroom. For me it's a privilege to be in this Indian dominated school. We need to talk about these things in all classrooms. In the English class when we come across the terms used to name the different races we must not just reject them. We should learn about them and where they come from because it is in the homes that many racisms arise. But the biology class is more open to discussion. It is in the biology class that we have been able to learn about the different races and the different cultures. **K6**

In the biology class we learn why Black females have big butts, why the fat is stored there. We learn in bio how these things arise - about the Black and White body. We put it together and see the reason for why the Black man's body is the way it is and why the White man's body is the way it is. And the teacher is the one who makes the decision whether or not to teach that. We should also have more White people like Gould to correct the White man's false teachings that have manipulated our understandings of the different races. Many White people have not yet accepted that the Black person is like the White. The Black person is progressing and the White person carries on rejecting. With more people like Gould we will go on the right path. In this way we will know more about ourselves as Blacks and correct ourselves; we will better ourselves; we will excel; we will progress. **K7**

The kind of language used can also aid progress. Why are there two or three words that one can barely pronounce at times or spell for the same structure or idea in biology. Was this English invented for the White people who had bigger skulls and were therefore cleverer? All races learn biology and have to learn the complicated English if they want to learn biology. Yet simple English would have allowed us to understand easily. And the language may even be sexist. Cells are called daughter cells and mother cells. Why are there never son cells or male cells? Is that because only

females reproduce. I don't know the answer to this but we have to begin to question our attitudes about what the language is teaching us about ... about society and sexism and politics. We have to talk about these things related to biology if we want to correct that which is wrong. **K8**

Our attitude to teenage pregnancies also needs to be questioned. Through discussions in biology we can begin to learn about being forced into fatherhood at a young age. Most of our parents are single parents. We need to learn so that we don't repeat the wrongs of our parents. And the sitcoms on TV that are now sexcoms just add to this. The male has a role to play in raising the family. Yet if a schoolgirl gets pregnant she's the one who has to leave school and she gets disgraced. She's the one that people talk about. The male just carries on. Biology is where we learn about reproduction. So this discussion has to be part of biology. It cannot happen in any other subject. **K9**

The teenage pregnancies also make it possible for us to learn about how other cultures behave and understand when in this situation – the Black understanding and the Indian understanding. We live in one country as different races and we have to learn about the different cultures and religions to respect the people we live with. In the bio class when we talk about the male and the female that's when many things arise about the different races and their behaviour. This gives us the chance to understand and communicate. This makes possible UBUNTU – togetherness as a group of people sharing ideas and working towards one goal. **K10**

With abortions and AIDS on the rise talking about teenage pregnancies will give us an awareness about abortion and AIDS. We need to learn about these things to live a better life. Many people are not informed about sex – they think it's just a game. That it's hard to take a decision about abortion; it's only easy for those who do not care. They are also not informed about AIDS; they think AIDS only affects others. In Home Economics we do some family studies but not much about abortion. Nothing in other subjects. It's appropriate to talk about these in bio because that's where we learn about the human being. Even though it is not in the bio textbook. What is in the bio textbook is specific. It's what the government wants to write. The government just wants to hide the fact that AIDS is there. But we have to learn about this and biology is the appropriate subject. For those who don't do bio the AIDS Organisations and groups like LIFELINE must come to the schools and talk about these things. It can't be done in the other subjects. **K11**

It's also true that it's the Black township girls who get AIDS. That's not racist. Take Kwa-Mashu. We were taught that we must not be scared of our parents but we must respect them. In the Black

culture we know that the belt is still there. But the youth of today … they want to be independent. They disrespect their parents like the White youth. Black children are disrespecting their mothers. The girls go for the cute boyfriends with the cash, hot cars, fashion and AIDS. That's in Kwa-Mashu. **K12**

And if we don't discuss this in the class where else do we discuss it. We don't even discuss sex with our parents. If we talk with friends we all agree to the same thing and we don't learn from each other. But in a class you hear from different students – of other places and races and then we learn. And in the class that's where people can support you if you are crying especially the teacher. You can pour your heart out and talk about everything. The class is where you also share feelings. The biology class in not only for learning about facts. It's also where you can learn about life-stories and life-skills. About HIV and how it affects the human body and the mind which is part of the human body. About honesty in relationships and abortions. About homosexuality. **K13**

Homosexuals are popping up all over. We have to learn about them and to accept them. It's how they were made. We can't inject something into them and turn them straight. And we don't know what our children will become. So, we should accept it. Homosexuals are human beings and should be treated equally. **K14**

All people must be treated equally. But people are still racists. Blacks, Indians, Coloured and Whites! In class people smile at me and talk to me. I get on with many Indians. I'm friendly and people like me. Yet when they are angry they use the kaffir word. Sometimes they say you Black thing and that I come from the bush. When I play a trick and hide a pen they tell me that I am learning to be a thief like the Blacks – my Black group. All this bothers me. I feel sad. I feel angry. But I cannot call them by the other race names … I just cannot. **K15**

I was very happy when I was chosen as a prefect. I doubted that I would be chosen because of my skin colour and also because of my behaviour at times. But I was chosen. However, when it came to head prefect my pink friend, why do we say White when the colour of the skin is pink, said not even to bother and submit my CV for selection. She was right. To be a head you must be clever. You must interact with others, participate in activities and be good at many things. I came to my senses and did not apply. I believed they would not choose me. **K16**

I tried to do Zulu as a seventh subject. The principal understood – he touched me when he spoke to me. Even you touch me. When I came to this school people didn't want to touch me. Many Indians would dust themselves if I touched them. That's the kind of racism that's still in this school. It's also in the way some people talk to us at the office; in the way some teachers mark our work; the way in which we are told about and forced to pay our school fees. **K17**

I decided that you should have the privilege of being the first to know my traditional name. I wanted you to use my traditional name because you never remembered my name - you would call me names like Wiseman and Knowledge! I feel more comfortable with my traditional name because you would not make mistakes. I've also experienced Indians at school making jokes about the names given to us as Black people – they would laugh at us and use our names for name-calling. So I want people to call me by my traditional name and pronounce it exactly the way it should be pronounced. If we have to make that effort with the Indian names I expect the same respect for me. **K18**

Life and racism. Biology and racism … **K19**

5.7 I'm a Black person ... I'm dark, ugly ...

Nelisiwe' story

I don't like Black people. I'm a Black person. I hate the colour. I shouldn't because God created me but I hate it. I see others ... light, cute. I'm dark. I'm ugly. I, we ... have to struggle for our hair, our faces, our bodies to look nice. That's hard work ... using relaxer and lightener and all that stuff. And we have to buy it! That is always how it has been with my family. It was always there as I grew up. My family too does not like the colour Black. **NF1**

God created us differently. We have different shapes. The Black person has a flat nose and the Indian and the White has a long, straight nose. God made some people clever. God made some people slow ... people like us the Blacks. But God did not make anybody stupid. Blacks are not stupid. Maybe Whites are cleverer because they have more knowledge. Most things in this world are made by them. That's because Whites are cleverer. That's why they are at the top and we are at the bottom. They treat us like we are stupid. That is what is in their heads. **NF2**

I don't know if this is part of biology but we have to know the truth. I don't even know if it is important to know about. But we have to know the truth. We need to know the kind of biology that Gould talks about so that we can know the truth. When people can design their babies, people will choose to have light babies because people don't like dark, ugly babies. We have to know the truth. **NF3**

Like with cell division. We only talk about mother cells and daughter cells. But fathers also produce sperm cells that together with eggs form the daughters and the sons. I think we should talk about this in the bio class. Mother cell giving rise to daughter cell – that's got nothing to do with the role of women in society. Mothers do produce. **NF4**

Just like the girls who produce – the teenage girls who get pregnant. But what happens to the girl is unfair. She carries the baby for 9 months while the boy is busy enjoying himself, carries on going to school. She has to leave school. She has to look after the baby. She bears the disgrace. Both of them should suffer. But not all people reject the baby – some groups accept the baby. Like what Nolwande shared with us happens in her community. We need to know what is happening in the world, especially in the different religions. This must happen, not only in biology lessons, so that

Nelisiwe Faith Mzanzi

GRADE '11' 'B'

BIOLOGY ESSAY

THE DIFFERENCE BETWEEN GENERAL biology and the open Conversation one/biology. Both these the Biology are understandable. The open Conversation biology is more complex, advise than the general one. It teach us a lot, because its tells us about real things, that happens in the world as a whole.

I prefer open conversation because every body has or get an opoturnatey to share his/her views. where we have to discuss about ~~abosh~~ abortion, some one will say abortion is right and other says its wrong. Well I think that it is not good at all to do abortion because you would'nt know how long will the ~~bad~~ baby survive. Sometime the mother don't even survive too.

As we are different from each other in terms of colour, we all learn from one another about different cultures. e.g. in our culture when it comes to marriage we or the boy pays ilobola on his fiances side because you can't marry a girl without paying ilobola. However ~~empo~~ the Indian, whites & coloured they don't do the same. In open conversation we learn without using a textbook.

we can know each other and learn from others how they do things and understand things. It's not important but we need to know. **NF5**

The same is true for abortion. I don't agree that abortions should happen. I don't know why it's happening. But it's part of biology lessons when we do reproduction. Parents don't talk about abortion to their children. Maybe they are scared of their children. Or maybe it's because it's not good. So they don't tell their children the truth. Yet they are the ones who shout at their children when their children get pregnant. That's why we must talk about this in biology. If there's a debate then there will be those who say why abortion is good and the others who disagree. This will help me understand better about abortion. About what to do if a disease is going to be transmitted to the child from the mother by a gene ... whether an abortion is the answer, whether the woman makes the decision by herself, keeps secrets from her husband ... about honesty and feelings in relationships. I think this is part of biology. But I disagree with abortion. **NF6**

Just like I disagree with them when they say Black township girls get AIDS. They are lying. It's not only the Black. When they say Black I don't feel very good. Yes, most Blacks are HIV positive but it's not only the Blacks like they say. Who are they? In our class it is those who are not from our culture. It's racist because no Indians stay in the townships. I can't believe Nolwande said that! It makes me uncomfortable that she only mentioned girls and not the boys. Sometimes it's the boy who gives this disease to a girl. We have to talk about HIV and AIDS in biology – what it is about, what happens when you have it and how it is spread. But if somebody says that which is racist and sexist ... I don't know if it will serve any purpose to talk about it in the class. **NF7**

Personal experiences with HIV and AIDS have a place in the class if the person sharing the experience is not feeling hurt and pain. Otherwise the experience must be shared outside the classroom privately with the teacher so that the pain and hurt are not heard by the class. That is what Gladys should have done. I won't be able to share with my class if I am hurting inside. **NF8**

I too was scared that I could have been pregnant or had HIV after I was raped. Nobody knows about this in school ... except Strongness and you. I had the tests and found that I was okay. When it happened it made me feel very, very bad, upset and angry. How could it happen to me? I'm fine now because it's not in my head; I forgot about all that. I don't care about it. But I'm not comfortable when we speak about rape in the class because of what happened to me. But we must

The general biology is sometimes bouring because its talks about animal, plants ect. There is no tyme for talking and share something we dont know, unusual. We usualy see plants, animals & trees although we don't see physically I realy enjoy biology ~~ef~~ specialy when it comes to open conversation ~~Algbou~~ Although I'm Nervous but sometimes I can share my views. I hope that in future I'll be able to learn more about biology and more about something I don't know.

Mam You are very funny. You are not selfish & you dont hate people. You make me laugh anytime wether I'm in good or bad mood. You are a carifying person. You gives love to every body you are not rastisim. You just loves everybody. Even if I'm finished school, I will still love you. I will miss you until the end of the world.

FROM **Nelisiwe Faith Mzanzi**

speak about it so the others will know what to do if it happens to them. It's the diseases that may occur from the rape that's part of biology, not the rape itself. But we have to talk about rape. **NF9**

Homosexuality too. Biology is the only subject where we spoke about abortion, racism, sexism, HIV and AIDS, teenage pregnancy and homosexuality. That must be because these sections are all part of biology. We've never had them in any other subject. Just a little in Home Economics on sexism. So this must be part of biology. In biology everybody also got an opportunity to share his or her view. By discussing these sections I am able to know some things which I did not know before. Biology must be facts from textbooks and also that where we learn from others too … what they are experiencing. That's the biology I would like to study. But the language of biology! It is difficult. **NF10**

Homosexuality is happening and we have to talk about it. It's against God's law and we must reject it. It's not part of life. We have to talk about how we ignore it or just reject it. That's important. **NF11**

Just like school is important. Without schooling I don't think I'll be able to do anything. I enjoy school – even though I repeated standard nine. School is nice because we have other cultures in this school … Indians and Coloureds. Indians because this is an Indian school. I have no Indian or Coloured friends. I had one Indian friend but she's left; she finished Grade 12 last year. **NF12**

My second time in Grade 11 – that class was fine. But the first time … I used to get hurt and angry when the students used to swear and say things like hey you muntu! It hurt us Black people. They used to take advantage of us in this school because we are not Indian. They used tell us that this school belonged to them and that they could do anything they wanted in the school. I did tell them I didn't like it and they stopped – with me. It's like South Africa. Some things have changed but not others – there are still racists. The president is a Black person but things are still the same. I hate being Black … **NF13**

My Picture of Miss Patel

20/11/00

Nomathanda Vusi

Grade 11B Room 14

Miss Patel is a person you dont want to get to the wrong side of. I'll give one reason She has a talent of embarrassing you in front of the whole School and when that happens to you you will never do wrong in front of her. She has this loving nature towards her pupils but when fun time is over She expects you to do your work and do your best She is not bossy or forcefull towards her Students because She lets you know that your future is in your hands there isn't much to Say because She is not a Complicated person. She likes things as Simple as possible but I have one problem with her She is very ~~loud~~ loud when angry

I used to Catch my Self Sleeping ~~at the~~ during the first half of the year because the biology classes were so boring I mean we had to try and remember Bio terms and on top of that we did not enjoy listening to the Same voice for an hour long period.

the Second half of the year things Started to be interesting and exciting ~~the~~ I looked foward to ~~to~~ the Biology periods because we talked about our experiances, things we've Seen and most of all we talked about what is important and what is ~~effecting~~ affecting our lives today we were given a chance to ~~teach~~ learn and educate each other ~~about~~ about life itself we talked most feared things like aids, HIV ~~and~~ I Certainly learnt a lot from the open discussion periods I am not really intrested in knowing how the Sperm and the egg meet to form a zygote I want to know about what really effects me as a growing person in the world and I want to know how I can make a difference.

5.8 You Think I'm A Strong And An Empowered Woman - HUH! Looks Can Be Deceiving ...

Nolwande's story

The scientists who make the discoveries and inventions are men and women who come mainly from Europe. America doesn't produce bright scientists. Just scientists who copy from others and want to take all the credit for themselves. But the scientists from Europe - they don't write the whole thing. They don't want to give others a chance to experience what she/he experienced. They don't want any talk about feelings and experiences. Me too. I get so emotional that I embarrass myself so I rather just keep my feelings and experiences to myself. You think I'm a strong and empowered person – a strong and empowered woman? Huh! Looks can be deceiving. **N1**

But come to think of it when feelings are shared it lets you work through where you are and lets you move on. So the biology class is somewhere where feelings must be shared. Take for instance when Gladys was upset. Her friend had died of AIDS. She shared with us. She cried. She got relief. She learnt that there were others with the same experience – that she was not alone. As a group we all benefited. Learning is not just what's written in the book. Learning is more than just what is written, goes further than what is only written. We must be alert to this. We must share to get knowledge. It's the same with abortion. Just because the child is in your womb doesn't mean that you the one making all the decisions. You need to share with the father, learn from the father. Decision-making comes from learning as a shared responsibility. In the bio class we need to share experiences and feelings. **N2**

We need to share our experiences of men as the superior ones and being in charge of everything. Women are deprived of that. The woman's job is to look after the children. The man, because he is charge, only helps or runs away and neglects the growing child. And deep-down we know that when biology is talking about mother and daughter cells it is saying what the woman's job is. In the old days we were deprived of that knowledge because people were afraid of what that knowledge would do to us women. In this way women continue to be deprived of the chance of being in charge. That is why we need to talk about more than just the facts of biology if we want to learn more than just what is written in the book, in the syllabus. **N3**

But it gets difficult when it come to the understandings from different cultures. Because while for some people it gives more understanding, it offends others. It can offend parents who teach their

children differently at home. That will cause confusion and conflict for the learner. Who does the learner listen to? The teacher or the parent. So yes, it should be part of biology and no, it should not be part of biology. If we do talk about the different understandings it will provide me with a clear vision of what I can do and what I cannot do. Sometimes that will be the same as what my parents have said. At other times it will be different. And you can't talk only about the Indians and Africans in the class - you have to talk about all the races present in the class because everybody in the class is equal and should be respected no matter what. **N4**

Like with teenage pregnancy – Naseema said you can have an abortion. But like Wonderboy said children are a gift from God; yes, a child is a gift from God. And if you can't look after the child you could give it up for adoption. You have to bring up what Wonderboy said and talk about adoption because abortion is a very big step. In the African culture abortion is a topic you shouldn't even have; it's a sin to kill a child. Maybe the parent's will understand and want to raise the child themselves. You cannot only talk about Naseema's suggestion. You must talk about Wonderboy's understandings too. **N5**

Teenage pregnancy in the biology class will also give the boys in the class a picture of what it is like to be a woman. They usually just run away and leave the responsibilities to the woman. But then again this might offend some people in the class. They wouldn't want to understand or listen. And then they won't participate in the discussion. So there are limits to the discussion. You can't let emotions go overboard in the class. It could lead to confusion in the subject. I don't have the confidence to share my feelings if they might offend someone. So I rather keep it to myself. Rather just stick to the facts of biology. **N6**

The facts of biology – like gene transfer. Gene transfer and disease transfer from a mother to a child. And then back to abortion as a possible solution. But you won't know if the child definitely has the gene. Abortion then cannot be the first priority. You cannot deprive the child of life when you cannot be certain. So we should talk about this and whether the decision you make is for you or for the child. We should talk about it and have knowledge about it. What if you have the child, the child contracts the disease and dies, your pain and unwillingness to risk having any more children. That's why it must be spoken about together with the partner's role in this situation. Abortion – the decision is not yours to make alone – it is a shared responsibility. That is what we need to learn. **N7**

Maybe an abortion could be done if a girl is raped. In our culture even then a girl is asked by her parents if she wants to keep the child or not. And they support the girl and advise her how to bring up the child if the victim decides to have the child. But that doesn't mean we must talk about rape in the bio class. That's the parent's job to tell the girl – about where she can go at night and where she can't. Especially in the townships. I live in a township, in Umlazi. I can't come and go as I please on the streets at night by myself. At night it is dark and I can't see; I could be raped by my friend; I could become a victim. In some townships like Kwa-Mashu it's even worse – by 6'o clock girls' know that they are not to be in the streets because they will be raped and maybe even killed. No, rape is for the parent's to talk about. **N8**

We need to talk about what goes on in the townships – even in the bio class. In that way people like Jamal and Kribashnee will be alerted to the dangers in the township – so if they are visiting friends in the township they are alert. In a township you don't trust anyone. Even the Africans who don't live in the townships need to know – just because you're an African doesn't mean you can walk the streets as you please. It needs to be discussed but it does become offensive to those of us who live in the townships. Just because everything happens in a township and there are criminals and thieves there puts you in the same category – even though you don't do that. So we need to talk about it but only to a certain extent – where it doesn't discriminate. **N9**

It's also true that Black township girls get AIDS. It's not only the girls who have been raped; it's also those blinded by love. The girls know that the guys change their partners but they don't do anything about it because they are blinded by love. Then there's also this idea in the township – my friends, neighbours and people close to me – who believe that AIDS is not a reality. So they take risks with their lives. Even when a neighbour has AIDS and is sick and still he won't take precautions. It's also because boys believe that you can't enjoy sex with a condom and if you use a condom you are not a man. The girls are then forced into sex and then get infected. If the girl tells the boy and suggests he goes for a medical check he begins to call her names and hit her and tell her to stop badgering him. And he carries on having different partners. This is part of the biology syllabus and we should talk about it. **N10**

Is this sexist? That's because the boys discriminate against the girls and give them a bad name even though they, the boys, are the ones who are responsible. Racist? I wouldn't blame anyone who says its Blacks. Take that time when the blood clinic found that 80% of student blood donors from a Soweto school were infected with HIV. Now its Black people who live in a township – so this gives

more power to discriminate against Blacks. It does happen in multiracial schools also – you get students there who are also infected. But that's second to the knowledge that Blacks are the ones who are violent; they just worry about the Blacks, what they do and what the rate of AIDS is amongst Blacks and don't bother with what is happening around them. So we should be made to learn about this – in biology. **N11**

White people think that Black people are dirty and filthy. So who would want to have a Black baby – especially if you were White and lived in a suburban area where there were White people. If that happened the neighbours would call you names. So with designer babies – people will choose babies they want. That is something that usually happens with Whites. Designer babies are not a topic that's spoken about in the African communities. The colour of a baby is not a topic spoken about; it's not something my mother and the neighbours would discuss. I'm not even sure that they know that babies could be designed … **N12**

You have to accept there are people that are different from us – like homosexuals, you have to accept them like you do handicapped people. It is shameful; it is against God's law. But at the same time you can't judge them – you have to learn to understand what that person is feeling. You can't change that person. They live their lives their way and I live mine. So we should bring it up in the class since we have different views and then come to an agreement that they are around us and we can't do anything about them. What if your best friend is a homosexual and tells you. Do you judge the friend and stop being friends because you don't like homosexuals? That's not fair especially if the friend told you to put you at ease. We need to talk about this in class. **N13**

We are all the same. It does not matter what race you come from; just because your colour is different from mine doesn't make you any better. Biologically we are the same. This is a big gap in the bio syllabus – we need to talk about this in this bio class. We need to talk about race and racism. We need to talk about Whites at the top and knowing everything and we know nothing. It does affect us. It's no longer a case of since you're Black you don't know anything and the only thing for you to do is to go to the farm and work there as a labourer; even if you get a chance to be educated you can't be as clever as a Black person. We should discuss these topics about race. Ideally the discussion shouldn't take place in the bio class – but then again since it is never brought up anywhere else in any subject and the only time we've spoken about it is in bio so I suppose bio is the place where we talk about it. **N14**

Genetics is part of biology so biology is the place for these discussions. Especially if you are White and you have a child that is dark from genes that you inherited from your grandparents. You could have a different opinion of that child and think that that child is stupid; doesn't know anything. You'll hurt the child emotionally as the child grows up. So, we should talk about it. We need to learn that because your colour is different does not make you any better. **N15**

Like saying the Black person is more intelligent in the bush and the White man is more clever because he has an academic understanding. Here you have to go back to the history, many centuries ago, when White people invaded the land of Blacks and used the power of being White, bribed chiefs and set themselves up as Gods to be worshipped. They set themselves up as the people with the most power with Blacks as slaves and brainwashed into believing they were stupid. If the tables were turned and the Blacks had done that then the Whites would know less and the Blacks would have been worshipped. And biology is where we discuss these issues. **N16**

Race and racism together with the kind of biology that Gould writes – just because or colour is different does not mean we should be compared to animals. Human beings are the same. If we discuss Gould's biology I will have more of an understanding about myself. I will have confidence in myself and my self esteem whatever other people say. I would know that I do not come from an animal. I wouldn't want to be compared to an animal. Unlike a Black person brought up amongst Whites and in a culture where everything is done in the White way. That person would forget where she/he comes from, what culture she/he belongs to and transforms and becomes White. The person has White friends, everything the person does is White, does not communicate with Black people and doesn't interact with Black people. We are all the same and should not discriminate against anyone. Even the biblical view says that God created man and woman, nothing else. Even if you are different, say a Tamil, it should not be a reason to discriminate. So we should be taught and made alert. **N17**

Biology can provide an understanding of many issues from genetics to mitosis. It gave me the chance to express my opinions and know what other people think. But the language of biology makes it difficult to understand the ideas of biology. The vocabulary makes it so difficult to understand, it confuses – it doesn't benefit you in any way. That's also why the knowledge you get from reading the books is forgotten once you write the exams. But where we have had conversations, where we have shared feelings, experiences together with what's in the book – we know. **N18**

Conversations in the biology classroom. Discussions in the biology classroom. Depends on the teacher. With most teachers they are trying to control us. They tell us what to do. We don't tell them what to do. Even if I have an idea about how the teacher could go through the process and the whole class benefit, I can't tell her what to do. She might be offended and our relationship could become difficult because she might think I'm trying to be the clever one. She'll then concentrate only on my faults. You do get teachers like that. This does happen. But I don't know teachers as well as I know students in my class and this school. **N19**

I was at times disappointed with my class. We discriminate amongst ourselves without even knowing it. We joke without realising that we are offending another person in the class. Like we do with Pretty and Nomali who are fat whose feelings we hurt with our jokes. But there was no racism in the class. We were a naughty class known for our absenteeism. On the whole though I enjoyed being in that class. **N20**

The Indian male students in this school – we didn't get on with them. They usually mocked us, the Blacks. So we stayed away from them. We didn't talk to them. There was a certain percentage of male students who didn't want to talk to us – like the ones who stood alone. When we tried to be friendly and talk to those students they preferred not to talk to us. Maybe it was because we were Black girls and they would be mocked for being with Black girls and that kind of stuff. I was not discriminated against in this school. But I did keep to myself. An empowered and strong woman … Huh! **N21**

Miss F. Patel.

She is a very kind person, understanding and loving. But as a student you wouldn't want to be in Patel's bad books because she know how to embarass a person. She doesn't even care whether you cry or not as long as she tells you whatever she feels like.

As for her teaching I wouldn't want to talk about it. We do appreciate that you preparing us for matric/ university but sometimes you have to think that we are still not that mature and we are still in standard nine.

Since she took me for biology I've never been so confuse in my life, as for failing dismally I wouldn't want to talk about. Sometimes she is very hard to follow. One minute she talk about mitosis, 1 next minute she is talking about something else. The 20 minute tests I really dispise it. The other thing I dislike about her teaching is when she gives us a tests and she doesn't do corrections with us. She just gives us textbook and she tells us to work it out ourselves. How can we learn we learn from wrong to right. We are already wrong she suppose to be doing corrections with us.

Pretty

5.9 I've Never Been That Confused In My Life ...

Pretty's story

Since you took me for biology ... I've never been that confused in my life! I wouldn't want to talk about your teaching. We appreciate that you are preparing us for Grade 12 or university but sometimes you need to think that we are not so mature. You come into the class, tell us what topic we are working on, go into detail but only give us a little bit of notes ... even though the subject is important. Give us notes and everything there will be much more understanding and less confusion. For a test we'll learn from the notes and write what you've taught us. That way we'll feel more secure about what we are writing, rather than writing about our own way of knowing. The summary textbook is enough and you don't have to spoon-feed us but you should give us notes. Sometimes I'm really confused ... **P1**

You don't stick to the syllabus. You include things that are not appropriate to the biology lesson. Things like gender, sexism, abortion and homosexuality. Values, morals, ethics and judgements shouldn't be discussed at all. That's not part of bio. It shouldn't be part of our notes. We need to write in our books only what the textbook is talking about. We need to use the language of biology. Even the words I don't understand. Words that are biology! **P2**

Take gender identity and women's roles. In some cases it's suitable for discussion in biology – like with cell division. Here it tells us about how we are formed and the woman's role – it talks about us. So here it is suitable. About it being sexist? Most of that I didn't know about so maybe I learnt some thing ... sometimes you need to talk about things that you don't know rather than keeping it inside and not knowing. **P3**

Things like how boys are not ashamed when they make a girl pregnant. That's because it's not the boy who is stuck with the big stomach or has to breastfeed the baby. Then the boy just dumps the girl and finds another girlfriend. This we should talk about in biology – the boy's responsibility since it takes two to tango. It's part of human reproduction. **P4**

Abortion though is not part of human reproduction. It will take us away from biology. Abortion and what happens in different communities needs to be spoken about. But not in biology. It will take us away from biology and we will waste the lesson. Speak about abortion in a different period –

maybe something like community lessons. This is not part of any school subject. In the subject periods we must talk only about the information dealing with the subjects. Nothing else. **P5**

Not about things like Black township girls get AIDS. In some ways it feels like that is true but I don't like it. I'm a Black girl who used to live in the township and I don't feel good about it. It's we Black girls who can get hurt. And it's not only Blacks who get AIDS; it's not only girls who get AIDS. That's racist and sexist. When somebody says something like this in the class we must pretend like it never happened so the Black girls in the class don't get hurt. And for Nolwande to have said this! Maybe it's true for Umlazi but not in Ntuzuma. We're a small community and not bad. The girl's in Ntuzuma they behave like Model C's – they hardly go outside. I'm not saying they can't get AIDS but I've never come across girls in our community with AIDS. **P6**

Ridge Road – that's where I live now. When I go home, I go into the flat and go to sleep. There's nothing else to do besides going to Musgrave Centre. Here the Blacks keep together and the Afrikaners keep together – we don't really get along with each other. It's not like Ntuzuma – friendly and where we are all one race and all get along. In Ntuzuma you can walk around, see other people and talk. The only thing nice about living in Ridge road is living with my mum and dad. **P7**

Coming back to HIV and AIDS. The biology class is not where we share our personal experiences about these things. Someone wants to talk about a personal experience – then call you and talk to you outside the classroom or during some free time. A personal experience has nothing to do with the subject. Even though it can get monotonous just sticking to the facts in biology - just stick to the facts. Only when it's suitable like in human reproduction some other things could be brought in. Otherwise stick to the facts. I wouldn't share my emotions in the class; I'm not that kind of person. I'd call you outside the class if I wanted to do that. **P8**

Genetics being used to produce designer babies - that's part of biology. But light skin and dark skin – I'm not certain if we should discuss that in bio even though it is part of genetics. Because some people think that if you Black you ugly and if you light you gorgeous. That's why it's true that if we can design babies then people will go for light skinned babies. But light skin and dark skin – if we talk about that in the bio class then it cause huge disagreements, huge damage. Black skinned people will be offended and feel ugly and things like that. No. we do not talk about this in the bio class. **P9**

Open discussions in the bio class don't teach anything. Everyone has his or her opinion. We don't end up with what's right and what's wrong. It was like that when you did that role-play on disease transfer through genes. Nobody learnt anything. You spoke about abortion and being faithful to your partner. You should not abort your child. We are still young and you should give us advice so that when we make a decision we go the right way. You should not abort your child. And if you start this topic you must end it the right way. **P10**

Just like teachings from the bible – they have nothing to do with biology. If somebody brings up homosexuality you know it has nothing to do with genes and everything to do with the bible. And if people want to talk about this they must do so in the guidance period and not in biology. We must stick to the syllabus, the facts. Sometimes you include things that are not appropriate to the bio lesson – things like this. **P11**

And when a learner makes a statement that is not appropriate it's your job to tell him or her that and give some advice. Like when learners make statements that do undermine Blacks by saying things like Blacks are only intelligent in the bush. Don't allow for any discussion because there will be a huge disagreement in that case. I'm not being racist but the Indian people will agree to one thing and the Blacks will group together and we'll have a huge disagreement. It will not change what's inside the minds of people even though people know what's wrong and what's not wrong. It's the same if you try to teach about biological determinism – that biology that Gould was talking about. People don't want to know the truth and learn that we are all equal. This is not a democratic South Africa. Only the word has changed but South Africa is still the same. There still is apartheid. Trying to change minds of people – maybe that's for the guidance lesson. **P12**

Even some of the teachers in this school are racist. Some of the teachers definitely don't like Black people. We get punished for talking but when Indians do the same things they are told please, don't make a noise. Black children are called idiots, sworn at and screamed at but never the Indian children. You are told things like you Black thing, shut up; I'll give you the marks to pass but make sure you leave this school and never come back; you shouldn't be talking cause you were born in the bush; save that attitude for your damn parents. When that happens I don't look at the teacher. I just look down. It hurts a lot. We keep quiet. There's nothing we can do about it. If we answer back we'll definitely be taken to the office and the office won't listen to us. The office listens to the teachers. **P13**

It's the same with some of the students in the school. Like the fat boy who pushed me and said move away you kaffir. I replied if you're calling me a kaffir then you're a coolie. The Black students are seen as hooligans. Some are like hooligans but it's not all of us. We are totally different from them. Not all Blacks are hooligans. Even in my new class where there are some racist students. Not like the old bio class where we were one family. I cope with it; I cope with the racism. **P14**

In my class they sometimes tease me. But that's to do with me being the youngest in the class, in the standard. They say hey you shouldn't be talking cause you're young. It's great to be the youngest. In the bio class I got the chance to speak and be heard without being teased. And I must have made useful contributions because they were listening to what I was saying. That made me feel good. **P15**

Even at home I'm told you are still young. I'm told that I must behave in an orderly manner. My granny says that; my mother says that. There's no sex education at home. I'm told don't do this and don't do that. That's all I'm ever told. At least because of bio I now know why I must behave in an orderly manner. I learnt something from the discussions. **P16**

But I'm still so confused. Do we talk about sex education in the bio class? Do we discuss dominance and stupid – Whites are dominant and Blacks are stupid in the class? Dominance is part of genetics – it's determined by the genes. Stupid has nothing to do with genetics. Should we speak about sex education, racism and AIDS in the bio class. I learnt when we did. But there are things that we must not talk about. I've never been so confused … **P17**

BIOLOGY PROJECT

"2000"

Compiled by: **Irfaan Tariq**

Grade: 11B.

5.10 We're In The 21st Century ... We Need New Forms Of Learning

Sandile Wonderboy

Biology is like math. It's always theory, fact. Nothing practical in life, nothing we think up ourselves. Not our own ideas, our own perspectives. You can't take away the facts from biology but you not only teaching future medical students. Most of us don't want to become biologists or scientists. You're teaching people who want to learn the general stuff in bio cause that's what we interested in. Like me – I'm interested in bio. I will never have much use for it but I'm interested in it. That's why we shouldn't focus on that designed to equip future doctors or biologists but on what we're going to be doing practically, as part of living. **S1**

In this day and age it's the teacher's responsibility to introduce new forms of thinking to pupils, to extend them. Like gender and sexism. Things we may have ignored in the past for reasons of the past. Even in bio. It's not a new form of teaching just a new form of learning, exploring new things. I mean we are in the 21st Century. **S2**

The bio class is the perfect place to talk about teenage pregnancies and sexual diseases. When we doing reproduction it's the perfect place to start. From how the students share their understandings we'll also learn how different cultures react. The class will benefit from the knowledge of the different cultures – the Black, the Indian and the Muslim. But it's not something we want to get into in the bio class. Cultural, religious and personal understandings and feelings – it's not something to be encouraged in the bio class. The top priority in the bio class is understanding biology. **S3**

You should be able to voice your understandings and points of view but it shouldn't affect the process of learning biology. Like take abortion – pro-abortion and anti-abortion. It takes us too far from what we're supposed to be learning about – reproduction, babies and things like that. That will take us away from what we should be elaborating on. You could mention it once or twice but it's not something that you should debate in the bio class, something that should from the basis of a discussion. If the teacher wants the students to talk about topics like this then it must happen separately, in a different time slot. If we going to talk about things like abortion in the bio class then we should focus on the procedure, dangers and things like the effects of abortion. Not anything else. **S4**

Biology Essay:

Role Playing:

Is one with a great status, as it grips the students attention. If you observe closely, pupils these days sit in the Biology class half asleep or unattentive. When they are given tasks they either don't know the work or are too lazy to do it. They complain about the work being hard, they don't have any notes or the teacher is uninterested in them. On the other hand when work is being acted out the tables turn and the pupil gives 100% attention. Role Playing is so effective that it has changed my attitude towards Biology. When it is being acted out, the student wants to get involved with the class, they understand their work 70% more than taking notes from a text book. Role Playing Biology is amazing and educational, I think that it sha l be excercised regularly an tought to students to all Schools in Kwa-Zulu Natal. In this way alot more students will be interested in Biology, the students will understand the work

It's the same with things like HIV, AIDS and sexually transmitted diseases. We must focus on the disease. But the race and gender of who gets the disease like AIDS – that's not part of biology. Yes, I agree with the understanding that Black township girls get AIDS. It could have been said from a racist perspective but I think it was an honest statement. If you had to ask most people in the townships they too would agree. But the bio class is not where we discuss such understandings. People's feelings need to be watched out for. Not everybody will be comfortable discussing that – AIDS is not something that should be taken lightly. It could be used to mock someone. And if we talk about the gender – that could become the very controversial because one could then say girls get AIDS more than boys and then it could be used to say that women bring about AIDS. **S5**

At this school we are comfortable if we had to talk about AIDS. That's because most of us here have not been affected by AIDS. But in a Black school to come into a class and discuss AIDS – it would have a totally different effect on pupils. I know this for a fact. Pupils in a Black school won't be comfortable. Not like here, in this school. But I think the teacher must first weigh the class to decide about such a discussion. I don't know if it is possible for a teacher to do that. You can't discuss this in any way. It's not something to be taken lightly. There are many ways in which we can discuss these kinds of this. Let's focus on the disease. **S6**

Even sharing one's personal experiences – like with AIDS. That's taking a chance. It could be positive. It requires strength to share the feelings from a personal experience. But it's something the teacher must stop. Whether it's talking about AIDS or abortion - because it could offend somebody in the class. But again the teacher should weigh the class. If the class can communicate then maybe such a discussion can be attempted. Maybe… **S7**

Designer babies. The way genetics is going these days – there's endless possibilities. We might as well talk about designer babies in the bio class. I guess so. What choices will people make? I don't think a White couple would go for a dark-skinned baby. Just like others – they would go for darker ones. So both choices are possible. **S8**

What about genes and disease transmission from mother to child? We should talk about how you get it from your mother, your grandmother … But about having an abortion and talking about this with your partner or not talking about it. That's taking you further away from the original discussion on genes. If you have the time and it doesn't interfere with the biology lesson it could be useful to have such a discussion. Like I think you need to share such things with your partner. But

properly, their marks would improve dramatically. And there would be a higher pass rate in both Biology and Matric results.

only if you have the time and it doesn't affect the lesson, the section you doing. I will learn – but there are limits. Especially time. **S9**

If it's not the result of gene transfer it should not be part of the class discussion. Like homosexuality. It doesn't have a place in the bio class. It's not worth it. Homosexuality is a reality you know. But what can we get from such a discussion. Homosexuality is controversial. It's a very harsh thing. But we can't speak about it in any lesson. Any discussion in school must happen in free time … if we finish our schoolwork. It depends on the teacher you know. Just informal discussions. **S10**

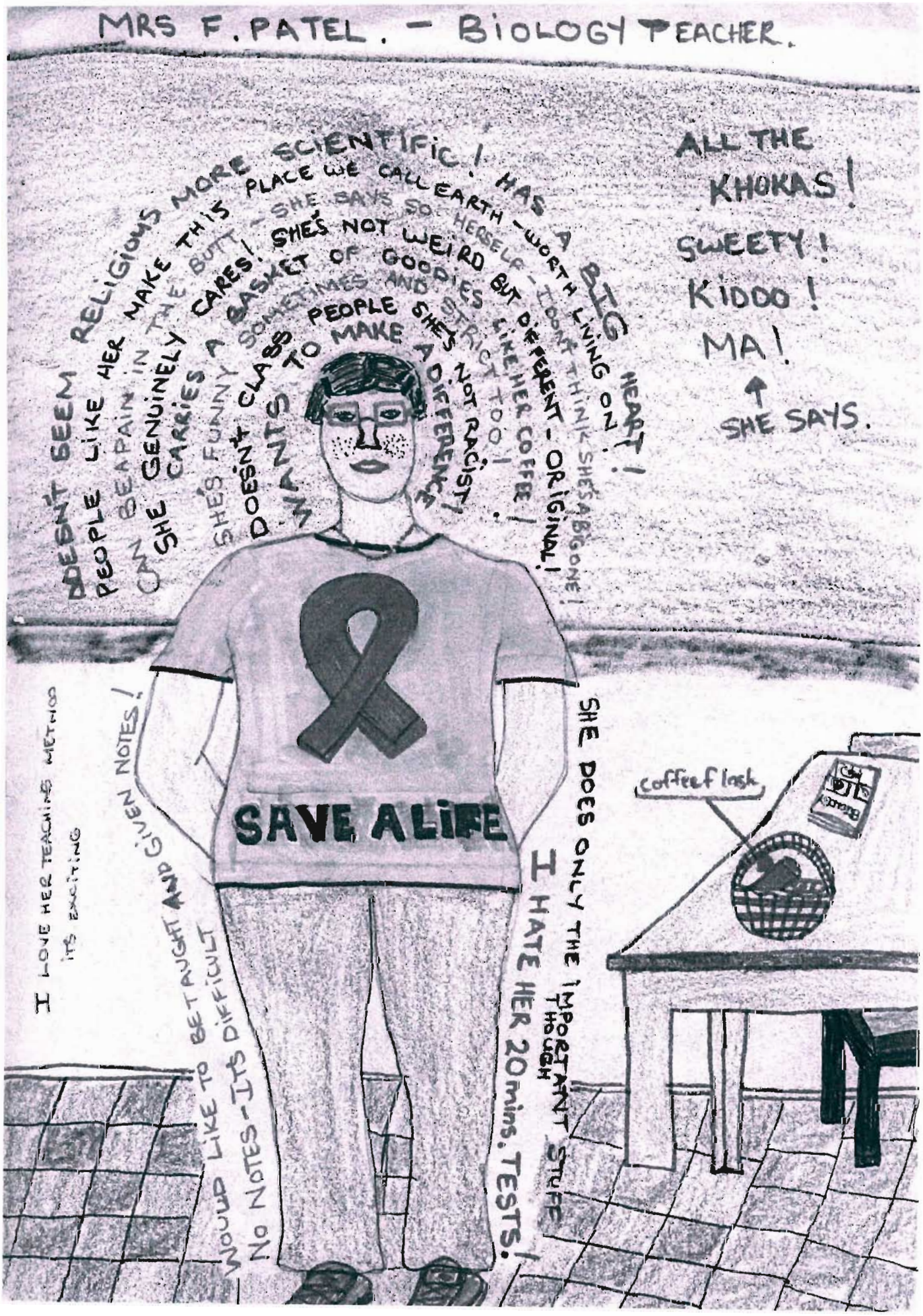
Informal discussions. These will also allow us to correct ideas that some may have like Blacks are more intelligent in the bush and Whites are more academic. It doesn't mean that change the person's personal understanding – just like you can't change a person's religious understanding. You might just change the person's understanding for that moment in time. But a discussion will let the person know it's not like that. Not a discussion in the bio class. That wouldn't be beneficial to us. But it must be discussed because it raises some concern – about how some people became people of power. An informal discussion. One that's guided by somebody who's informed about such things, somebody who can guide the feelings, somebody who can focus the discussion. Not just anybody. **S11**

For me biology is interesting. I don't find the language a problem. I'm sure I speak for most of our biology students. But I would like to do biology that is both practical and general. Then I get to pick whatever knowledge I want. That's the way to go in the 21st century. **S12**

I was comfortable with my bio class – I wasn't nervous and could share my thoughts. But now with the new class group – I'm nervous. I'm no longer comfortable. Even the other classes, the school – the children they keep to themselves. The Blacks, the Indians and the Coloureds. That's become normal for us. The different racial groups must keep to themselves – we're taught that. I mean we sit with one another but … I've had my fun at this school. Fun for me is having good friends – people that didn't mock me, interfere or fight a lot. I've been happy. **S13**

I did get angry though. I got angry during biology – when you shared the information written by SJ Gould with us. I got angry that biology actually encouraged racism, encouraged people to believe they were superior. We need to learn about the kind of biology that Gould writes about. It's

controversial, racism is, but it should be part of our syllabus. I'm not sure how things operate in the education system but maybe it's the way the people in the system themselves were taught. It's how they were taught in the universities and that's why the syllabus is designed the way it is. The universities only taught what people believed were facts and brainwashed people. It's now up to the teachers to explore, to teach … for the 21st Century. **S14**


MRS F. PATEL. - BIOLOGY TEACHER.
DOESN'T SEEM RELIGIOUS MORE SCIENTIFIC! HAS A BIG HEART!
PEOPLE LIKE HER MAKE THIS PLACE WE CALL EARTH - WORTH LIVING ON.
CAN BE A PAIN IN THE BUTT - SHE SAYS SO HERSELF - I DON'T THINK SHE'S A BIGONE!
SHE GENUINELY CARES! SHE'S NOT WEIRD BUT DIFFERENT - ORIGINAL!
CARRIES A BASKET OF GOODIES LIKE HER COFFEE!
SHE'S FUNNY SOMETIMES AND STRICT TOO!
DOESN'T CLASS PEOPLE SHE'S NOT RACIST!
WANTS TO MAKE A DIFFERENCE.
ALL THE KHOKAS!
SWEETY!
KIDDO!
MA!
SHE SAYS.
SAVE A LIFE
I LOVE HER TEACHING METHOD
IT'S EXCITING
GIVEN NOTES!
WOULD LIKE TO BE TAUGHT AND
NO NOTES - IT'S DIFFICULT
SHE DOES ONLY THE IMPORTANT THOUGH STUFF
I HATE HER 20 mins. TESTS!
coffee flask

5.11 I Am Not A Robot ...

Waseela's story

When I take in knowledge, put it into my head and spit it out again without understanding ... I am choosing to be ignorant. That's what I'm doing. I am behaving like a robot ... not communicating, not thinking, ignoring my feelings and ignoring the feelings of others. That's not learning. Learning happens when I understand and I cannot truly understand if I ignore feelings. I want the space to express my feelings – even in the bio class. If teachers treat me like a robot without feelings and I am not allowed to express my feelings in a class then that's what I'll be when I finish school ... and I too will treat the world like that! **W1**

I have to question. I have to know why I am learning what I am learning. I will be passing the knowledge I have to my children. I am going to influence the future. I have to question sexism in the biology class. I have to question the sexism in my world. Even biology represents the woman as the one who has to do everything; to bring up and look after the child. That's not right. For a better world it is this kind of thing that needs to be tackled first. You can't pass it off as a small thing in the class. It is these small things that lead to bigger things – bigger catastrophes. **W2**

At home my mother loves her boys more. My father loves his boys more. He even admitted to me he didn't want a girl. I still cry when I think about that. I try to understand but I can't. They were supposed to stop me from going to school when I was in Grade 7. It was because, you know, girls end up doing the wrong things according to my father. They get ideas and stuff like that there – things that should not happen. I know at one time when I was small I used to wish I was a boy. Because boys had all the fun. Girls have to be tidy and clean up and do things like that. **W3**

Women are required to wait hand on foot on the men in my home. They are required to be considerate and caring of the feelings of the men – the same is not there for them. My religion says that men are supposed to protect the women and things like that. I love my religion. But that does not mean women cannot stand up for themselves; that we are so fragile that we will break if we are touched. **W4**

Biology does nothing for women. It does not promote respect for women. Biology does nothing for a woman who falls pregnant outside of marriage. It allows for that woman to be called a whore, a bitch. There is discrimination against women. Such women are fallen - women to be disowned by

In class it is a different story. I understand in class but when it comes down to learning the facts it is very hard to incorporate. Mrs Patel is a good teacher but she sets very hard tests. There are no assessments. The biology that is taught in class does give you facts and hard evidence but is hard to understand
You are sometimes nice. Very Strict in marking.

fathers, by parents. Even when a girl is raped it's not the man's fault. They just disown the girl. The girl is a source of disease. **W5**

But the discrimination has made me stronger. I work hard at school to show my parents, to show my father, that girls are not like that. I have become more responsible, unlike my brothers. I'll never want a child of mine, a girl especially, to go through the same thing. So it has obviously made me a better person. I want to make them proud of me – that's the main thing. You know since I started talking about my oppression, my so-called oppression, at home my mother has been more understanding. She's much fairer now. If I had had kept quiet it would have gone on. I told my mother about this. We had a heart to heart talk, I cried. My father – I spoke to him too. He pays more attention to me now. I guess I empowered my mother as a woman in a way. **W6**

Even in the bio class when somebody says 'Only Black township girls get AIDS' we have to talk about it. I'm not shocked when people say things like this in class. It's always the girl who's the source of the disease. But it's not only how girls are seen – it's the racism as well. If we don't talk about this when it is said in the class then the pupils who will be the future leaders will continue to have these kinds of things in their heads. They will bring up their offspring as racists and we'll have a nation of racists. We can't ignore such statements. We can't ignore the feelings. We are not robots. **W7**

Talking about HIV and AIDS. At present in biology we don't talk about our own experiences with HIV and AIDS. How we feel when somebody close to us dies of HIV and AIDS. But it is something that we should do. We have to communicate with each other and to understand each other. Watching somebody close to you dying of HIV and AIDS and not being able to talk about it – even in the bio class. That's why people continue to have ideas like only Black township girls get AIDS. It's because we don't talk about it; we don't share what happens. **W8**

We have to talk about different understandings. We come from different backgrounds. We can't expect to learn about only one type of background. We have to learn about others as well. It makes us better people. Then we won't mock others, we won't discriminate against them. Culture and racism are definitely part of the biology classroom. We need understanding and tolerance and patience with each other. I think we don't have that. **W9**

Racism is definitely part of the school. I've never seen a Black pupil hanging out and being best pals with an Indian pupil. It always seems like the Black pupils are always on one side having their fun. When they sing and dance all the Indians just look at them like there is something wrong with them. The Indians talk and pass comments and say things like they think this is their township. Yet I've got some wonderful Black pupils in my class; they are just like you and me; just like Indians and Whites. **W10**

When we study reproduction we should also talk about teenage pregnancy. We need to talk about understandings from Naseema's and Nolwande's backgrounds, about abortion, about the disgraced pregnant girl and her disgraced family, about children outside marriage as a part of an accepted lifestyle and children being a gift from God. It definitely must be part of the bio class. It will give us knowledge. It will give us not only one type of belief, not only one type of understanding. It will give us better understandings and if we are ever faced with this situation we'll do the reasonable thing, the rational thing. **W11**

As for homosexuality – you know I agree with Naseema. Homosexuality is shameful. I … I'm not discriminating against homosexuals. If you want to be homosexual it's fine with me. I choose to pass it of. I don't discriminate against it nor do I give my opinion against or for it. It's there. I can't help it. It's part of biology – we going into sexual reproduction. We have to talk about it. **W12**

This understanding that has been there for ages that we have of Blacks at the bottom level, then maybe we have the Indians, then the Coloureds and then the Whites at the top – that's how we are. Whites as the goody-two-shoes because they were fair-skinned and treated as pure and good and innocent; Blacks like trash, like dirt … like evil. Believe it or not this is still peoples understanding of Blacks even though we have the Bill of Rights. That's why we have to discuss these issues in the bio class – when we talking about HIV and AIDS, when we talking about genetics and designer babies. Race categorization, scientific racism should be part of biology teaching, part of the biology syllabus. **W13**

I think that most teachers would think it's too much of work to actually go into things like this. They're just interested in finishing the syllabus. Understandings and feelings and things like that there. I think they think that way because they feel its no use. They pass it of as a small thing; it doesn't matter. They don't know that it's this that makes us human. We have feelings, we have

choice and we have a brain which we think with – and to think they say that this is not important. **W14**

It's as if they don't finish their aim in biology they will get into trouble with the office. The office definitely exerts a power on the teachers. And there's a hierarchy in school in school even between the pupils – the power between the richest and the poor … then we go into clothes and labels and things like that. Just like the power of the White man over the Black. White men wanted power over the Blacks so they brainwashed them. They did this by telling the Blacks they were stupid until they got it into their minds and then they oppressed them; they had power over them. **W15**

It's important to finish our syllabus. We need to finish our work. But if we don't talk about certain things we are not going to understand. If we understand what we are learning we will be better equipped for the exams. I'll tell you the truth – when you first brought in those kinds of discussions in the bio class I used to get annoyed with you. I wanted to just get on with the work. Maybe it's the way I was brought up. School is where you must do work; you don't worry about people's feelings and about people crying at school. I wanted to do work – I was worried about getting the work done by the final exams you know. I didn't want to be stuck with the work at the end of the year – as it happens with some teachers. The lessons were interesting but I found myself pushing it back because I wanted to get done with my work. I wanted to give in to the lesson and I wanted to push it back because I wanted to get my work done. Then I got used to the lessons and understood better. I am not a robot. **W16**

5.12 CONCLUSION

How this Grade 11 experienced biology education is revealed through the stories of the ten students. Students came into the class expecting a traditional biology education that they were familiar with, a biology education that taught the facts of biology from an objective, rationalist, technicist and neutral position. This factual biology was reinforced by how the textbooks too presented the biology that students had to learn. This traditional biology had no place for feelings and everyday, real-life issues.

In this biology class, the students came into contact with the facts of biology but the facts themselves were challenged. The challenge occurred through for example, examining biology education's role in perpetuating the notion of races as superior and inferior by remaining silent on this issue and in this way escaping the acknowledgement of biology's complicity in racism and also through women, because of their inherent inability as decision makers, being confined to the role of nurturers as decided for them by men. The dialogue in the biology class then moved from just the facts of biology and brought into the lesson student understandings about what it was that should make up biology education. These dialogues around whether biology education should remain within the facts of biology or whether everyday issues linked to student social realities highlighted the conflicts that the students had to deal with. The academic facts of biology were a requirement for successful schooling. Open, conversational biology that focused on facts and also on students' everyday realities provided students with some understanding of how they themselves were shaped as persons within the class, the school and the wider society. It was this biology education that was distressful and caused conflict for the students The conflict for students lay in not wanting to deal with: personal oppressive realities that when highlighted was painful to the student; the reality of the student in a position as an oppressor; or with wanting to focus exclusively on being a successful student.

Despite the conflicts about whether a factual, academic biology or an open conversational biology that challenged social realities could contribute to the students development , for the students tests and examinations were recognised as that which had the greatest value because it was only through tests and examinations that success in biology, and other subjects as well, could be achieved. It was this success that would then determine a students place in society once schooling was complete and whether the student went on to achieve 'better' or not in society. This contradicts then what the curriculum policy identifies as what should be valued by students. The curriculum policy envisages the student as one who values and acts in the interests of a society based on respect for democracy,

human dignity and social justice, amongst others, as promoted through the Constitution of the country Curriculum realities and student realities about what it is that must be valued continue then to be distantly removed from each other.

In the next chapter the events as they unfolded in the biology classroom when lessons were taught on cell division, human reproduction, genetics and biological determination are presented as lesson stories. In these stories the various instances of provocation and the student responses to the provocations are highlighted.

CHAPTER 6

DISRUPTIONS IN THE BIOLOGY CLASS:
lesson stories.

6.1 INTRODUCTION

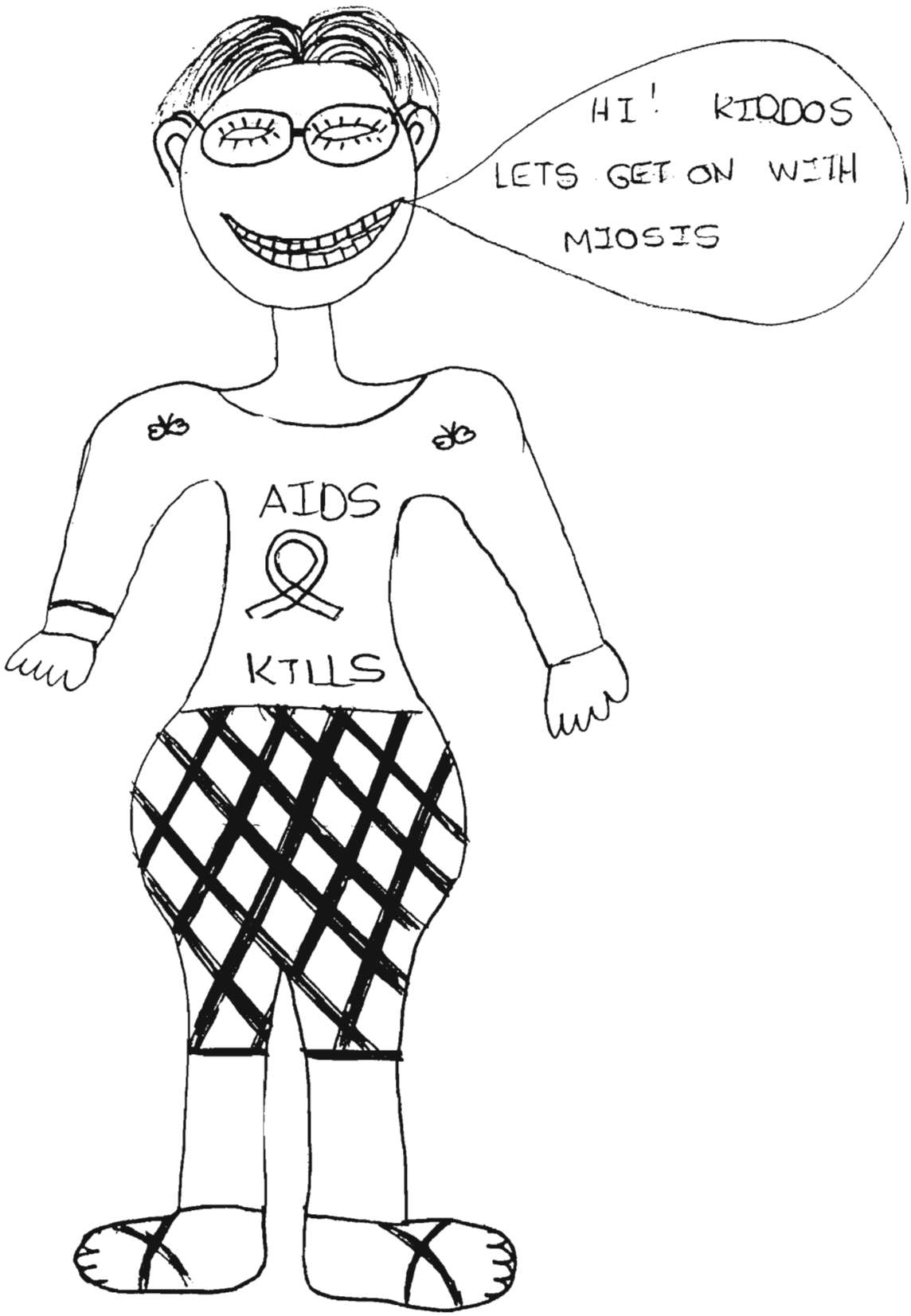
Through storytelling student experiences in the biology classroom, the school and the wider society were factionalised. How the students experienced biology education itself is told in their stories. The biology education provoked, disrupted and challenged the students; it also confused and caused them distress. The students had to deal with what should be in biology education and whether this should be confined to only the facts of biology or whether it should also take into account the realities of their everyday lives. The challenge of what is with what ought to be was what students had to grapple with. It is these stories that were presented in the last chapter.

In this chapter the four units of biology education that disrupted notions of what biology education is are presented as factionalised stories. The focus in the stories is on the challenges presented through biology education and how students responded to these challenges from my perspective as a teacher-researcher. The four units taught were cell division, human reproduction, genetics and biological determinism. The content for each unit is prescribed in the syllabus document (see Appendix 3). The minimal content to meet prescribed syllabus requirements is contained in the syllabus guide text 'Understanding Biology' by T Isaac (see Appendix 4).

Cell division was taught in two parts namely mitosis and meiosis. Mitosis, the division of somatic cells, required that each phase of the process of cell division from interphase through to telophase be taught. The importance of mitosis to living organisms needed to be known also. In meiosis, the division of sex cells, it was the first division of meiosis that was emphasised with a special emphasis on crossing over in Prophase 1. The significance of meiosis for reproduction was part of the information that students also needed to know. They also had to be able to distinguish between mitosis and meiosis as a process.

With human reproduction the anatomy of both male and female reproductive systems needed to be known. This was to be followed by gametogenesis – how sperms were produced through spermatogenesis and eggs through oogenesis. Ovulation and menstruation then followed. The

Nome : **Sameera Ahmed Khan**



students were then introduced to the process of fertilisation with a brief exposure to embryonic development, gestation and post-natal care. Sexually transmitted diseases were an optional part of the programme – what was called an extended activity.

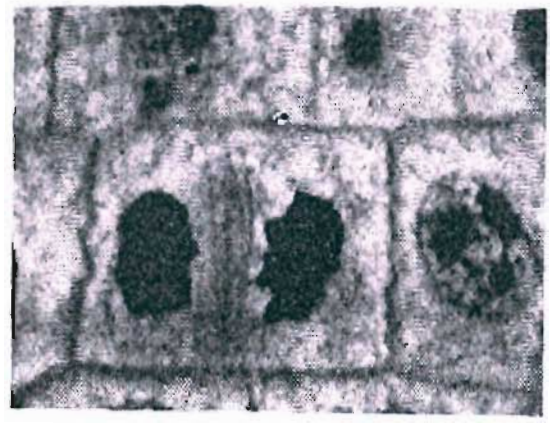
For genetics students had to become familiar with the terminology of genetics before any genetics was taught. Once this was done gametes were focused on as vehicles through which characteristics were transferred. Thereafter attention was focused on the mechanics of monohybrid and dihybrid crosses. Sex termination and gene mutations were also to be introduced to the students. Practical applications of genetics focused on how genetics served human interests with reference to increased productivity and the inheritance and prediction of blood groups. Anything outside of these applications could be mentioned but were not examinable.

With biological determinism students were introduced to biology's historical role with reference to race categorisations. Biology's complicity with dominant political positionings in the 1700's and 1800's to give credibility to slavery amongst other understandings was shared with students. How women were also categorised through biology was also brought to the students' attention.

The first three units of biology to be taught to students as prescribed by the syllabus document were focused only on the facts of biology. There was no space in this content laden programme for any deviations outside of the prescribed factual academic knowledge. It was this traditional biology that students were used to and expecting. What they got instead, besides the facts of biology, is told through the lesson stories.

6.2 CELL DIVISION: MITOSIS

Aah! Yes the cell. All organisms are made of cells – unicellular to multicellular; plant and animal. Organisms are different. The various structures within each organism are also different. So, this means there must be different types of cells. Yes there are – a myriad of types of cells! How then do we tell the different types of cells from one another? Through the cell structures, of course. They're different. Yet they have certain common features also. Like the cell membrane, the cytoplasm and the nucleus. This is true for eukaryotic cells – the cells that have a distinct nucleus. All plants and animals have eukaryotic cells – so how does one tell a plant cell from an animal cell? Only the plant cell has a cell wall. There are other differences as well … **CD1**



Mitosis in plant cells

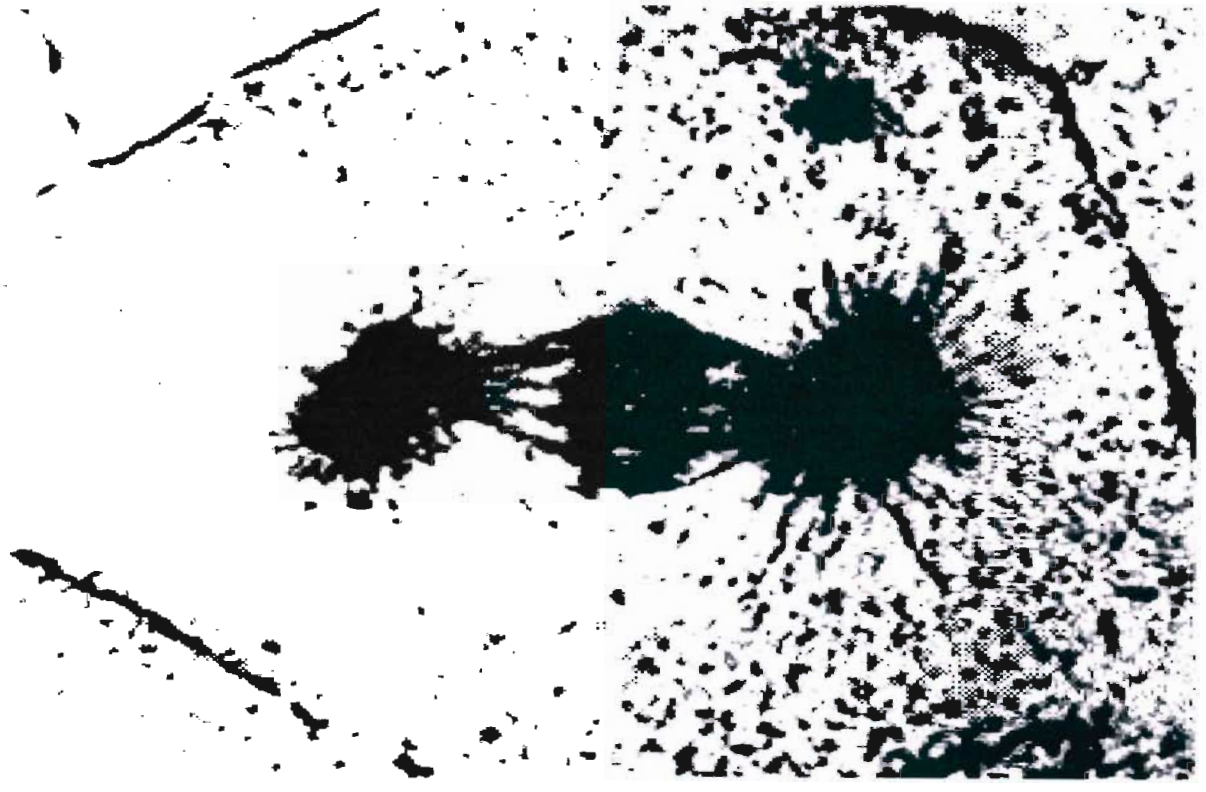
Now that nucleus. The controller of all events in the cell. Surrounded by a nuclear membrane, filled within with a ground substance of nucleoplasm, a nucleolus and most important of all: that omnipotent chromatin material, that genetic material, that DNA, that tangled web, that decider of ALL things. And if a new cell has to be made then that decider of ALL things must be made in the same number and of the same kind - as in the original cell. You can't have a cell without its 'blue chip'! **CD2**

Why must new cells be made? For continued growth; to replace damaged cells; to replace worn out cells; to replace dead cells and for asexual reproduction (in less complex organisms). How then are new cells made? By cell division of somatic or ordinary cells; by mitosis. Then again, there is also that type of cell division in the sex organs, meiosis that produces only sex cells: eggs and sperms and pollen grains. When we talk of cell division what exactly is it that we're speaking of? We're talking about the events in the cell nucleus – specifically about what happens to that tangled web of chromatin. **CD3**

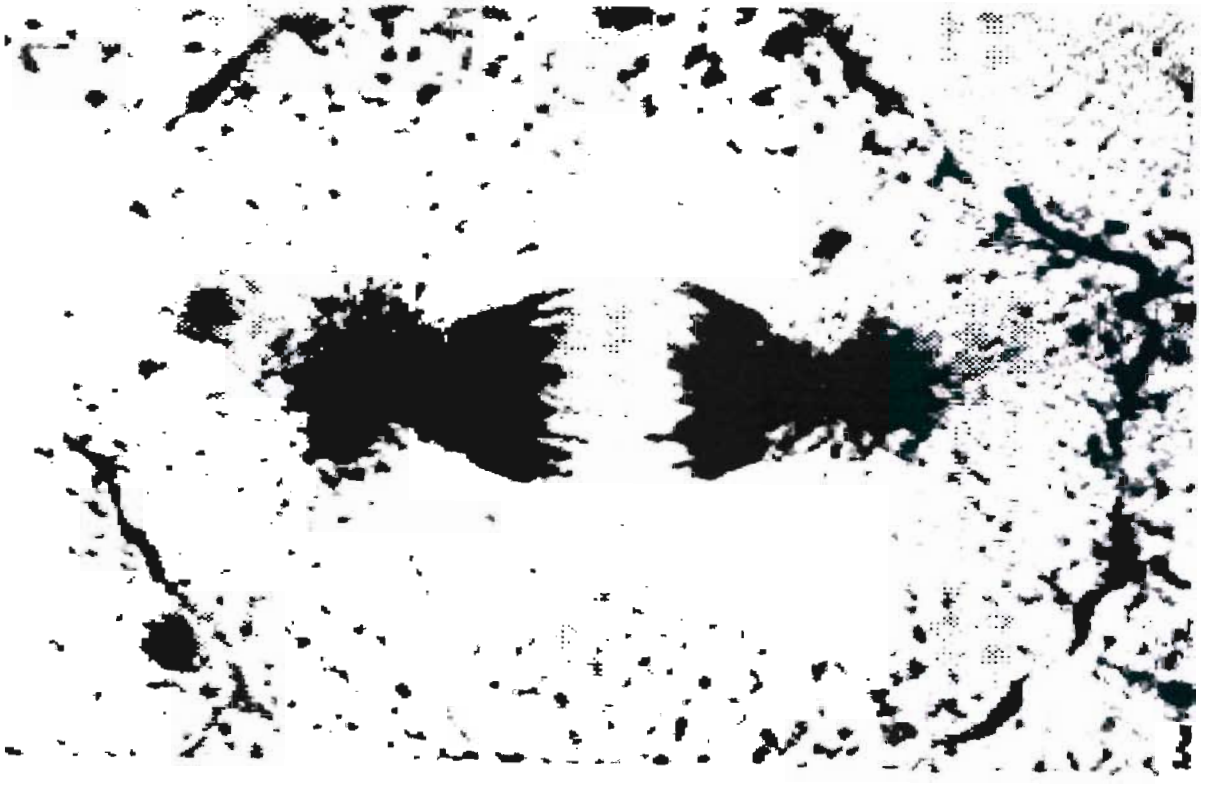
Mitosis – the division of a somatic mother cell to give rise to two identical daughter cells. Identical in what way/s? Identical genetic material – in mother and daughter cells. How does this happen? First the nuclear contents divide followed by division of the cell cytoplasm. A continuous process this cell division but for convenience (?) and for '*easier*' understanding (?) lets divide this continuous process in five phases: interphase, prophase, metaphase, anaphase and telophase. **CD4**

The preparatory interphase is when DNA replication takes place so that the genetic material is doubled in the mother cell. The new genetic material is identical to the original DNA. Cell structures also duplicate themselves. Then the task, in earnest, begins. Prophase heralds the unwinding of that tangled web of chromatin into distinct chromosomes! Look closer. Each chromosome is made up of two identical chromatids held together by a centromere. Chromatids – where did these come from? From the DNA replication during interphase. Hey! Look! The nucleolus and the nuclear membrane are disappearing; a spindle is developing between the two poles and through the equator of the cell. **CD5**

And now to metaphase. No nucleolus. No nuclear membrane. They've disappeared completely! The chromosomes are lined singly at the equator of the cell. Each appears to be attached by its centromere to a spindle thread. Hang on. Is that one or two centromeres? Can't say for certain … another of those unresolved issues in science! **CD6**



Early anaphase.



Late anaphase.

Wow! The spindle threads are starting to get shorter and thicker. They're contracting! The centromere/s split. The chromatids making up each chromosome are separated. Look! Each set of chromatids … uh hmm … I mean, daughter chromosomes is moving to a pole. Daughter chromosome? Yup! Cause each chromatid is really a single-stranded chromosome produced by DNA replication during interphase. **CD7**

The daughter chromosomes have arrived. Where? At each of the poles of the cell, silly! See, they've gathered as a group – one group at each pole. Count the number in each group. Magic! It's the same as the original number in the original mother cell! Look again. The nuclear membrane has re-formed. The nucleolus too is reappearing. Abracadabra! … two nuclei with the same number and kind of chromosomes as the original. What's that happening now? The chromosomes are becoming entangled … uh huh … that tangled web once more. **CD8**

Now what? Oops … forgot to mention to you cytokinesis. Cyto … what? Cytokinesis – the division of the cytoplasm. Look closely at the animal cell. Can you see the cell membrane beginning to constrict on either side of the cell? There … almost at the centre of the cell. That constriction is getting deeper. I know what's going to happen … the constrictions will meet and join and Voi-là! two new daughter cells. Just like I predicted – two daughter cells from the original mother cell. And the plant cell? What's happening there … I see. No constriction but a cell plate being laid down between the two nuclei … again almost at the centre of the cell. Hang on. That cell plate is becoming a cell wall. Now we've also got two daughter plant cells – identical to the mother cell. **CD9**

So that's how a somatic mother cell divides to form two identical daughter cells. It is the mother that produces and when she produces daughters the daughters will in turn grow to be mothers to produce more daughters and so on … Does this mean that it is the female who is the producer and the nurturer. What is this language saying? Males. Why, they are the discoverers and inventors. In science they are the Fathers of … Mothers of … in science – they do not exist! **CD10**

Why is the class laughing that hesitant laugh? Ah! Arthur and Naseema are arguing the role of men and women. The class is not sure, that's why the hesitant laugh. Arthur believes that women are the producers and nurturers. Naseema vehemently disagrees. For Naseema this is the twenty first century and men like Arthur do not know what they are talking about. They see women as inferior.

Nolwande joins in the fray. She shares from her experience: it is the male child, the son that is the favoured. Not if he is Black adds Arthur. Now Tivashni too shares her idea that men are always given a position of superiority – just like the language too is perhaps doing in science. The teacher is of no help. All she can say is "I don't know; these are issues you have to begin to think about". **CD11**

Arthur shares that perhaps when cell division, mitosis, was first described the human experience of a mother giving birth guided the explanation. This is perhaps why the idea of mother and daughter cells found favour. The language used allowed for an 'easier' understanding of the process. For many in the class this still does not take away from the idea of males as superior and females as inferior – from Naseema and Nolwande's verbalisations and general agreement with their understanding. Arthur disagrees – it is precisely the female's ability to produce and nurture that makes females superior to males. Ronald is in a spot. Many in the class do not want superior or inferior status given to either sex. **CD12**

Waseela is fed-up! She just wants to get on with the lesson and the biology. The biology class is not the class for discussions of this type! There are several who agree with Waseela – they nod in agreement as she makes her feelings known. Naseema and Nolwande do not agree – they want to continue with the discussion about the roles of men and women. **CD13**

The teacher steps in and decides from her all powerful position as the teacher. She suggests to the class to go back to all their science texts that they have used over the years and identify the roles given to men and women in the texts and the language used in the science texts. She asks 'is there a message that continues to train us about the role of men and women in society as we read through the language of science, the role-models in science?' She goes on to say she does not know!!! And that each person in the class has to make up her/his own mind on these issues. **CD14**

And now for meiosis … where a mother cell divides to form four daughter cells or gametes each with only half the number of chromosomes as compared to the mother cell. This is necessary so that when two sex cells or gametes, for example an egg and a sperm cell, come together to form a new individual during sexual reproduction the new individual will have exactly the same number of chromosomes as each organism in the species … **CD15**

6.3 HUMAN REPRODUCTION

Thus far we've looked at the structure of male and female reproductive systems and gametogenesis. A quick review of the various parts: the male system is made up of a pair of testes, the male gonads, located in the scrotum – the testes containing seminiferous tubules lined by germinal epithelium that produce sperm/spermatozoa by spermatogenesis; the various tubes responsible for carrying the sperm and related fluids and nutrients to the outside of the body viz. the epididymis, the vas deferens, the ejaculatory duct and the urethra; the secretory glands which produce the fluids and nutrients viz. the seminal vesicles, the prostate gland and the pair of Cowper's glands; and the external reproductive organ – the penis through which the urethra runs opening at its tip. **HR1**

A noisy class this. Some are sharing in the review by providing the information and following through with the diagrams in the text; some are engaged in their own discussions not in the least related to the review; and some though silent and looking at me are a million miles away – their glazed expressions tell a story of its own. **HR2**

The female reproductive system made up of a pair of ovaries in the lower abdomen, the female gonads, lined by germinal epithelium which produces the follicles within which oogenesis takes place to produce the ova or eggs; a fallopian duct or oviduct which carries the egg or ovum from the ovary to the uterus; the pear-shaped, hollow organ with muscular walls - the uterus or womb - which becomes lined with a highly vascular, that is: rich with blood vessels, endometrium on a regular basis; the neck of this pear-shaped uterus being the cervix which leads to the vagina or birth canal; and then to the outside by the vulva. Remember that when fertilization occurs the foetus is attached to and develops within the uterus. **HR3**

For those sharing in the review it's a case of learning the language – what the new words are, how to pronounce them and the fear of forgetting this additional language that must be learnt! **HR4**

With gametogenesis the germinal epithelium divides by mitosis to produce a diploid/2n spermatogonium in the testis – in the sexually adult male; and a diploid/2n oogonium in the ovary – of the developing female embryo. Each of these then grows to form a primary diploid spermatocyte in the testis and a primary diploid oocyte in the ovary. Each of these then goes through meiotic divisions. The primary diploid spermatocyte after the first meiotic division forms two secondary

spermatocytes and after the second meiotic division forms four haploid spermatids which will grow and form the haploid sperm cells. **HR5**

In the sexually adult female a single diploid oogonium grows and becomes a primary diploid oocyte that then divides by meiosis. The first meiotic division produces a small first polar body and a much larger secondary oocyte. The secondary oocyte goes through the second meiotic division to produce a small second polar body and a much larger haploid ovum. **HR6**

Why the need for the meiotic divisions? Meiosis allows for a reduction in the number of chromosomes in the sex cells – to half that or the haploid number as compared to an ordinary cell with the complete or diploid number of chromosomes. This is what allows for the new individual that is formed to then have exactly the same number of chromosomes as each of the organisms within the species. For human beings a diploid cell has 46 chromosomes and a haploid sex cell viz. an egg/ovum or a sperm has only 23 chromosomes each. This means when a sperm fuses with an egg the new individual or zygote will have in it 46 chromosomes – the same number as in each and every human being. **HR7**

Now let us look at ovulation and menstruation. What does the term ovulate mean. *Does that mean just before a girl gets her periods? Does that mean the period itself?* It's obvious that those participating in the lesson do not know. My voice expresses my frustration as I try to lead towards the meaning – something to do with the egg … I finally give up and share the meaning: it refers to the release of the egg! **HR8**

When a female reaches puberty two things happen: she begins to develop secondary sexual characteristics and she begins to ovulate and menstruate. She now releases an egg and also has her periods if the egg is not fertilized. The very first egg that the female releases could be fertilised by a sperm – so this means the female can become pregnant. The body's message from the very first period is: I am now capable of reproducing; I am sexually mature! **HR9**

I am going to try and explain what happens using a twenty eight-calendar day cycle. This is the average for females that are ovulating and menstruating. Remember that average means there are females who fall outside the twenty eight day range. Also, when a female first begins to menstruate her cycle could be irregular – she may menstruate every several months. So there is no way of knowing when she could be ovulating and she is still capable of falling pregnant! **HR10**

Let's start with Day 0 of the twenty-eight day cycle being the onset of the period. The female begins to menstruate. What causes this? If an egg has been released and has not been fertilised there is no need for the endometrium lining the wall of the uterus. This endometrium now begins to break away and this breaking away is aided by contractions of the muscular walls of the uterus. And that's when I hear some of you sharing that you are having such terrible period pains! On average it takes approximately seven days for the lining to be removed from the uterus. Immediately after that a new one begins to be laid down – in preparation for the next possible fertilized egg. **HR11**

I notice that the class is silent. I have everybody's attention! Even the glazed looks from those that were miles away have gone. They are all paying attention to what I am sharing with them. Does this mean that they did not know of the mechanics of ovulation and menstruation? **HR12**

± 14 days after the onset of the period another egg is released and enters the Fallopian tube. If there are sperms in the vicinity the first to reach the egg will fertilize it. If the egg is not fertilized it will degenerate after a few days. Depending on when the egg is released it would be safe to say that fertilisation could occur in any time between day10 and day 18 after the onset of the period. Where does the egg come from? It comes from the follicle in which it was formed. A large follicle with a mature ovum is called a Graafian Follicle. It is the follicle that releases the hormone oestrogen that will prepare the endometrium lining for the implantation of a fertilised egg or zygote. So the unsafe period for unprotected sex is on average between days 10 and days 18 – it is during this time that there is a great likelihood that a female could fall pregnant. I wonder is it this that learners do not know and why we have a high rate of teenage pregnancies? Is this also why the male often claims that he cannot be the father of the child? **HR13**

This galvanises the class. I am told that there are learners in Grade 11 about to become parents – something that teachers and management do not know of as yet. The female learner has not been to school for some time while the male is at school every day. An uproar ensues. Why is it that males get away with this and it is the female who is left to suffer the consequences? It takes two to tango and both should be responsible. But not all teenage boys think this way. Well, if a teenage boy is that immature then he should not partake in sex. The debate rages on. **HR14**

Waseela now shares her thoughts. (Gone is the Waseela who wanted only biology). It is always the girl who is undermined; the one who is seen as doing all that is wrong in society; and who is always

called bad names. Noelene enters the fray – just because she's walking around with a big stomach. Waseela continues: the girl cannot come back to school while the boy carries on as normal. If the girl has to come to school she will be picked on. **HR15**

I then ask if it is possible that only the female is responsible for a pregnancy given what I had just shared with the class from a biological position. The class in unison chorused ever so loudly: *No ways!* **HR16**

Nolwande then shared her experience. Her teenage sister fell pregnant. The pregnancy and the child were both accepted. The child was born and the father comes to her home and assists in raising the child. His family also provides financial support for the child. This is how it is done in her culture in the township. She also shares that her father has warned of dire consequences if she had to fall pregnant. Tivashni expressed that if she fell pregnant she would have to get married and have the child together with being disgraced in her community. For Tivashni her community is not accepting like Nolwande's. **HR17**

Trust Kaiser to add to the debate! His neighbour fell pregnant. She herself was uncertain as to who the father was – she had shared this with Kaiser. To make sure the baby was supported financially she identified one person as the father. This male, also a friend of Kaiser, accepted the baby as his responsibility. Kaiser was in a dilemma – did he tell his friend the truth or not. This added to the burning issues in the class and two-timing girls were now part of the discussion. Nolwande confirmed that this was part of her experience as well and that witchdoctors were often asked to confirm the paternity of the child. I noticed that nobody spoke of two-timing males! **HR18**

And suddenly there was Naseema's booming voice. In no uncertain terms she stated that an unmarried pregnant female was a disgrace to both her family and community. There was no place for this in Naseema's world. For Naseema, in a pious Muslim family where the male head of the household was also a community leader this was totally unacceptable. This would also be true if the female had been raped. Under those circumstances Naseema, who stated clearly her abhorrence to abortion, suggested that perhaps abortion would be an answer to take away from the disgrace to the family and any other unmarried female daughters in the house. This would also prevent the community from being disgraced. **HR19**

The class shouted her down. For the first time Wonderboy spoke in my class. He had never ever spoken previously. Even if I asked him a question he was never prepared to speak. The Black learners laughed on hearing Wonderboy's voice – in a way that seemed strangely, to me, encouraging. The class became quiet – it was as if new ground was being broken. Wonderboy shared with us a saying in Zulu that he then translated for our benefit: A child is a gift from God. He went on to share that since this was the case humans have no right to destroy that which is a gift from God. **HR20**

I looked at my watch. Ten minutes to go before the hour's lesson ended. I took over again. I shared that learners needed to think through issues raised by themselves during the lesson. I stated: let's go back to the Graafian Follicle. At intervals of approximately every four weeks a follicle ruptures to release a mature ovum or egg. This is called ovulation. The ovum enters the Fallopian tube and moves through to the uterus. The ruptured follicle is now called a corpus luteum which, if a pregnancy occurs, will secrete the hormone progesterone to maintain the pregnancy. If fertilisation has not taken place then the corpus luteum degenerates and no progesterone is produced. This results in the endometrium lining breaking away from the uterine wall once again and being sloughed off. A period has started again and with it a new twenty-eight day cycle. **HR21**

The buzzer sounds. The class gathers their things together and leave. They're arguing with each other again. The lesson has disturbed them and their sense of disquiet reaches out to me. **HR22**

6.4 STD'S AND HIV

Sexually transmitted diseases. Gonorrhoea, syphilis and HIV. This is an optional part of your biology programme. I believe, however, that it is too important to ignore. So I am making this a definite part of our programme. These are highly infectious diseases which lead to painful deaths and are very common in South Africa. **STD1**

They are sexually transmitted. Through unprotected sex. Unprotected? Not using condoms and having sex with an infected person. Go on. You young ones know about unprotected sex – what with all the adverts in the media these days because of HIV and AIDS. What's that? The adverts are boring! I wonder why? What have been your experiences of the diseases I've mentioned? You've not heard of gonorrhoea and syphilis? Let's look at pages 348 and 349 in the text and see what the

text says about these diseases. Mm, interesting - no mention of South Africa and the sexually transmitted diseases are due to the behaviour of prostitutes! Who are you going to believe – the text or me? And are prostitutes solely responsible for the continued spread of the infections? Should we continue to call them prostitutes or sex-workers? You're upset with what the text is saying. You have to work out honestly why you respond that way to the written word, the truth of the textbook. **STD2**

HIV – have you had any personal experiences of HIV? Oh, you know of people who have HIV. They are not people you know personally. Not part of your family. Oh, people where you live do not have HIV. Gladys, why are you crying? You do not want to talk about it. Not a problem, it's okay. Can we get you anything – water, a tissue. You're okay? It's all right Gladys you do not have to talk – you have a right not to talk if you do not want to and you have a right to cry. All humans cry – some are just better at hiding their feelings. **STD3**

Yesterday we were talking about HIV and AIDS. How is HIV transmitted – by unprotected sex, blood transfusions, drug-users sharing needles. There must be direct blood-to-blood contact outside of unprotected sex for the virus to be transmitted. HIV is the human immunovirus that causes AIDS. AIDS is acquired immune deficiency syndrome. If it's acquired then it's not natural it's artificial. **STD4**

Can you remember what immunity in the body is about? Yes that's right – the body's ability to produce antibodies to fight diseases caused by viruses. Nolwande talks about infant vaccines – polio, smallpox and measles. The class agrees – yes that is how the vaccine works – you get a dose of the virus in the weakened or the dead form and the body then builds up a resistance to the virus. You are then protected from that disease. Nolwande's mother is a nurse. That's where Nolwande learnt this. **STD5**

So then what is it with HIV? Why does the body not develop a resistance to HIV? No suggestions. HIV survives by destroying the body's resistance mechanisms. In doing so it also destroys any resistance the body has developed for the very many diseases the body has already encountered. Which means the body can now be infected by any disease and also by several diseases at the same time. Silence! This class is all ears. **STD6**

Are you saying that the body becomes defenceless? That's what I'm saying. And that you will catch any disease that comes along. That's what I am saying. You will have no immunity. Your body can no longer protect itself – it no longer has the means to do that. HIV takes care of that! **STD7**

It's also difficult to diagnose HIV in the first six months of the infection. This is a clever virus – it enters your T-cells, White blood cells and masks it presence while establishing itself. So you won't know it but you's got it. And after this window period when you do get to know it is already too late. The virus is already firmly established in your system. **STD8**

But can't you get treatment against it immediately after you've contacted the virus. I've heard you can go the hospital and get some medications that can act against the virus, shares Ronald. True, that can be done. But how many of us will know that truth. Which one of us present here is willing to declare I am HIV positive so that those around us can take care in case of accidental blood-to blood contact. Which of us is willing to tell this to our sex partner? You're shaking your heads. You disagree with me! What I am sharing with you is what we know is the truth, a reality of ours. **STD9**

It's the boys who do not speak the truth and who sleep around and pass HIV. That's not fair Nozihpho to the males. There are women who are also silent about their HIV status and transmit the disease. It works both ways. **STD10**

Gladys wants to say something to us. She's hesitant yet determined. What is it Pretty asks. I cried two days ago because my friend had just died from the illness. She died the day before. It was painful. She just got so sick and weak. She was a skeleton. She got it from her boyfriend. He did not tell her he had AIDS. He promised her so many things even though he knew he had AIDS. But she did not die from AIDS. She was sick in the chest. She had TB. That's what she died from. **STD11**

Yes, many people with AIDS die from opportunistic infections. The body is unable to defend itself. The opportunist bacteria and viruses take advantage and infect the body. The body gets weakened even more. It picks up even more infections. It then gives in and gives up on life. Does HIV know the difference between race, class, gender, urban, rural etc.? No ways, a sing-song response from the class. **STD12**

In KZN the age group with the highest rate of infection is the 15-25year age-group. That's your age range. Oh, and KZN has the largest number of HIV positive people in South Africa. What's that Mbeki? Oh, they are Black people. Why do you say that? Does the class accept what Mbeki is saying? You do – most of you. It's Black people in KZN who have HIVand AIDS. Any ideas why we see it like that? Is it because the largest population group in KZN according to race in KZN is the Black? Waseela's upset. She shares that she knows of Indians with AIDS – not personally but she knows there are Indians with AIDS. There are some nods. But then the newspapers only speak of Black people insists Mbeki. **STD13**

The buzzer goes. **STD14**

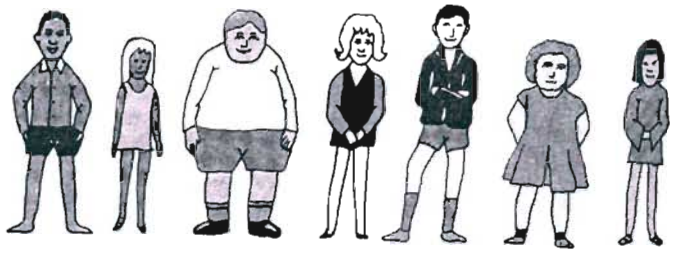
6.5 GENETICS

Genetics involves a study of the transfer of hereditary characteristics from parent to offspring. It also includes variations that may occur in the transfer of hereditary characteristics. Heredity refers to the transmission of characteristics from parent to offspring. **G1**

We will be looking at monohybrid and dihybrid crosses only in our course. Our understandings in genetics come from the work of an Austrian monk called Gregor Mendel who carried out his experiments on garden peas between 1857 and 1864. Mendel was persecuted in various ways by the church for his work. His work was also largely ignored and only received recognition around 1914. The Church was antagonistic to Mendel's findings since the findings challenged the supremacy of the Church's explanations about life. **G2**

Monohybrid crosses involve breeding where only one pair of contrasting characteristics is considered. The gene is the unit that is responsible for a characteristic. Contrasting characteristics are coded for by the same gene and could be for example the gene for height i.e. tallness and shortness; the gene for colour i.e. red and White (flowers) etc. **G3**

When Mendel crossed a pure breeding tall pea plant with a pure breeding short pea plant all the offspring in the first filial/F1 generation were tall. When Mendel crossed F1 offspring he found that in the F2 generation he got 3 tall and 1 short pea plant. His work with round and wrinkled seeds, yellow and green seeds and green and yellow pods produced similar results. Based on these results Mendel made the following conclusions: first, when 2 individuals with pure-breeding contrasting



Human variation

Gregor Mendel (1822–84), working with pea plants, laid the foundation for modern genetics although his great work was not recognized by the scientific world until 1900.

Ear variations

(a) Ear with lobe.

(b) Ear without lobe.

characteristics are crossed the individuals in the F1 generation all display the dominant characteristic. He called this the Law of Dominance. Second, for each characteristic a plant possesses two genes which separate so that each gamete (sex cell) contains only one of the genes – Mendel's first Law or Law of Segregation. **G4**

TT	x	tt			where T is for Tall and t is for short; Genotype
T	T	x	t	t	Meiosis
Tt	Tt		Tt	Tt	F1 generation
All 4 plants are tall					Phenotype

Tt	x	Tt			Genotype
T	t	x	T	t	Meiosis **G5**
TT	Tt		TT	tt	F2 generation
3 tall : 1 short plant					Phenotype

TT/tt – homozygous pure-breeding

Tt - heterozygous hybrid

Dihybrid crosses involves breeding where two pairs of contrasting characteristics are considered. Mendel also crossed pure breeding plants with round and yellow seeds with plants with wrinkled and green seeds. All F1 offspring produced round and yellow seeds. When F1 offspring were crossed Mendel obtained in the F2 generation plants which produced the following seed types:

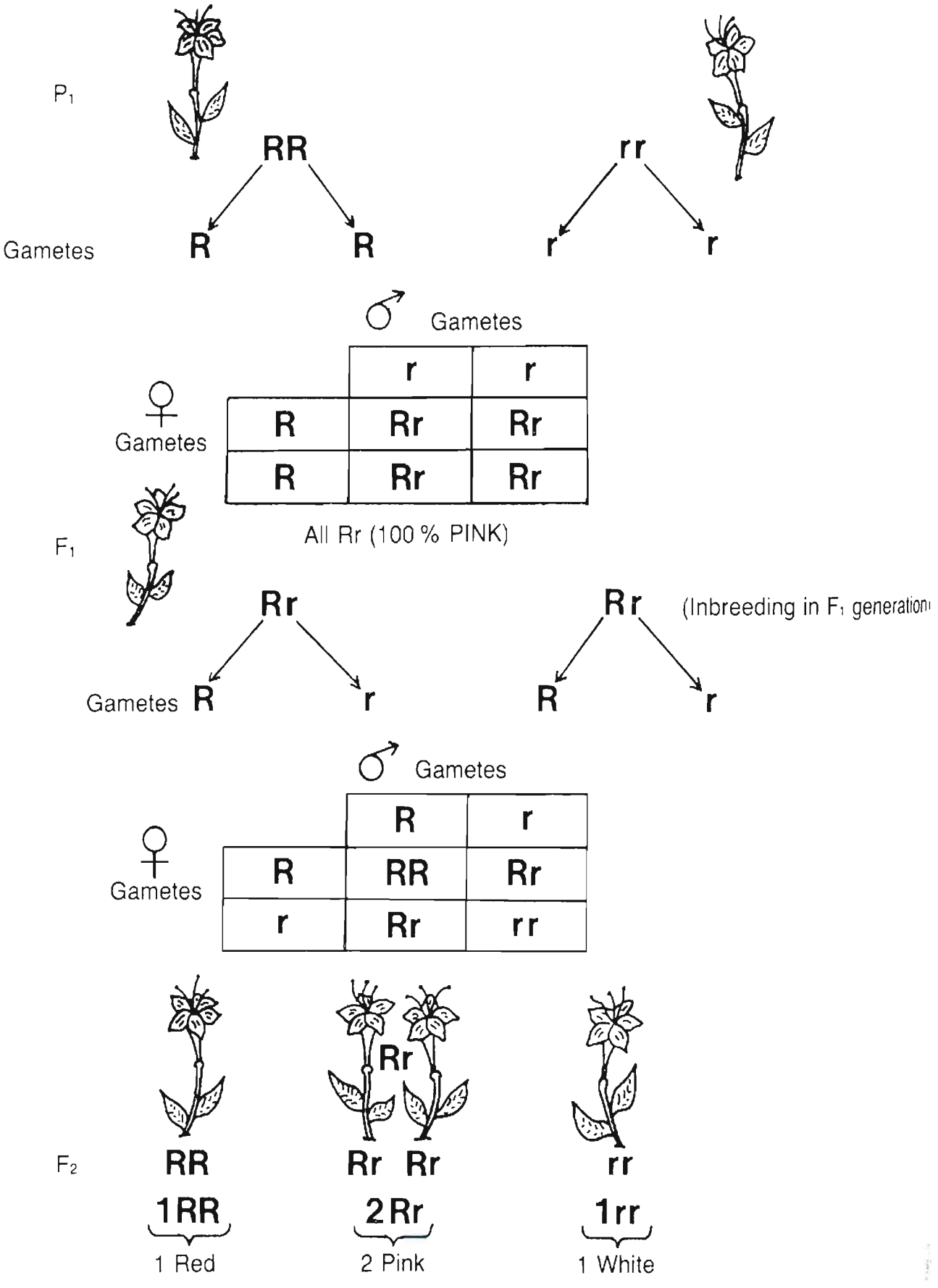
9 round, yellow seeds

3 wrinkled, yellow seeds

3 round green seeds and

1 wrinkled, green seed **G6**

From this Mendel developed the Law of Independent Assortment which states that the genes controlling the different characteristics are separate entities not influencing each other in any way, and sorting themselves out independently during the formation of gametes or sex cells. **G7**



Incomplete dominance of flower colour

Round, yellow x wrinkled, green phenotype

RRYY x rryy genotype

MEIOSIS

RY RY X ry ry gametes

ALL RrYy F1 genotype

ALL round, yellow F1 phenotype

RrYy x RrYy

RY Ry rY ry x RY Ry rY ry gametes

9RRYY : 3Rryy : 3rrYy : 1rryy F2 genotype

9 round,yellow:3 round, green: 3 wrinkled, yellow: 1 wrinkled, green F2 phenotype

G8

The Law of Dominance does not always apply – sometimes an intermediate characteristic emerges. This when neither characteristic is dominant and each exerts an equal influence. This is understood as incomplete dominance and is seen e.g. when a plant with red flowers is crossed with a plant with White flowers and the offspring produce pink flowers. **G9**

In the same way characteristics are transmitted from parents to offspring for all organisms – both plant and animal. The characteristics transferred are many for each organism. This is also what happens in humans, who are part of the animal kingdom, Kaiser. **G10**

Did you read the article by Mark Henderson in the Mercury on October 5, 2000 (see Appendix 2) titled *Baby bred to give his sister life. London – The first test-tube baby to be genetically selected so that his cells can be harvested to save his critically ill sister has been born to an American couple. Adam Nash was conceived after tests to ensure that his cells were suitable for a lifesaving transplant for his six-year old sister, Molly, and his birth five weeks ago has provoked unprecedented debate among British doctors about the ethics of "designer" babies. ...The procedure has divided experts on medical ethics, some of whom believe it could pave the way for the creation of "designer" babies chosen for a range of genetic traits ... this is a very difficult issue ... it is a start towards being able to choose the right Coloured eyes and the right intelligence...*

G11

We're now in the technological age where we will soon be able to design babies according to what we want! Isn't this an exciting possibility for the future. Jamal you're not happy with this possibility? Share with us your concerns. You say that given a choice people will choose to have light-skinned babies. What makes you say this? Because for you this is what people like and prefer. You know this because of how people chose to talk – given a chance they all try to talk like White people. They like to imitate Whites because they think it's better. Even your father does this when he carries out his business. He's told you that if he speaks like a White people want to do business with him. The way so many of you are nodding your heads it seems that you agree with Jameel. ***G12***

Anneline you say that it does not matter what colour you are - you must be accepted. Your aunt used to call you Blackie and only her children were acceptable to her because they were light-skinned. This hurt your feelings you say. You agree with Jamal that "designer" babies should not be allowed because then there would be light-skinned people born to only people who could afford it. What about those who cannot afford to have light-skinned babies. Does this mean that dark people then will become the servants of the light-skinned people? ***G13***

I notice that Ronald is unusually quiet (trouble brewing?) – not indicating at all whether he agrees or disagrees with this discussion. Unusual for one who never lets a chance go by – a chance to bring in the issue of colour. What comes through is that for most students the idea of "designer" babies is not what they would choose. There are some who say nothing – does this mean they agree with the idea of "designer" babies but are intimidated by the response of those who have already voiced their thoughts. ***G14***

So much for our respite from Ronald who suddenly with gusto asks if all characteristics are transmitted by genes. Yes, I reply. Does this also mean that there is a gene responsible for homosexuality, asks Ronald? I hedge around this question because I am uncertain about where Ronald is going to with this question. Ronald launches into a tirade against homosexuality and shares with us how he despises homosexuals. He's taken both me and the class by surprise – that's for certain. The class reacts and lets him know in no uncertain terms that his views are not their views – they find his views unacceptable. Ronald comes back to me and demands to know if there is a gene for homosexuality. He is trying to force an answer from me and trap me. There is something going on that I do not understand. There is something happening in this class that I cannot grasp. The outspoken students like Mbeki and Anneline are all at the same time telling

Ronald what they think of his understandings. Naseema now joins in the shouting match. Surprise, surprise. She teams up with Ronald. That's one for the books – I would never have believed that these two would ever agree on any issue. **G15**

Now I am part of the fray and also yelling at Ronald! I am doing this because Ronald is screaming at the class in an attempt to dominate the class understandings. Total chaos! A small group in the class is very quiet, not saying anything – not even to each other. They are paying close attention to who is saying what – there is that intent, telling look on their faces. **G16**

I impose my understandings on the class. They will be quiet. They will only speak with my permission. If they cannot respect each other's viewpoints then nobody will be allowed to speak – the lesson will be a silent one. I instruct Ronald to be quiet; I tell him to shut up and that if he cannot do that then I will put a Band-Aid strip, which I will get from the first-aid box, across his mouth. The class falls silent. I too am silent – I need to recollect myself and try to understand what had just happened. I feel hot and bothered. **G17**

Naseema shares her understanding that homosexuality is not what God and nature intended. She also sees it as bringing shame to the family. Many in the class agree with her when she talks of God and how God intended it to be on Earth – an Earth where there is no place for homosexuality. They shake their heads in agreement and say yes as she talks. An uneasy peace is established in the class. Ronald now gets to say his piece – he will not accept homosexuality. That is not what God intended. He despises and will continue to despise homosexuals. He can do this because he is a spiritual person. **G18**

I am still confused. I have missed something in my interaction with the class. **G19**

6.6 ABORTION

Hi Class. Any concerns that you have that you want to share? Yes Naseema? You want to go back to our discussion on pregnancy outside of marriage and abortion. You want to state again that the family name is important and that such a pregnancy shames the family. So perhaps a solution is abortion. You don't agree with abortions happening but at times it is necessary. Okay class – there's no need to bite her head off. She is sharing that which she feels strongly about and we need to hear

her even if we disagree with her. Yes Kaiser – oh, from today your name is Mbeki Kaiser and that is what I must call you. Mbeki. Okay, but you will have to remind us if we forget. **AB1**

For today we'll be doing a role-play for our lesson. Role-play in biology? That's your question – who said it can't happen. Let's try it out and see where it gets us. Remember your participation is what will make the lesson happen – no participation, no role-play, no lesson! Rules for this role-play – I'll start it off to give direction. Then you add your thoughts/ideas/understandings as we go along and let's see what emerges. Any problems with that? **AB2**

I can see that some students are uncomfortable with what I've just shared. Some also look pretty fed-up with what I've just shared. Here goes!!! **AB3**

Hi folks. Lovely day today. Yeah I've just got back from the doctor. You remember I said I had an appointment with her. Well she's confirmed that I am pregnant. You think that's exciting Chreestheena. I don't. I'm scared. I'm really scared. **AB4**

I wonder what my partner's going to say. I'm sure he'll be over the moon. Should I tell him? Shouldn't I tell him? What's that? Mbeki, you say he must be told. Why should I? It's my baby and my decision. Yes, he is my partner but that does not mean that I have to tell him everything. That's being dishonest. Why do you say that? Not telling him is not being dishonest; it's just me recognising and protecting my space. That's necessary for me because I'm really scared. **AB5**

Why am I scared? Because I've never had the courage to tell him that I'm a carrier of a disease. I carry the gene for a disease that causes the brain to degenerate – it's called Huntington's disease. I've never told him this. I could pass this disease to my baby. That's what really scares me. When does the brain start to degenerate? When the person is quite old, usually. But there's no way of knowing that it may happen earlier. If that happens, how will I manage? How will I cope? What if I'm not there – who will look after my child. I don't know if I want to have this child. That's why I can't tell my partner as yet. **AB6**

What do I mean when I say I don't know if I want to have the child? I'm talking about … maybe abortion is the answer. My partner will never agree to an abortion. Now you see why I can't share my pregnancy with him. You say that he is an equal partner in the relationship and that it is his right to share in the decision. But he's never going to agree to an abortion. I know he won't. **AB7**

It's not right for me to make a decision by myself. Why do you say this Noeleen. Imagine having to live with this disease if my child has it. It's not easy. The decision is not easy. But abortion is the way out. And he will never be any wiser. **AB8**

That's not God's way. Yes I know Sandile said that a child is a gift from God, Pretty, but not a child with a disease. That's cruel. Cruel of God and cruel to the child. It's not fair to the child to let it be born knowing that it has this terrible disease. Fazilla you look disgusted. You say this is not acceptable. No human has the right to make the decision about another human and the baby is a growing and living human already. So many of you are nodding in agreement. Your religious beliefs don't allow you to abort a baby – that's murder for you Suhaifa. And so many of you agree with Suhaifa also. **AB9**

I'm sure God understands why I need to do this. If God is forgiving then God will forgive this act of mine too. Yes, Naseema, I agree with you. It's my body and my decision to make and I don't have to tell my partner. I don't understand why you all disagree with Naseema. Ronald, you're very passionate about your beliefs. We've heard you. Yes, most of the class shares your beliefs. But what about those in the class who are silent and not saying anything? You can't assume they also share your beliefs. And Naseema must also be allowed to have her understandings and beliefs too. It's got nothing to do with her being a modern woman. It's got nothing to do with women saying they are equal to men and that's why they can make their own decisions. **AB10**

Anneline that's interesting – we must respect all beliefs even if we disagree with them. This means that if I choose not to tell my partner and go ahead and have an abortion you should respect my decision even if you do not agree with my decision. It's my choice after all, is it not? No? It's not. How can you insist on that Ronald? You can because you're a spiritual person. I do not know about that. What I do know is that I am scared, very scared about this pregnancy. And now you've confused me – I don't know what's right or what's wrong. All this talk about my partner having an equal right to any decision that must be made and that if I don't include him I'm being dishonest. That's not going to help the child in any way if the child has the disease. Oh, I'm so confused … **AB11**

Thank you for participating so vigorously in the role-play. What's the right decision? I do not know. What I do know and what I heard is that each of us has different understandings and that we

need to learn to respect each other's understandings. Okay, Ronald – not if it's murder. That's just it – not everybody believes it is murder. What do I believe? That is not important. What is important is that what is right for you may not be right for somebody else – for a whole lot of reasons. And you may never know what those reasons are. That will make it even more difficult for you to understand. And if that is the case, can you judge somebody else's decisions as right or wrong? I do not have answers for you – you have to find your own answers. **AB12**

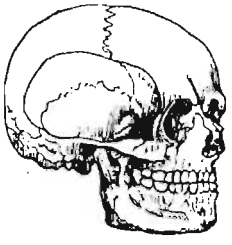
Why are you looking so fed up Fazila? What's up? You're wondering why I have wasted your time. This is not in the biology syllabus. And you will never be tested on this in the tests and exams. I've wasted a lot of your time doing a role-play that has taught no biology. Quite a few nods agreeing with you. Yes, you're quite right – this is not in the biology syllabus and you will never be tested about your beliefs on abortion. The question then is do we ever talk about such issues in the biology class? **AB13**

We should, Pretty. Why do you say so? These things are never spoken about at home amongst the Black people. And you need to learn from each other about these things. And there is no sex education in the home. All we learn is from our friends and half the time we don't even know if what is being shared is right. That's why there are so many teenage pregnancies and so many people with AIDS. If we don't talk about abortion in the class we'll never talk about it at all. Desiree you agree with Pretty. Why? Because what Pretty says is true but not only about the Blacks. Even in the Indian homes parents don't provide sex education. And they don't talk about abortion – only to say it's bad and it's wrong. Yet it happens even in our own families and we have to start talking about these things. Maybe not in the biology class. But if we don't talk in this class then in which class will we talk about it, when will we talk about it – I can't see it happening in any other class in school says Chreestheena. Some agree with her. Some still appear unconvinced about whether this was a biology class of worth or a waste of their time. **AB14**

6.7 BIOLOGICAL DETERMINISM

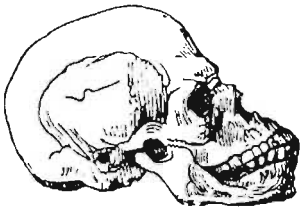
Today I'm going to share with you an idea in science called Biological Determinism. Yes, you're right; we've finished with the prescribed syllabus. What's that – why then are we looking at something else in biology if it is not in the syllabus? Do we learn only about that which is in the syllabus? Says who? I tell you what – let me share some of what I want to with you and then if you do not want to talk about any of it we will leave it at that. Fair deal? – okay. **BD1**

Apollo Belvidere

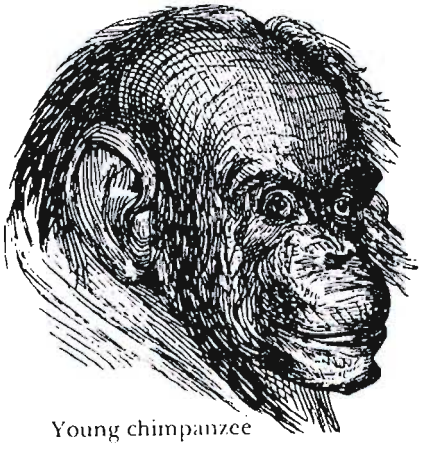


Greek

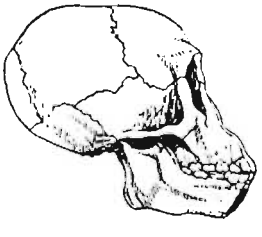
Negro



Creole Negro



Young chimpanzee



Young chimpanzee

The unilinear scale of human races and lower relatives according to Nott and Gliddon, 1868. The chimpanzee skull is falsely inflated, and the Negro jaw extended, to give the impression that blacks might even rank loweer than the apes.

So what is this thing called biological determinism? In dealing with this idea and how it has influenced our understanding of people I will draw from this book by Stephen Jay Gould called the *Mismeasure of Man* that was first published in 1981. You are free to borrow the book at any time you want to go through it as long as you sign it out. Please do not accept the ideas I am drawing on as the only ideas on the issues – you need to read what other persons have to say about these ideas – because many of the ideas put forward in the 1800's and early 1900's have since been rejected – as you will find in the last chapter of this book. Why then do we even look at these ideas – if many have been rejected? I am trying to understand why we understand and categorise people the way we do – Black and White, superior and inferior, etc. Have the earlier understandings put forward in biology influenced how people have been understood? ***BD2***

Biological determinism, according to S J Gould, *holds that shared behavioural norms and the social and economic differences between human groups – primarily races, classes and sexes – arise from inherited, inborn distinctions and that society, in this sense, is an accurate reflection of biology* (p 20). Gould also states that a principal idea within biological determinism is the claim that worth can be assigned to individuals **AND** groups by determining intelligence as a single quantity. This claim was supported by valid science data in the form of craniometry, measuring the size of the skull (to see how much of brain it could accommodate), during the nineteenth century and certain types of psychological testing and intelligence testing, in the twentieth century. Biological determinism favoured the understanding that people at the bottom were made up of intrinsically inferior material – poor or less brains, bad genes or whatever (p31). In this way the biological justification of racial prejudice put an additional burden of intrinsic inferiority upon despised groups. In other words biology as a science supported the idea that there could be inferior races of people. **BD3**

Now, isn't that strange? According to what we've worked through in the animal Kaiser there is only a single group that makes up a single set of humans – *Homo sapiens*. Yet biology justified the idea of different human races – those that were superior and those that were inferior. Should we continue with this discussion or would you rather end it at this point. You want to continue – even though it's not in the syllabus. Okay then. Lets then go back to the ideas of the nineteenth century and see how they have/have not played a role in shaping how people think. Has history shaped current social understandings? Has biological determinism from the nineteenth century reinforced the accepted social understandings? For the scientists from the nineteenth century into the twentieth did prior

Orangutan

Hottentot wagoner

Chimpanzee

Hottentot from Somerset

Two more comparisons between blacks and apes from Nott and Gliddon, 1854. This book was not a fringe document, but the leading American text on human racial differences.

prejudice dictate their conclusions? I'm going to hand out to you some statements made by both statesmen and scientists taken from the book by Gould. **BD4**

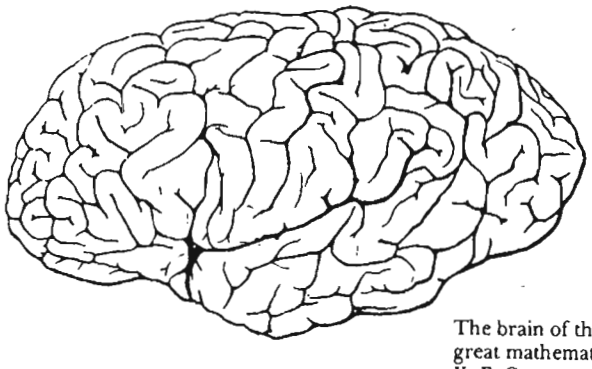
1. *I advance it ... as a suspicion only, that the Blacks, whether originally a distinct race or made distinct by time and circumstance, are inferior to the Whites in the endowment both of body and mind.* Thomas Jefferson (1743 – 1826), the 3rd President of the United States of America (p35). **BD5**
2. *There is a physical difference between the White and Black races which, I believe, will forever forbid the two races living together on terms of social and political equality. And inasmuch they cannot so live, while they do remain together there must be the position of the superior and the inferior, and I as much as any other man am in favour in having the superior position assigned to the White race.* Abraham Lincoln (1809 – 1865), the 16th President of the United States of America, in the Douglas Debates in 1858 (p35). **BD6**

These were the social understandings not only in the United States but also in Europe during the nineteenth century. Were the leading scientists of the times influenced by the existing social understandings? If they were, did their prejudices influence their conclusions? Did their prejudiced conclusions become FACTS of biology and of science? Lets look at some understandings by different scientists and you can then decide whether or not biology and science influenced the existing social understandings about Black and White people. You will take turns to read from the sheet starting at the back with silent Suhaifa. **BD7**

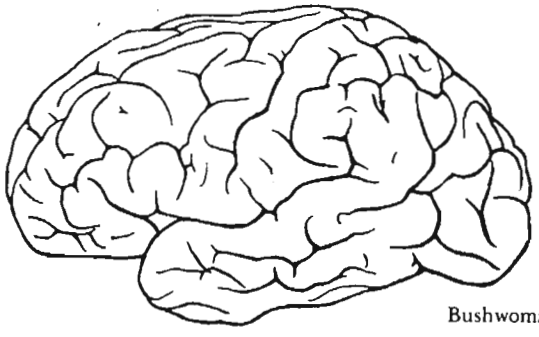
- Linneaus (1707 – 1778) a famous taxonomist mixed character with anatomy. In 1758 Linneaus stated that the *African Black is ruled by caprice whereas Europeans are ruled by custom.* Of African women he wrote: *Women without shame, breasts lactate profusely... The men are indolent and anoint themselves with grease* (p35). **BD8**

- Three great naturalists of the nineteenth century who did not hold Blacks in high esteem. **BD9**

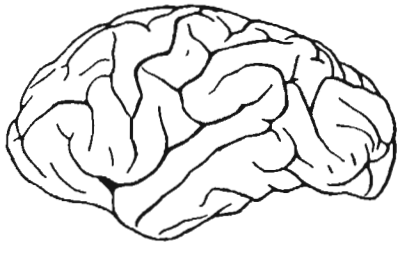
    1. George Cuvier (1769 – 1832) in 1812 referred to native Africans as *the most degraded of human races, whose form approaches that of the beast and whose intelligence is nowhere great enough to arrive at regular government* (p35-36).



The brain of the great mathematician K. F. Gauss

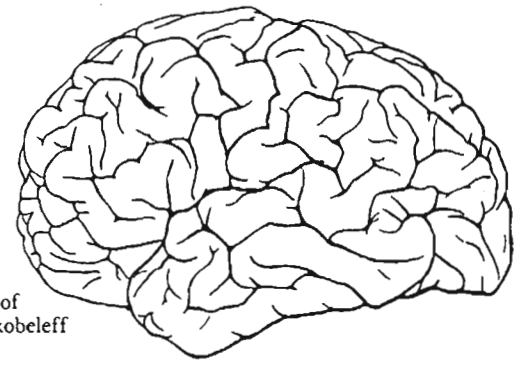


Bushwoman

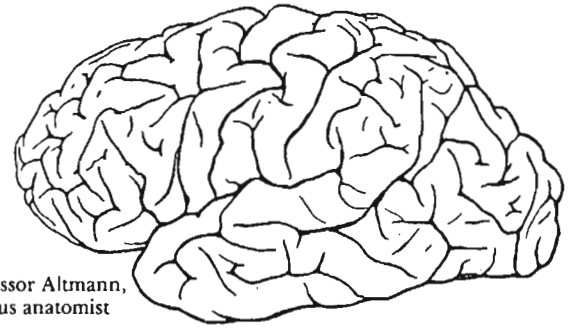


Gorilla

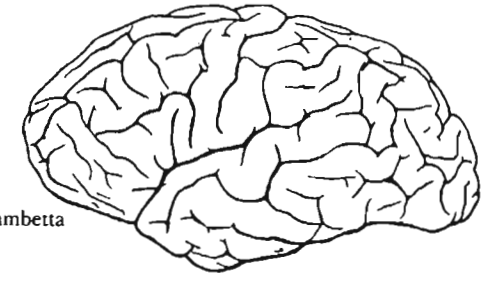
Spitzka's chain of being according to brain size.



The brain of General Skobeleff



Professor Altmann, famous anatomist



Gambetta

Spitzka's depiction of variation in brain size among white men of eminence.

He remembered 'Hottentot Venus' in this way on her death: *She had a way of pouting her lips exactly like what we have observed in the orang-utan. Her movements had something abrupt and fantastical about them, reminding one of those of the ape. Her lips were monstrously large. Her ear was like that of many apes, being small, the tragus weak, and the external border almost obliterated behind. These are animal characters. I have never seen a human head more like an ape than that of this woman* (in Topinard, 1878, p86). **BD10**

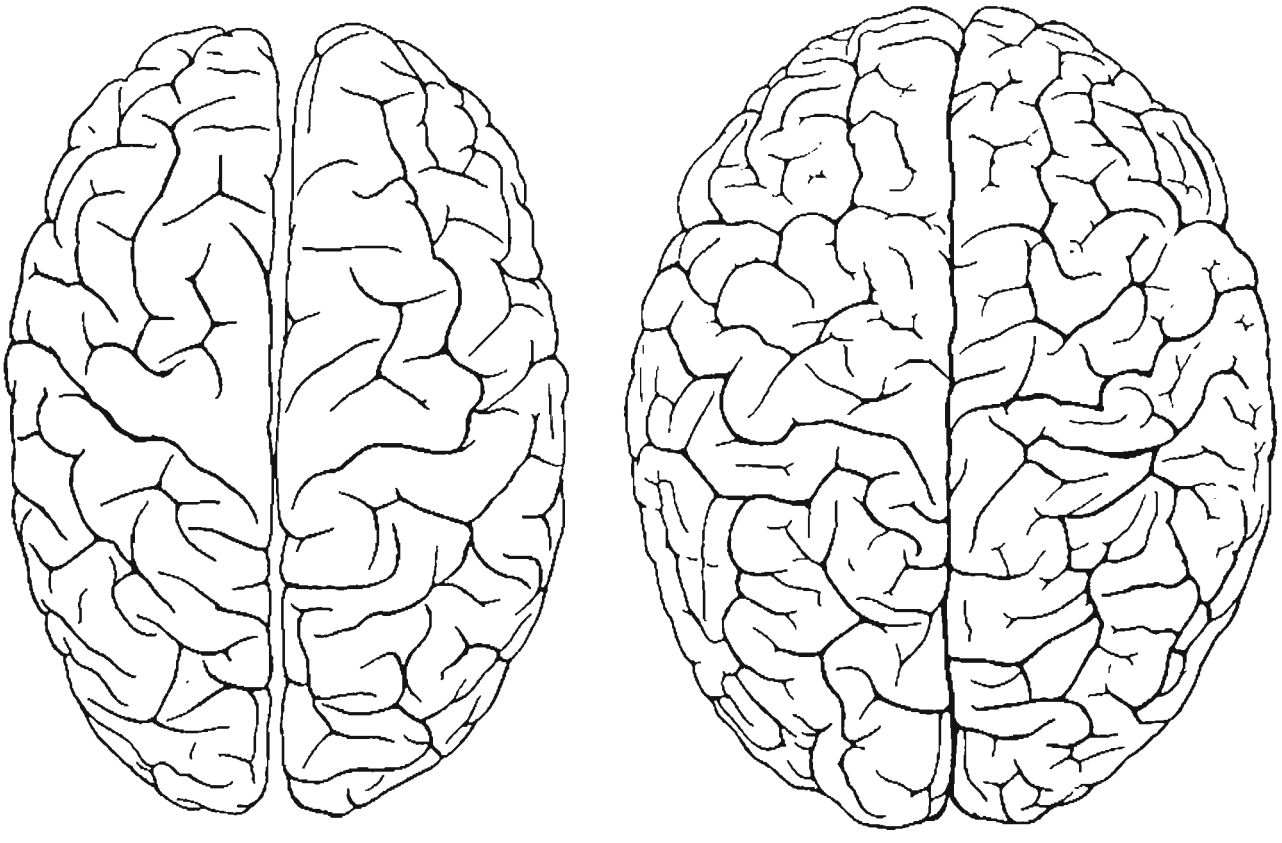
2. *The brain of the bushman ... leads towards the brain of the Simidae (monkeys). This implies a connexion between want of intelligence and structural assimilation. Each race of Man has its place, like the inferior animals* (p36)... the naturalist and geologist Charles Lyell (1797 – 1875). **BD11**
3. Charles Darwin (1809 – 1882) in 1871 wrote about a future time when the gap between human and ape would increase by the anticipated extinction of such intermediates as chimpanzees and Hottentots (p36). **BD12**

Hold your ideas for now. Write them down. We'll start to share once we've gone through the statements on this sheet. **BD13**

- A scientist of the nineteenth century who defended equality was J F Blumenbach (1752 – 1840). He believed that racial differences were due to influences of climate. Nonetheless he did not doubt that White people set a standard from which all other races had to be viewed as departures (p37-38). **BD14**

- The scientist who did the most in establishing and enhancing the prestige of American biology during the nineteenth century was Agassiz (1807 – 1873). He believed that legal equality must be granted to all... however, social equality should not be allowed to Blacks – lest the White race be compromised and diluted. In August 1863 he stated: *Social equality I deem at all time impracticable. It is a natural impossibility flowing from the very character of the Negro race...* for Blacks are *indolent, playful, sensuous, imitative, subservient, good natured, versatile, unsteady in their purpose, devoted, affectionate – in everything unlike other races; they may be compared to children, grown in stature of adults while retaining a childlike mind ... Therefore I hold they are incapable of living on a footing of social equality with the Whites, in one and the same community, without being an element of social*

The brain of the great mathematician K. F. Gauss (right) proved to be something of an embarrassment since, at 1,492 grams, it was only slightly larger than average. But other criteria came to the rescue. Here, E. A. Spitzka demonstrates that Gauss's brain is much more richly convoluted than that of a Papuan (left).



disorder ... Blacks must be regulated and limited, lest an injudicious award of social practice sow later discord (p48). **BD15**

- Samuel George Morton was a distinguished scientist and physician and had the reputation of being a great data-gatherer and objectivist of American science (p51). He collected human skulls because he needed to test his hypothesis *that a ranking of races could be established objectively by physical characteristics of the brain, particularly size.* Morton's fame as a scientist rested on his collection of skulls and their role in racial ranking (p53). Morton used the skulls to provide a measure of the brain it once contained. His hard data/facts provided irrefutable evidence on the mental worth of human 'races'- Whites on top, Indians in the middle and Blacks at the bottom (p53). His final summary of cranial capacity by race was (p55): **BD16**

RACE	*MEAN CRANIAL CAPACITY(in^3)*
Modern Caucasian	*92*
Mongolian	*82*
Malay	*85*
American (Indian)	*79*
Negro	*83*

BD17

- Such understandings were reinforced by scientists like Galton (1822 – 1911), a pioneer of modern statistics, who put forward the idea that measurement was the primary criterion of scientific study. **BD18**

- Paul Broca (1824 – 1880) a craniometrist and professor of clinical surgery favoured the understanding that the size of the brain was related to the degree of one's intelligence (p83). According to Broca (1861): *In general, the brain is larger in mature adults than in the elderly, in men than in women, in eminent men than in men of mediocre talent, in superior races than in inferior races ... other things equal there is a remarkable relationship between the development of intelligence and the volume of the brain (p83).* **BD19**

- In 1866 Broca wrote: *A prognathous/forward-jutting face, more or less Black colour of skin, woolly hair and intellectual and social inferiority are often associated, while more or less White skin, straight hair and an orthognathous/straight face are the ordinary equipment of the highest groups in the human series.* A group with Black skin, woolly hair and a prognathous face has never been able to raise itself spontaneously to civilisation (p84). **BD20**

You're all very quiet. Kaiser you do not look happy at all. Class, do you think that the biology of the nineteenth century and that biological determinism played any role at all in influencing how humans relate to each other? Or am I trying to create difficulties where there are none – remembering that many of these ideas have, with evidence in recent times, been rejected by biology and science. **BD21**

Am I saying that the evidence has been shared with and understood by all the people in the world? No Naseema, I have not said that. Why do you ask? Because if the idea about who is superior is already there then it will not just go away like that – especially if not everybody has got and understood the evidence. What Naseema is saying makes sense, according to Nolwande. That is why there has been racial domination and Whites have kept the power and continued to dominate – because of the kind of ideas that existed. And to make it worse those ideas came from the respected world of biology and science! It doesn't matter that those were ideas in the nineteenth century – they have definitely influenced how people think even today, despairs Nolwande. **BD22**

Ronald now must have his say. He believes that Whites are more clever and have academic understandings whereas Africans are more intelligent in the bush – they can tell you more about the bush and how to survive in the bush. Put a White person in the bush and he won't survive – because he does not have bush intelligence. Nolwande agrees that Whites have 'book' intelligence. But why, then have Whites taken advantage of Black people if they are academically cleverer, she asks? She then shares this thought with us – Is it because apes are Black and Africans are Black that comparisons have been made between them? Ronald comes back with this thought: You know, just like the Blacks were brainwashed into believing they were stupid, Whites too have been brainwashed into believing they are dominant. Many heads nod in agreement with this statement. **BD23**

That's why the Whites still believe they are superior and Blacks have to always fight for their rights says Nelisiwe. Maybe it was this biological determinism that worked so well to brainwash people about thee races. Does this mean that science was abused by people to brainwash people so that a group, the Whites, remained in power questions Nelisiwe. **BD24**

You know, even today, if you look around in South Africa you do not see White people working as labourers says Kaiser. It's only Black people who are labourers and that's not just Africans. I mean, look at the street-sweepers and rubbish collectors – they are Coloured, Indian and African. The Whites are the drivers. Look at those people who are working on the roads – the Whites give the instructions and then go to sleep in the shade, while the Black people do all the hard work like digging in the hot sun. Is that ever going to change? Kaiser is getting passionate as he gets to think his thoughts aloud. The buzzer goes. He is forced to call his thoughts to a halt. **BD25**

Class on your way out collect the page with some statements on how women, Blacks/Negro's were viewed by the world of science in the nineteenth and early twentieth century. No we will not have time for class discussions on those statements. If you do want to talk through any of the ideas feel free to do so but it will have to be after school. Bye for now and study for your exams! **BD26**

On Black/Negro And Women's Brains

1. Huschke, (1854), a German Anthropologist: *The Negro brain possesses a spinal cord of the type found in children and women and, beyond this, approaches the type of brain found in higher apes* (p103). **BD27**
2. Carl Vogt, (1864), a celebrated German anatomist: *By its rounded apex and less developed posterior lobe the Negro brain resembles that of our children, and by protuberance of the parietal lobe, that of our females ... The grown-up Negro partakes, as regards his intellectual faculties, of the nature of the child, and the senile White ... Some tribes have founded states, possessing a peculiar organisation; but as to the rest, we may boldly assert that the whole race has, neither in the past nor in the present, performed anything tending to the progress of humanity or worthy of preservation* (p103). **BD28**
3. G Hervè (1881), a colleague of Broca: *Man of Black races have a brain scarcely heavier than that of White women* (p103). **BD29**
4. Broca (1861): ... *But we must not forget that women are, on average, a little less intelligent than men, a difference which we should not exaggerate but which is, nonetheless, real. We*

are therefore permitted to suppose that the relatively small size of the female brain depends in part on her physical inferiority and in part on her intellectual inferiority (p104). **BD30**

5. Gustav Le Bon (1879), the founder of social psychology: *In the most intelligent races, as among the Parisians, there are a large number of women whose brains are closer in size to those of gorillas than to the most developed male brains. This inferiority is so obvious that no one can contest it for a moment, only its degree is worth discussion. All psychologists who have studied the intelligence of women, as well as poets and novelists, recognise today that they represent the most inferior forms of human evolution and that they are closer to children and savages than to an adult, civilised man. They excel in fickleness, inconstancy, absence of thought and logic, and incapacity to reason. Without doubt there exist some distinguished women, very superior to the average man, but they are as exceptional as the birth of any monstrosity, as for example, a gorilla with two heads; consequently we may neglect them entirely.* **BD31**

6.8 LESSONS FOR CONTINGENT BIOLOGY EDUCATION

The lesson stories, in this chapter, tell about a biology education that is different. That which makes this biology education different is a commitment towards social justice. This commitment begins to be realised through exposing how seemingly innocuous facts of biology reinforce and perpetuate existing oppressions and subordinations that are both visible and non-visible. These stories highlight what could be done through post-apartheid biology/Life Sciences education in South Africa as part of an effort towards realising those principles of human rights and social justice contained in the curriculum policy.

The current official interim biology curriculum identifies human rights and social justice as that which must be promoted in keeping with the Constitution of the country. Human Rights and social justice will not be part of the biology programme however if the issues that can work towards them, as identified through the lesson stories, remain at the margins by being regarded as optional or as extended activities that are not examinable. In a content driven biology programme the focus remains the facts of biology and value continues to be placed on student performance. HIV and AIDS is now in that part of the curriculum that teaches viruses as a unit. The focus is on the biological facts around HIV and AIDS. The interim biology curriculum remains silent about socio-economic aspects of the HIV AND AIDS pandemic. Issues of race and gender discrimination are still missing. Inclusion of indigenous science knowledge is regarded as the vehicle through which equity and human rights will be obtained through the interim biology curriculum where the focus is

still an objectified, rationalist, technicist and neutral biology education which allows for magnanimous inclusivity as part of a sensitivity to diversity in working towards a human rights culture.

The new National Curriculum Grades 10 – 12 (General), to be implemented for Grade 10's in 2006, identifies human rights and social justice as that which must be promoted in keeping with the Constitution of the country. The statement also claims that it is sensitive to issues such as race, gender, poverty and language among other factors. Learning Outcome 3 of the Life Sciences (that now includes biology) states that learners should be able to demonstrate an understanding of the nature of science, the influence of ethics and biases in the Life Sciences and the interrelationship of science, technology, indigenous knowledge, the environment and society. This Learning Outcome finds expression through the core content of four knowledge areas identified within the Life Sciences. The knowledge areas are tissues, cells and molecular studies; structures and control processes in basic life systems; environmental studies; and diversity, change and continuity.

These knowledge areas make provision for the possibilities around issues of oppression and subordination in the Life Science classroom. The space for engagement with the issue of gender discrimination is provided when the history of DNA is the topic for study; another such space is provided in the study of biotechnology where the issue of the creation of poverty and wealth can be part of the learning achieved through the Life Sciences. The inclusion of Indigenous Knowledge within the Life Sciences can be creatively used to ask questions around previous exclusion within the frameworks of dominant knowledge in the Life Sciences. Through these and other such spaces within this learning outcome, oppressions and subordinations such as gender, poverty, food security, language, etc can be named and challenged. The naming and challenging must also involve teacher and student experiences if there is a serious intent of advocacy and agency towards social emancipation. Raising challenges that exclude the students and the teacher in the Life Sciences class will turn these wealthy possibilities provided for by the curriculum into tokenist efforts that will then give credence to that critique of the curriculum as nothing more than a political symbolism.

The Life Sciences curriculum makes no mention of race in any of the four knowledge areas. Life Science's historical complicity in giving scientific validation to the notion of races and racism cannot be ignored. A space for this study is perhaps present through the study around the contestations of creation and evolution that is included as part of the knowledge area diversity,

change and continuity. This will require not only creativity from the teacher of Life Sciences but also a willingness to take risks around taboo issues of creation and evolution itself.

The stories reveal an absence of any discussion on apartheid's stratification of society in South Africa itself when dealing with biological determinism. The focus on the lesson was on the history of racism as established through biological determinism. An opportunity to link the past with South Africa's historical present was missed out on – my assumption being that this would be done by the students themselves. Based on subsequent interviews with students it is evident that such assumptions cannot and should not be made. Explicit links between apartheid's race stratification of society, legislated racism in South Africa and the validation of racism through biological determination should be used to provoke and challenge students in classes that are still influenced by South Africa's recent apartheid history. Biology lessons on abortion and the right to life also ignore current legislation in South Africa that allows abortion and current policies around age and consent on this procedure. The same is true for the constitutional rights of all persons with regard to sexual orientation, which were ignored in the biology class. These constitutional provisions cannot be ignored in the biology class if the agenda of biology education is towards human rights and social justice. The Bill of Rights, which is Chapter 2 of the Constitution of the Republic of South Africa, should therefore also become part of what goes on in any biology classroom.

A biology education focusing on oppressions and subordinations as part of an effort towards social justice, as highlighted by the lesson stories, is possible. Such biology education demands that the teacher be open to as many possibilities as determined by the diversity present within the biology classroom. These diversities included amongst them the diversity of race, gender, class, language, religion, etc. The myriad of diversities, typical of South African classrooms, challenges students in the biology classroom as both the oppressors and as the oppressed and subordinated. These various diversities and the challenges that they present when students are provoked into responding on issues of race, gender, class, language, religion, etc. through biology education is disruptive to the students as they are confronted with conflicts and contradictions of their own lives – at times it made for explosive dialogue. The explosiveness too is part of a biology education different form the normal, the ordinary, the mundane, the traditional. The explosiveness makes visible strongly felt oppressions and subordinations and the feelings characterising these discriminations. This biology education then is not devoid of feelings. It is this that then raises questions also about biology education as objective, rational, neutral and value-free.

The next chapter provides a first level of analysis that is descriptive. The analysis comes from iterative readings of student and lesson stories with the explicit intention of identifying oppressions and subordinations as experienced by the students through biology education, the school and the wider community. The naming of the oppressions and subordinations allowed for the categorisation of the discriminations. Identified oppressions and subordinations were then explored with a view to understanding how each was constructed and contributed to the shaping of student identity – both as the oppressor and the oppressed.

CHAPTER 7

RUPTURING THE BLOOD VESSELS:

biology education and discrimination.

7.1 INTRODUCTION

I have taken you through part of that capillary network that is the lifeblood of the lives of the students and the slightly larger vessels that make up my classroom. This I have done through the factionalised stories of the students and the biology lessons in my classroom, in the last two chapters. I see the students as the capillary vessels connected to the larger arterioles and venules, the classrooms and the school itself, which in turn is connected to the arteries and veins that make up the wider community. This is the living, pulsating circulatory system that I use to describe my class, the school and the wider community. The blood corpuscles (cells), both red and white, are akin to experiences that shape the lives of students and myself – experiences that also include oppressions and subordinations. I cannot travel through every single vessel with every single corpuscle– the route that I have chosen limits me. You are at liberty to change the route and the direction in finding your own meaning through this maze. In this chapter I will use these capillaries, their corpuscles and the larger vessels of the classroom in my attempts to get to know what it is that pulsates; what it is that lets that lifeblood flow in the directions that it does – flowing yet contained; streaming forth yet restrained. I will try to distinguish between the capillaries in their individual and their myriad coalescences – with its blood that has made these the lived lives in the classroom, the school and the wider society.

In this chapter I provide a descriptive cross-case analysis as the corpuscles traverse through the capillary network and larger vessels. This comes from the data that I (re)presented as stories in the previous two chapters and the analysis developed using the stories - through the rupturing of vessels and the bursting forth of the previously unknown corpuscles. In this chapter I offer a first level of analysis, that is, an analysis grounded in the data from the stories in Chapters 5 and 6. Connecting and engaging with and furthering existing theory become possible on completion of this first-level analysis in subsequent chapters. It must, at the very outset, be stated that this analysis is but one possible interpretation of the data. There will be as many interpretations as there will be readers of the data itself.

Oppressions and subordinations experienced as discrimination is explained as a situated dynamic through which certain identities are marginalized. This chapter describes how the marginalized identities were used to generate discriminatory categories from the data. The categories include: race and colour; gender and patriarchy; bodies and sexuality; class poverty and sexually transmitted diseases; institutional power and hierarchy; religion; and language. Race and colour as a discriminatory category was generated from an initial foray through biological determinism. This foray revealed interrelationships between race and colour and issues that included class, worth, power, innocence, criminality, violence and dirt amongst others. Gender and patriarchy functioned to allow patriarchy as that which not only determined the female's role as a nurturer in society but also as that which controlled pregnancy through patriarchal judgements. Patriarchy also set up males as the powerful protectors and decision makers in society. Patriarchy's preservation by females and the silence around males in roles ascribed to females is acknowledged. It is through a notion of bodies that the worth ascribed to a female body could be measured. This worth was determined by responses to unmarried pregnancies, transmission of sexually transmitted diseases and the female's right to choice on decisions regarding her own body in instances such as abortion. The issue of sexuality forced students to confront their own conflicts about homosexuality as evil and homosexuals as gentle, caring persons. With class, poverty and sexually transmitted diseases, race and gender intersected with class in attributing the transmission of sexual diseases to poor Black females. When it came to issues of institutional power and hierarchy, student power resided with Indian males on the basis of this being the dominant population together with the history of the school as Indian. Power relationships, linked to race and class, from students-teachers-school management-principal was operationalised with Black female students as the least powerful and the principal as the most powerful. Stigmatisation by religion contributed to the discrimination of unmarried pregnant females; religion also prescribed against abortion and homosexuality and through this contributed to discriminations that existed. The language of biology that gave to biology status not only mystified and confused students but it also made it difficult for students to understand the content of biology. This alienation from the content was linked to failure in biology. It is these issues that this chapter explores.

Getting to know the corpuscles required the rupturing of the vessels in more ways than one. The students I taught knew one 'truth' of the biology classroom. Negative disruptions disrespectful of classroom interactions were unacceptable. My actions involving parents in what went on in the classroom - the good, the bad and the ugly - were 'legendary'. It was this 'truth' that students came with to the biology classroom either from their own direct or through indirect experience. This was the 'truth' that in part initially curtailed student responses to the 'loaded' questions about

discrimination that I deliberately 'dropped' into lessons. The provocation, within the typical factually - based content lesson that students were accustomed to and familiar with, was hesitantly received. Over the years the familiarity and customisation of students to the 'typical' lesson had entrenched in them the knowledge of what lessons in science and biology were about. Anything that questioned oppression and discrimination in and through biology was for the students a 'negative' disruption in the set scheme of events. This negative disruption robbed them of the security and comfort of the familiar and known – this too then contributed to their hesitant response. Once students recognised though that the voice of their experience was the valued voice they willingly shared of their experiences publicly in the classroom. This happened quickly for some students and gradually for others – as evident in their stories. Some students though chose to remain uninvolved spectators throughout classroom interactions during the research period. Outside the biology classroom though they too became involved in discussions that started in the biology classroom – as reported by those students not hesitant to share the goings-on in the biology classroom itself. In this way I learned that the uninvolved students were vocal outside the classroom about the classroom discussions not being part of biology.

I started with a concern for racism but it was the much broader phenomenon of discrimination that includes racism in its multiple forms that emerged in the data. Discrimination is a situated dynamic through which certain identities are marginalized. In and through this marginalisation that becomes focused on and visible some identities then become silently and invisibly privileged and powerful. This discrimination is situated in that it plays out differently for the different 'Other' identities as determined by the environment in which this 'Other' identity is located; it is this too that gives to it its dynamic. How discrimination is then permitted and allowed to express itself within socially imposed self-regulated constraints, in various environments be it the classroom, the school or the wider community, then translates into the experienced discriminatory practice.

In this chapter the description of discriminatory practice/s for each corpuscular category, if it exists is, is provided as it arises and locates itself within the biology curriculum and content, the biology classroom, the school and wider community. Each of these contexts informs and is informed by other/s and through this the identified discriminatory practice/s that emerged became possible to describe. Not only is the practice described – I 'bravely' (or is it 'foolhardily') also attempt, through my eyes, to explain how these practices have become entrenched and why they continue to be perpetuated and maintained. It is this together with the wider perspective of my own experiences and my multiple positions that I occupy within the school that guides my analysis through this chapter.

As part of the analysis, categories in which discriminatory practice/s were located were identified and, using the data, described. Each category is informed by the existing literature and also my interest in what I perceived and identified as oppressive and discriminatory. For organisational reasons though each category has been discussed separately. However, the categories seldom operate exclusively of each other. The categories operate in a myriad of combinations grounded within the various environments that exist within space and time in the lives of individuals and collective groups of people. Categories used to locate discriminatory practice/s in this chapter include gender, sexuality, race and class, student self-identity, religion and language.

The codes used within this chapter as part of the analysis are codes found in the chapters containing student and lesson stories. As explained previously, each paragraph of each story is numbered starting from 1 and in ascending order. The paragraph also has a letter code – the letter derived from the first initial/s of the student's name or the title of the lesson stories. The codes link the descriptory analysis of discriminatory practices, which entrench, perpetuate and maintain oppressions and subordinations, in this chapter to the students' voices on these practices in the previous two chapters.

7.2 RACE AND COLOUR

Persons were defined by race – both within and outside of the classroom. The existing race categories, a continuity from the apartheid period into the present, were White, Indian, Coloured and Black. Students identified themselves and each other and located themselves and each other within these existing categories. These categories had been historically determined and were a significant feature of apartheid. With race went class: Whites being economically at the top and Blacks at the bottom; Indians and Coloureds occupied interchangeable economic positions and were located between the Whites and the Blacks. The students saw themselves as Black, Indian or Coloured living in the Black townships or in the suburbs of the city. The Black townships, 'creations' of apartheid, continue to exist in the post-apartheid period. Students' reflections on themselves as Indians, Coloureds or Blacks in an environment that had in it Whites also, provided a window into how they understood race and class stratification as it operated within the context of their lives. Intelligence, animalisation, sexually transmitted diseases specifically HIV and AIDS, 'designer babies' with light skins became the biology content through which issues of race and class were explored. These explorations permitted also a peep into student experiences within the school as raced and classed persons.

The formal prescribed biology curriculum in genetics, as stated previously, focused on Mendel's experiments, monohybrid and dihybrid crosses with and without dominance, law of segregation and independent assortment, sex determination, determination of characteristics, gene mutation, natural selection and some applications of genetics such as increased productivity and inheritance and prediction of blood groups. No mention was made of the history of biological determinism and its

was total silence (a rarity for this Grade 11 class). They did not ask for the discussion to be abandoned.

As the lessons progressed Kaiser's expression made his 'unhappiness' visible (BD21). The silence in the class forced me to take stock and I then found myself asking the students and myself whether I was creating difficulties about race and associations with race - where none really existed. Naseema, supported by Nolwande and Nelisiwe, voiced that if the historical shaping of race groups was not publicly known, existing ideas of *who is superior* would *not just go away like that* (BD22, BD24). The *respected world of biology and science* of the nineteenth century that was responsible for the domination by and the power of the White race was articulated by both Nolwande and Nelisiwe (BD22, BD24); *ideas that influence how people think even today* despaired Nolwande (BD22).

Arthur distinguished between *academic intelligence* and *bush intelligence* with academic intelligence being the preserve of Whites and bush intelligence that of Blacks. Many students agreed with Arthur's suggestion that *just like the Blacks were brainwashed into believing they were stupid, Whites too have been brainwashed into believing they are dominant* (BD23). This distinction was acceptable to Nolwande and led her to question out aloud why it was that *Whites have taken advantage of Black people if they are academically cleverer*. She also questioned whether the comparisons between apes and Blacks came from the observations that *apes are Black and Africans are Black.*

Kaiser's observations that ... *you do not see White people working as labourers ... It's only Black people who are labourers ... the Whites give the instructions ...the Black people do all the hard work* ... led him to conclude that race and labour were inextricably linked (BD25). Race and its relationship to intelligence, animalism, superiority and power and class existed for the students and emerged through the interrogation of some of the history of biological determinism as explained by Gould – when this was made part of the biology curriculum and content. These relationships were not confined to only interactions within the biology class; they were located also within the school and the wider community.

Intelligent, clever, know(ing) everything, dominant, superior, at the top, having power were the terms used to describe the White race and the ideas that governed how White people were located by both the school and the wider community. Townships were associated only with Black people. These were the ideas that the students knew of and came with into the classroom - even if the

student did not herself/himself subscribe to these ideas. *We are all equal/the same/everybody is equal* was clearly the view of Nolwande, Anneline, Pretty and Jameel. At the same time they acknowledged that the ideas about Whites as intelligent etc. were the significant ideas that continued to operate and determined how the races were viewed (N14, AN17, P12, J11). ... *even if you get a chance to be educated you can't be as clever – as a Black person* (N14).

Being less confused about Whites being intelligent was a desired outcome for Chreestheena and this could be achieved through talking about existing understandings of the different race groups. This would *better people's knowledge and get rid of the old ways* (C13) and *people would then realise Blacks are not stupid* (C14). Nelisiwe was accepting of *Whites as cleverer because they have more knowledge* and *Blacks as slow*. This however, did not mean that Blacks were stupid which is how Blacks were treated (NF2). Besides being intelligent and at the top, Whites, for Waseela, were *also treated as pure, good and innocent and Blacks like trash, like dirt ... like evil* and this despite the existence of the South African *Bill of Rights* (W13). Denying people information was, according to Arthur, used to *create turmoil* and establish *power*. He also believed that *if you don't learn about racism you become a racist* (A20). The *primary school instilled* in Arthur that *White males were at the top and Black females at the bottom* (A22).

In comparing the races Kaiser compared an *outside world of books ... and inventions* occupied by Whites and the world of the bush of *the Black man* where he *was first spotted.* For him, Blacks when they ventured into the outside world *were not given a chance by Whites* and this was how Whites maintained their dominance. He also acknowledged that even *today Black people still believe they are... not intelligent* (K4). Being at what he described as an Indian-dominated school, where he could never have been chosen as the head prefect, was for him *a privilege* (K6, K16).

Not having discussions around such understandings was the preferred stance of Pretty, Sandile and Jameel. Pretty was of the belief that *It will not change what's inside the minds of people ...This is not a democratic South Africa ... There is still apartheid* and therefore any discussions would be meaningless (P12). Sandile too believed that there would be *no change in the person's personal understandings* and that *you might change the person's understanding for that moment in time,* which is why only 'informal' discussions, if any, should occur (S11).

Jameel's unwillingness for such discussions being held stemmed from his apprehension that *a lot of Black people might think it (Blacks being stupid) is true ... Such a discussion could lead to further discrimination.* For him it was opportunity that was responsible for the differences amongst

people (J12). He also spoke of the silence around the questionable status of Whites as superior (J13). Jameel went on to share that there were times when he felt *inferior to other races. As a Coloured I often feel I don't know anything about Coloureds. Where do Coloureds come from ...there is nothing to speak about when it comes to Coloureds. They have never achieved anything* (J13, J14).

Nolwande and Kaiser also spoke of the animalism associated with Black peoples. Colour was not the basis for comparing people with animals for Nolwande who *wouldn't want to be compared with an animal* because this would rob her of her self-esteem (N17). Kaiser shared that when *humans (were) compared to animals ... you start to think of it in that sense* (K2). For these students' animalism,which linked Black people closely with animals and defined their position as close to 'wild', 'untamed' and uncivilized, too contributed towards entrenching the hierarchy amongst the races in that it 'justified' the location of Blacks at the bottom of any hierarchy of peoples on the basis of race.

Class as experienced through lifestyle was also understood as being inextricably bound to one's race. Traditionally, in South Africa, Blacks as workers living in poverty in Black townships was where the Black race was relegated. The understanding ... *since you're Black ... the only thing for you to do is to go to the farm and work there as a labourer* was rejected by Nolwande (N14). Blacks' as workers was still part of Kaiser's life: *Look at the world around you. Black people are still in the back of the vans; Black people are still working in the gardens; Black people are still the maids* (K4).

It was finance that decided how equal people were according to Arthur and this gave lie to his experiences at school about all being equal ... *the only time you are not equal is when it comes to finance* (A22). Upward economic mobility of Blacks was of concern to Chreestheena because *Indians don't get a chance to improve* (C14). A shift in the lifestyle of the Black race was Chreestheena's observation. Pretty's experience as part of the upwardly mobile group, spoken of by Chreestheena, highlighted the non-existence of integration amongst the different races. Pretty now lived in what was previously a wealthy suburb for the White race. *Ridge Road – that's where I live now ... Here the Blacks keep together and the Afrikaners keep together – we don't really get along with each other* (P7).

The lifestyle in the Black township was also characterised by violence and criminality. *At night it is dark ... I could be raped ... I could become a victim ... In some townships girls' know they are not*

to be in the streets (after dark) because they will be raped and maybe even killed ... People needed to be alerted to the dangers in the township ... everything happens in a township and there are criminals and thieves there claimed Nolwande (N8, N9). The lifestyles described by the students located the races within specific classes with violence and criminality being the preserve of Black townships. The upward mobility experienced by some Blacks was no guarantee that race would no longer be a factor in the separation amongst peoples.

While teaching Mendel's experiments, monohybrid and dihybrid crosses with and without dominance, law of segregation and independent assortment as part of that prescribed for genetics, the news of a genetically selected and bred baby was reported through the media. As stated previously a newspaper report (Appendix 2) of this event became part of the biology content in genetics. The report was used to examine future possibilities of 'designer babies' that would allow for parents to select desired genetically determined traits (G11). The deliberate selection of genetic traits introduced ethics into the Grade 11 biology curriculum.

In the class, the newspaper report created concern amongst students. Designer babies were not seen as an exciting future prospect. Jamal unhappily declared *that given a choice people will choose to have light-skinned babies ... this is what people like and prefer*. Designer babies and the selection of desired genetically determined characteristics highlighted how persons continued to be evaluated on the basis of skin colour and class. In Jamal's experience people, including his father, imitated White people *because they think it's better* and because it encouraged business. His declaration found support amongst many students (G12). Jamal had identified yet another link between race and class. Race - class interactions linked to the colour of the skin was part of Anneline's life experience. Anneline, because of her dark skin colour was called Blackie by her aunt. From this aunt she had learnt that worth was linked to skin colour and her concern was about who would afford and benefit from such technology. The race-class relationship raised also the possibility of dark-skinned peoples becoming the servants of light-skinned peoples (G13). Discussions on designer babies brought up understandings around skin colour and the relationships between skin colour, race and class in the biology classroom. These relationships identified within the biology classroom were not confined to the classroom – they permeated that which existed within the school and the wider community as well.

Dark skin was synonymous with dirt, filth, evil, ugliness ... light skin with better, right, beauty, pure, innocent, wealth, power ... this was what skin colour conferred on persons. These were the ideas that prevailed within the school and the wider community. Discussion on designer babies

provided some insights towards some insight on the meaning of skin colour within the context of race and class. Nolwande knew *that White people think that Black people are dirty and filthy. So who would want to have a Black baby* and for her designer babies, if they happened, would *happen with Whites* (N12). ... *darker skinned people – it's like they are dirty which was why the normal person will go for a lighter skinned baby* was Chreestheena's understanding (C11). Ugliness, a part of Black skin, for Pretty emerged as she shared ... *if you Black you ugly, and if you light you gorgeous* ... (and) *if we can design babies people will go for light skinned babies* (P9). Light skin and dark skin, for Waseela, resulted in different treatment being meted out to Whites and Blacks. *Whites ... because they were fair-skinned* ... (were) *treated as pure and good and innocent; Blacks like trash, like dirt ... like evil* (W13). Kaiser had learnt that White meant *wealthy* and *powerful.* Which was why *lighter skin* was *more acceptable* and *if people get a chance to design their babies they are going to go for light skin babies* (K5*). Lighter eyes, lighter hair and lighter skin are thought of as better ... and a lot of people say if I ever have children one day I want to have fair children* was how Jameel shared his experiences about response to colour. *It's also true that if people can design their babies they will want to have light skin babies* (J9).

Anneline's experience of being called a *nigger* had taught her that light skin was prettier. At school she had learned from a friend *that our baby is fair but you must see the neighbours. It is dark, dark, dark and ugly* (AN13). Ugly was how Nelisiwe described herself. *I'm a Black person. I hate the colour ... I see others ...light, cute. I'm dark. I'm ugly.* She also believed that given a choice ... *People will choose to have light babies because people don't like dark, ugly babies* (NF2, NF3) and the effort it takes to meet the features related to whiteness (NF1). From his time in primary school Arthur was called *Blackie* by his peers who were *Indian* like him. *I have to live with the fact that I am ... the Blackest kid around* despite the hurt and feeling of inferiority it caused him. He also believed that if people were given a choice they would choose *lighter skinned babies* because *light skin is so-called right ... they still think that light skin is better* (A24, A16). Light skin and hence the 'lighter race' was the favoured option because of the perceptions associated with skin colour. Thus race together with class, through skin colour, continued to be used to identify and reinforce perceived differences between people.

Besides race and class, gender and sexuality were also part of the environment and contributed to discriminatory practice. The text now moves to examining ideas students had about gender and sexuality. It is also important to recognise that whilst race and class and gender and sexuality did not operate exclusively of each other they have been described separately in an attempt to begin to make some sense of student ideas and to analyse oppressions, subordinations and discriminatory

practices. Although these overlap and are intertwined for the purposes of analysis it is useful to separate them out to see where and how they are operationalised and shape meanings and interactions.

7.3 GENDER AND PATRIARCHY

Patriarchy and women's bodies were two areas that allowed for an exploration into gender - through gendered understandings and explanations that existed within male-female relationships. Patriarchy dealt with understandings based on men and dominance within male-female relationships. Women's bodies explored how the female body was used to keep women in positions of subservience to men.

Entry into gender and patriarchy was through the metaphor of the mother cell–daughter cell when teaching cell division. The biology content on cell division, mitosis and meiosis, required that only the process of mitosis and meiosis, the biological importance of mitosis and meiosis, and a comparison of mitosis and meiosis be taught. While teaching the content of mitosis I questioned, as we moved from anaphase into telophase, whether the metaphor of mother cell-daughter cell furthered the notion of females as producers and nurturers. This switch to 'non-content' confused students and some faces registered disbelief – had they heard me correctly! I compounded the confusion further by questioning why it always was the males who were described as the inventors and discoverers in science giving the men of science the esteemed title of 'Father of ...' (CD10). Through lessons dealing with human reproduction the patriarchal understandings that guided the response to teenage pregnancies / pregnancies out of wedlock were illuminated.

Initial hesitant response to being provoked during the lessons by the students was because the students themselves were uncertain as to whether this was actually part of the discipline of biology. The 'argument' taking place between Arthur and Naseema about the role and position of men in society in the biology class added to the hesitation. Supported by Nolwande and Tivashni, Naseema was vocal in her response to Arthur stating that he was of that ilk of men whose view of women as nurturers was part of a greater understanding of women being inferior to men. Tivashni questioned whether biology, through its metaphors, served to entrench existing understandings of male superiority and female inferiority. (CD11). Despite Arthur's protests that the metaphor allowed for an 'easier' understanding of the process of cell division, most of the biology class agreed that

socially men were regarded as superior to women – a perspective most of the students in the class challenged (CD12).

The issue of the high rate of teenage pregnancies among students also provided some insight into student understandings on positions occupied by men and women in society when it was suggested

the pregnancy. If he was acknowledged it was with reference to his innocence in the pregnancy with the understanding that the girl should have known 'better'. The male was understood as that person who behaved in socially acceptable ways that a male would – in fact he was regarded as *cool* (AN3); the female was understood as wanton and lacking in morals. When it came to Black females who were pregnant the school did have a policy that allowed for their return to the school soon after the baby was delivered. This return was explained away on the notion that teenage pregnancies were a 'way' of life amongst Black people - a racism entrenched within the school policy and excused under the guise of cultural difference. This way of life was 'excused' on the basis of the culture of the Black people that allowed for such immoral impropriety within the school's 'Indian' context. No mention was made of the pregnancy. The male partner did not exist. Only a select few namely: the principal (a male), myself and occasionally the form teacher, if the principal deemed her able to keep this shameful truth to herself, were privy to this secret. Here the principal became the 'father' of the Black girl and in this way patriarchy is re-established over racism. If the form teacher was a male he would never be told. In this way the school entrenched gendered and raced identities.

Men were recognized as superior, powerful, owners, decision-makers, in control of - and therefore, in the position to be the protectors of women. Women were recognized as subservient to men in that they were described as inferior to, subordinate to, owned by, keepers of responsibility designated to them, controlled by and in need of protection of men. This was how students saw men and women positioned in society. This positioning of men and women in society guided not only how students saw men and women located in society, but also how the students would understand the subject content when men and women were part of or alluded to in the content of biology. This made the biology *easier to understand* (A9, C2, N3, CD12). It was this that made it possible to identify patriarchy as an operational category of gender discrimination that students came with into the biology classroom. Since the formal biology curriculum did not engage with any of these understandings, its focus being on the 'facts' of biology, it meant that students could leave the classroom with either their gendered understandings further entrenched because of the metaphors of biology; or with the ideas changed, not changed or challenged either positively or negatively not only because of the non-engagement with existing ideas in biology but perhaps through their own lived experience.

Within the school and wider community females, according to the students, occupied positions where the female was

- carer and nurturer;
- subservient to the male; and
- an object of disgrace when pregnant and not married.

The notion of mother cell-daughter cell and photographs in biology textbooks featuring babies always carried by women and children with women in the sections dealing with both nutrition and human reproduction are the metaphors used by the teachers with biology as if neutral to promote understanding in biology but these could evoke other meanings often out of the range of the teacher in the student – meanings that further entrench socially accepted identities of the female in the role of the carer and the nurturer and the male in that role with reduced or minimal responsibility in pregnancy, child-rearing, etc.

As carers and nurturers, the word 'mother' for Arthur meant *taking care of* and this captured for him the role of a mother; he was aware that mother also meant *supporting* and *reproducing* (A9). For Chreestheena, the female role of *reproducing* captured the essence of female identity and was how the world worked (C2). Anneline too saw it as the *females job* to *produce* and *care*; this was a female *responsibility*. The female's role as a carer became a 'non-questionable' for Anneline through the church pastor (whom she held in the highest regard by virtue of his religious position). Anneline's understanding of the female in the position of a carer was further entrenched through her religious life in how she interpreted the pastor's sharing with his congregation the position of his wife as a carer and by extension the position of women in general as carers (AN2). Identifying and focusing on the role of the woman as a carer made sense to Pretty; talking about the known role of a woman was not in any way being discriminatory to women (P3). Waseela's parents not only subscribed to the idea of women as carers and nurturers; but also taught this to Waseela and her brothers through the different ways in which she and her brothers had been brought up (W2, W3, W4).

The role of men and women when it came to the caring for and the raising of children emerged when dealing with issues around teenage pregnancies. The innocence/absence of the male in the case of a teenage pregnancy absolved him of all responsibility and also of caring for the child once it was born. Non-responsibilty and hence non-involvement in caring for and raising of children was also true for men in marriages, according to Nolwande, for whom all responsibility for the child began and ended for the male with him being only *in charge* (N3). Chreestheena recognized it was the mother who always took *more care of the children* (C3). For Anneline, unlike the males, the females showed *more responsibility* and knew *how to care* and this was why the responsibility of

caring was always the female preserve (AN2). Waseela's parents had taught her that it was the woman who had to do everything and bring up the children; this was a lifestyle her mother subscribed to and never questioned; and it was how Waseela, as a female, was being trained for her role in life (W4). Kaiser's world was made up of mainly *single parents*; *fatherhood at a young age* was also part of his world yet males played little or no role in raising the family; *and the sitcoms on TV that* were *now sexcoms* served to foster the males lack of responsibility in caring for children (K9). Responsibility of caring for children was a female task assigned to her by the male from his position of power. A male did this by putting himself in charge and tasking the responsibility of caring for and raising of children to the female and in this way he continued to operate from his position of power. He alone did not determine his position of power; in this he was aided and abetted by women who also subscribed to the notion of the man in charge and the female as responsible for caring and raising of children. In this way women preserve patriarchy.

While Nolwande, Chreestheena, Waseela, Nelisiwe, Kaiser and Jameel acknowledged that the female was identified in the role as carer and nurturer they rejected this existing understanding. Such an understanding emerged from notions of the *woman's job* as a carer while the man *took charge* of the woman (N3). Chreestheena believed that it shouldn't *only be the female anymore* who should be the carer since this contributed to the female remaining in an *inferior role* and allowed the male to evade responsibilities required in caring of children (C3). It was the woman's task to look after and take care of and *wait hand and foot on the men at home* (W4) and this for Waseela was not right (W2). Nelisiwe did not see this as the role of women only in society. She recognized that fathers, in producing daughters and sons, also had a responsibility, which was never spoken of and in that way avoided by males (NF4). Kaiser did not have answers to the existing understandings around the role of women as producers, carers and nurturers but not having answers was no reason not to question the existing understandings and attitudes towards men and women (K8). Jameel acknowledged that women were *always spoken* of as carers and nurturers and that this in itself was a *sensitive issue to many people.* In speaking of and for women and their responsibilities, Jameel identified that women were not given a chance to state their *point of view* if it was different from that which was understood as a given regarding women's responsibilities (J2). Sandile saw the need to speak about the gendered and discriminatory roles and positions of women – what he identified as learning's that would be in keeping with requirements of the 21st century (S2). It was the continued acceptance of women in the role of carer and nurturer that was used to keep women in positions of subservience to men by both men and women.

Males then become stereotyped as the superior protectors of females and children. It was male authority that determined and prescribed how the female nurturer would be 'allowed' to enact her prescribed role. Such stereotypes, while subordinating women, made no reference to and provided no space for males as carers and nurturers; made no space for males like Jameel (J2 – J8). The silence around male caring and nurturing relegated male nurturing to the realm of the silenced and 'invisible'. In this case the silence and invisibility was not linked to ascribing the powerful identity but instead to a refusal to acknowledge that outside the prescribed and socially accepted male role and identity. In this way what was not seen or spoken of stayed outside the equation; did not upset the balance in the set-scheme of life's accepted social operations that had functioned for generations and continued to function in the historically shaped present. For women who assumed the role of 'protector' this had to be with the blessing and the largesse of the male in his benevolence; where male approval was wanting both males and females then acted to marginalize the female through labelling.

There were a variety of strategies that were used to keep women in the subordinate and subservient role. Nolwande explained that women were denied access to knowledge because of the recognition that with knowledge would come the ability to take charge and *people were afraid* of that happening (N3). It was constant negative criticism of women for Chreestheena that was used to keep women in an *inferior role* and allowed for her to be *ruled* (C3). Religious 'understandings' were also used to locate women within the world of men. For Anneline this happened through her pastor's public proclamations of his wife's actions. It was the pastor who thus determined the role of the woman and for Anneline this spelt the 'truth' (AN2). Waseela's religious upbringing had taught her that it was the men who had *to protect women*; it was this that took away from the woman the ability to *stand up* for herself; that created the idea that women were *fragile* (W4). When a woman was raped it was the woman's fault and *not the man's fault* and that the girl/woman was disowned by the parents was also understanding that operated in Waseela's world (W5).

Pregnancies out of wedlock provided further insight into how men and women were positioned amongst each other in society. With teenage pregnancy, male's renounced all responsibility and this was the accepted practice in Nolwande's world (N6). Christina spoke of the male being made exempt by virtue of his position as *a man.* (C3). Anneline described as *cool* the Grade 11 learner about to become a father; his action of *sitting with a cell-phone in the math class* (and) *phoning to check if she was having contractions* as also *cool*; for her a male never suffered any disgrace when he fathered a child outside of marriage (AN3). Being ashamed was not for a boy when he made a girl pregnant - that notion of powerful masculinity; for the boy it meant he could *dump the*

(pregnant) *girl and find another girlfriend* (P4). That the *boy continues enjoying himself; carries on going to school* for Nelisiwe was unfair (NF5). In Kaiser's experience the *male just carries on* with no pressures brought to bear upon him (K9). Jameel shared that many *guys in the school have the egotistical idea that if a girl is pregnant it's her fault; if she's willing to have sex then it's not the guy's problem* (J3). These were the understandings that students came with into the biology classroom about teenage pregnancies and pregnancies outside of wedlock. It was these understandings that provided insight into how males asserted themselves through the notions of innocence and blamelessness and through this then maintained power over women.

Chreestheena highlighted, through discussions around teenage pregnancies, that it was the female who had to take the *blame*; the female always took *the rap for everything* (C3). For the female though a pregnancy outside of marriage would be a *different story*; if it happened to Anneline she would *be totally disgraced*; the female was always disgraced, a notion of the subordinate female in such circumstances (AN5). Being ashamed was reserved solely for the female if she was pregnant and unmarried according to Pretty (P4). Discrimination was an experience reserved solely for women according Waseela. This for her was exemplified when an unmarried pregnant woman was called *a whore* and *a bitch*; when the unmarried pregnant woman was *disowned by* (the) *father* (and) *by parents* (W5). It was only the girl who *bears the disgrace* if she found herself pregnant in Nelisiwe's experience (NF5). Kaiser too spoke of the schoolgirl being *disgraced* in the event of a pregnancy; being the one *that people talk about* (K9). Arthur alluded to the silence that existed around teenage pregnancies and the attitudes that existed towards teenage pregnancies – it was the silence that told of the taboo of the teenage pregnancy; of the female as irresponsible and disgraced (A10). Jameel's close school friend, who was *liked* by everybody and *respected*, could not bring herself to tell him that she was pregnant because of her *embarrassment* and shame at finding herself pregnant; it was the schoolgirl and her family that was *disgraced*. In Jameel's experience religion too was used to subjugate the unmarried and pregnant woman by making the woman an *exile* from society through keeping her at home in such a way that she was *never to be heard* and *never to be seen* (J5). Disgrace was branded onto an unmarried and pregnant female. This disgrace ensured that she remained powerless in relationships with men. The disgrace branded onto such females served to act as a constant reminder to all females about their worthlessness if they fell foul of the position allotted to them within a morality defined by males for women and subscribed to by both men and women.

This exploration of male-female interactions with the students revealed males as dominant and occupying positions of power. In these relationships the roles and positions of females as carers and

nurturers was used to keep females subordinate to males. Various strategies existed and ensured that females remained locked within these understandings and 'punishments' meted out to females, as in instances of pregnancy outside of marriage, established the subordinate position of the female to the male in the society that the students came from to the biology classroom. Patriarchy was a common and accepted feature in the lives of the students in the biology classroom. It was this unquestionable dominance of the male and his position of power that also allowed for the female body to exist as a commodity – a commodity whose importance and worth was determined by the male in the world of male-female interactions.

Biology education through its use of gendered language, through the symbolism in text as found in its portrayal of women in photographs, placing on women the responsibility of transferring of sexually transmitted diseases etc. continues to entrench patriarchy in society. It is this that can be challenged through the creative use of biological 'facts' and textual representations in biology education.

7.4 BODIES AND SEXUALITY

The importance and worth accorded the female body emerged when dealing with human reproduction and genetics. Human reproduction required that students learn only the facts about male and female reproductive systems, gametogenesis, ovulatory and menstrual cycles, fertilization, embryonic development and implantation, gestation and post-natal care. In teaching reproduction in this way socio-cultural and religious meanings ascribed to women's bodies could be deleted from a traditional biology curriculum. Sexually transmitted diseases were an optional part of the biology curriculum in human reproduction. In being an optional part of the curriculum the secrecy and associated taboos around sex and related issues as a feature of society could be maintained for those teachers who felt uncomfortable about such discussions in the classroom. The official curriculum too was unwilling to offend society on the required secretiveness on sex and related issues. Human reproduction thus allowed for an engagement with sexually transmitted diseases and also on abortion.

In genetics the focus was on Mendel's experiments and monohybrid and dihybrid crosses with and without dominance, law of segregation and independent assortment, sex determination, determination of characteristics, gene mutation, natural selection and some applications of genetics such as increased productivity and inheritance and prediction of blood groups. The focus on abortion, an optional part of the biology curriculum, as part of the biology lesson however, occurred

when teaching inheritance of characteristics, specifically a disease characteristic, in the unit on genetics. Sex determination and the transfer of characteristics opened a space in biology education for interrogating issues of sexuality.

The worth accorded to a female was extrapolated from responses of students towards the female body. This was ascertained through the various positions taken by students in the class when dealing with

- the female body in instances of a teenage pregnancy;
- the females as the source and transmitter of sexual diseases; and
- the female's right to choice on abortion in instances of genetically transferred diseases.

Student understandings and beliefs came from being confronted with an 'atypical' biology – one that taught not only fact and content (the responsibilities to the students with regard to the formal curriculum had to be met) but also engaged students around social issues that framed their everyday lives. It was my deliberate and intentional interventions that made biology 'atypical'.

Fertilization of an egg by a sperm led to pregnancy or gestation that led to external physical bodily change and thus became public knowledge. Thus any pregnancy including a teenage pregnancy could be disclosed. Classroom conversation around teenage pregnancy began to make clear how the female body was viewed from the perspective of a pregnancy outside of a marriage. The female and her body were described in unflattering terms as '*walking around with a big stomach*' by Noleen who would be '*picked on*' if she chose to come to school in her pregnant state according to Waseela (HR15). In Tivashni's case a pregnancy outside of marriage would force her into a marriage because the evidence of her pregnancy through her body would make both her and her child unacceptable within her community (HR17).

Naseema suggested an abortion was a solution for any pregnancy outside of a marriage - including one that was the result of a rape. The pregnant female would have no say in this instance. The abortion would ensure that the female body would not provide public knowledge of the pregnancy (HR19). The silence around married pregnant females spoke of the social conditions that made pregnancy permissible for both males and females. Female subordination by both males and females was thus reinforced through using the unmarried pregnant female body as a vehicle to reinforce male ownership of the female body.

I deliberately drew the students' attention to those pages in the textbook (Ayerst et al, 1989, p 348 - 350) where it stated that it was prostitutes who were responsible for the transmission of sexually transmitted diseases (STD2). It was females who used their diseased bodies to ply their trade. Since HIV and AIDS is now a serious problem amongst South Africans, especially amongst persons in the 15-25 years age group, it was this that became the focus of the classroom discourse. The silence around the positive HIV AND AIDS status was a cause for concern especially with regard to how the disease was transmitted. Nolwande claimed that the silence around a positive HIV AND AIDS status was specific to males - who were the ones who slept around and transmitted HIV (STD10). Gladys's late friend had been the victim of her boyfriend's silence on his positive HIV status (STD11). The female body was thus viewed as either diseased or as a receptacle for disease. In the instances where silence surrounded the positive HIV AND AIDS status the female was not consulted on whether her body was available as a receptacle for the disease.

A taboo topic, despite constitutional legitimation, is abortion. Taboo because of the socially valid religious understandings that give value to the acceptable and unacceptable. As a part of the interventionist and unexpected teaching strategy I engaged students in a role-play on this taboo topic. During the lesson I assumed the role of a pregnant female intent on an abortion. Students became involved through being asked for their responses to my stated intention. Students then became pitted against one another through their responses. Being pitted against one another in positions that accepted or rejected abortion brought out student beliefs because students were now secure and 'safe' in their engagement with each other. Abortion as a solution when a disease was genetically transferred illuminated student positions on whether a female had the right to choice on abortion without her partner's involvement. For most students in the class abortion was a no-go area with religious beliefs being the point of departure. For Pretty, Fawzla, Safia and Arthur religion denounced abortion and called it murder (AB9, AB10). This meant that any woman who then decided for herself and her body and chose to have an abortion was engaging in an unacceptable act of murder. Naseema was the only student who stated in class, despite the disagreement she faced, that a decision on an abortion concerned only the woman and her body and nobody else (AB10). For the rest of the class, as stated by Kaiser and Noleen, any decision about an abortion had to be a joint decision of both male and female partners (AB5, AB8); the female could not decide the fate of her body by herself; and that this was part of the honesty that was demanded of any relationship. Females making decisions about their own bodies when it came to abortions did not find favour amongst most students in the classroom despite current South African law that has legalised abortion and also gives to females the right to make their own decisions about abortion. This too

made clear that a female lacked ownership of her body. These were the understandings that guided the student interactions with the biology content in the classroom.

The positions taken by students in the biology classroom when ascertaining the worth ascribed to a female body also characterised positions that existed within the school and wider community. The pregnant unmarried female body, the female body and sexually transmitted diseases specifically HIV and AIDS and the female's right to choice on abortion provided insight into what worth could be given to the female body. In the wider space, outside of the biology classroom, physical abuse and violations perpetrated on the female body provided further insight on the female body and worth.

Within the school and wider community the changing female body of a pregnant unmarried female provided the evidence for the shame and disgrace that was heaped upon the hapless female and in many instances her family as well. While Nolwande's family was accepting of her unmarried sister's baby this was not without Nolwande herself being warned by her father of dire consequences for herself if she found herself unmarried and pregnant – there would be no escaping the evidence that her body would provide (HR17). Chreestheena accepted the shame and disgrace that went with the pregnancy as evidenced through the body of an unmarried woman (C4). The pastor at Anneline's church in a sermon made reference to the increase in the number of teenage pregnancies and spoke of how such events in recent bygone times were *big things*, that is unacceptable and inexcusable things (AN5). Anneline too subscribed to the pastor's notion of an unmarried pregnancy being unacceptable; if it happened to her, then from the evidence of her own body, she would be *totally disgraced* (AN5). For Pretty the *big stomach* and the *breastfeeding of the baby* were part of the shame visited on the female – through her body. The male now also had the liberty of *dumping the girl* and finding himself another partner; he moved from one body to the next as needed (P4). This was a view expressed by Nolwande also. In Nolwande's experience men chose to have no idea about what it was to be a woman as happened with a teenage pregnancy. Once the female was pregnant the male *usually just ran away*; that is if he could no longer use her body to suit his needs he moved on to the next available female body (N6). The female body existed then to service the needs of men. *A whore* (and) *a bitch* were names used to describe an unmarried, pregnant female exposed through the evidence of her changing body; and such *fallen* women were then disowned by their fathers in Waseela's experience (W5). Jameel shared that if an unmarried female's body provided evidence of a pregnancy she was exiled from the community by being made a prisoner within her home (J5).

Besides Anneline and Chreestheena, the students disagreed with the existing understandings within the school and the wider community towards unmarried and pregnant females. It was the distinction that was drawn between a pregnant married and a pregnant unmarried female that pointed towards the regard given to a woman's body. No mention was made of the bodies of married pregnant women. The swollen 'stomach' and breastfeeding – natural events inherently associated with pregnancy and childbirth were used to locate how women and their bodies were located in the wider social context. The shame and disgrace visited on pregnant unmarried females, on the evidence provided by their bodies, spoke volumes on how women's bodies were really understood as commodities of little or no importance or worth. The silence and associated acceptance of a pregnancy within a marriage was used to affirm the woman in her role as a producer. The wrath visited on a pregnancy outside wedlock reflected the wrath of a social system on females who chose to act outside of set social roles. The subordination of females, by both males and females, occurred through how the female body was meant to be used. The production of progeny and caring and nurturing was possible only through social public permission evidenced through marriage. Anything outside of this was illicit and unacceptable. Placing a public moral judgement then on unmarried pregnancy was how females and their bodies continued to be held in check. In this instance the silence and invisibility around the male's role and responsibility served to entrench his position of privilege and power in all male-female social interactions.

The wider community provided the initial understandings for students about males and females and sexually transmitted diseases specifically HIV and AIDS and how this was related to the woman's body, not only as diseased but also as a source and transmitter of sexual disease. These understandings were then mediated amongst students within the school community and brought into the classroom. As these understandings were being explored Nolwande's claim was one that most students related to. She claimed that Black township girls, both those *blinded by love* and those who were *raped*, were the ones with AIDS (N10). Chreestheena agreed with Nolwande that it was township girls who transmitted AIDS and added that it was the prostitutes from the townships that were responsible for the transmission of this dreaded disease (C6). Ignorance about AIDS in the townships was why the girls in the townships continued to be the transmitters of the disease; it was why Nolwande's understanding about the source and transmission of the disease had to be correct for Anneline (AN10). The church had also, through its youth counselling programme, made Anneline aware of how a man in choosing to be silent about his positive HIV status deliberately infected a female – the female body being used by the male as a repository for the disease (AN11). For Pretty what Nolwande had shared about township girls was an unpalatable 'truth'; in focusing on girls Pretty too acknowledged that girls were the transmitters of disease (P6). Nolwande's 'truth'

could also be misused to say that *women bring about AIDS* was Sandile's concern (S5). The township girl's body as the source of AIDS was true for Kaiser's township, which was different to that of Nolwande's (K12). Since the brunt of the blame would always be the females, according to Arthur, women needed to be *more aware* of sexually transmitted diseases like HIV and AIDS because at the *end of the day it would be her body that would be infected* and from which the disease would spread (A11).

Nelisiwe, Waseela and Jameel rejected Nolwande's claim. Nelisiwe recognised that males too played a role as transmitters (NF7). Despite her rejection Waseela recognised that this did not take away from the 'popular' view that the girl was the *source of disease* (W5, W7). Jameel noted that males were left out of the equation while females were targeted as the source and transmitters of HIV and AIDS (J7). Chreestheena, even though accepting of Nolwande's claim, shared that the focus when the disease was discussed was always the female; the male remained innocent by virtue of being male – *for males it doesn't matter* (C7). Jameel expressed that in making her claim, Nolwande as *a female was discriminating against females* and thus reinforcing existing ideas about women as the source of and transmitters of disease through their bodies (J7). The notion that the woman's body was the source of sexual diseases from which disease transmission occurred was acknowledged by all whether it was accepted or rejected as a truth; this positioning of women further strengthened existing understandings about the non-importance and the worthlessness associated with women's bodies.

The non-importance and worthlessness of the female body was also evidenced through the physical abuse and the violations perpetrated on a woman's body through unprotected sex, beatings and rape. Male unwillingness to use condoms, according to Nolwande, was based on the male claim that condoms took away from the enjoyment of sex and *being a man;* and any suggestion by a female about the use of a condom or the need for a medical confirmation of the male status with regard to a sexual disease evoked in the male a response to the female where he called her *names* and *hit her*. In this way girls were then *forced* into sex (N10). The lack of respect for women and their bodies, for Waseela, was evident in the response to rape: *when a girl is raped it's not the man's fault* (W5). Nolwande also held the female responsible for the violation of her own body. If a female chose to go out from her home after dark she could become a *victim* of *rape* and could even be killed (N8).

Contrary to what Nolwande understood, Nelisiwe had been raped in her own home during the day which left Nelisiwe feeling *bad, upset and angry* and asking herself the question *how could it have*

happened to me - both because of the violation of her body and the disregard for her as a person of importance and worth (NF9).

The violation of rape could result in a pregnancy. Pregnancy provided the space for a discussion around abortion – with pro- and anti- abortion positions providing further insight into how the female body was ascribed worth. Under these circumstances an abortion was a possible solution. Naseema's response that an abortion could be the solution completely disregarded the pregnant female's role in the making of such a decision about her own body (HR19). An abortion could be an alternative to the shame and disgrace used to put a *woman into exile* suggested Jameel; the woman's role in any such decision about her body not being considered (J6). Sandile's anti-abortion stance based on the notion that a *child was gift from God* and an abortion could therefore never be a preferred solution took away the pregnant female's right to decide for herself what it was she wanted for her body (HR20).

Both male and female students contributed to the view of a woman's body as non-important and worthless. Males did this through assuming their rights over the female body that for them was a commodity. Women contributed through the notion that the female was responsible for the violations perpetrated on her body and that the male was absolved from any and all responsibility for violations perpetrated by him. A few students, females such as Waseela and males such as Jameel, disagreed with and resisted this understanding.

The female's lack of control about any decision concerning her own body or her right to choice was further highlighted when interrogating the female position on abortion in instances of hereditary diseases. The hypothetical instance of a pregnancy being aborted because of the transfer of a gene for a hereditary disease brought to the fore responses that revealed how a female was positioned under such circumstances. The female was denied the right to decide for herself and her body – any decisions around an abortion had to be a joint decision taken by both the female and her partner. This position remained unaltered even if the partner was known to have an anti-abortion stance. Nolwande together with Kaiser believed that any such decision was a *shared responsibility* (N7, K13).

An anti-abortion position was taken by Pretty, Nelisiwe and Arthur (P10, NF6, A14). Arthur reiterated his belief that an abortion was akin to murder – it *basically boils down to killing a baby* (A14). Sandile's silence around abortion was in keeping with his understanding that a child was gift

from God and abortion a non-mentionable – here again the female had no choice about her body (S4, S9).

Anneline had experienced the community response to her aunt's abortion – *a lot of people criticized her*; and she had learned from this experience that a woman making a decision about an abortion was surrounded by condemnation (AN9). A woman was not afforded any dignity when it came to her making decisions about her own body because she did not 'own' her body. Her body was the property of 'people' around her; both male and female. It was the 'people' who decided for her and in this way denied her both importance and worth of her body.

The shame and disgrace heaped on the pregnant unmarried female or female teenager from the evidence provided by her burgeoning body; the female body as a source of sexually transmitted diseases and the female as the transmitter of these diseases; the female body as a site where violence could be perpetrated without a qualm; and the female being denied the right to choice about an abortion – each of these issues was opened for interrogation through the biology lessons. This lack of worth and non-importance of the female body highlighted the discrimination experienced by women living in a male dominated, patriarchal society.

At the same time the female students, as dictated to by operational understandings of the wider community and the school, remained concerned with their bodies as evidenced in the care and attention lavished on them. This care and attention too was sanctioned by existing social requirements as to what was a 'beautiful' and acceptable female form – a thin body smartly clothed in branded fashion and face and hair adorned according to the dictates of current acceptable fashion. Through these superficial trappings the actual worth/worthlessness of the female body remained hidden only to surface if and when the burgeoning body through unsanctioned use was forced into public view.

Sexuality and sexual preference was not part of the formal biology curriculum. The male and female reproductive systems, gametogenesis, ovulatory and menstrual cycles, fertilization, embryonic development and implantation, gestation and post-natal care as that which dealt with the human reproductive system implied that heterosexual relationships were the only relationships that existed. With both human reproduction and genetics the transfer of sex characteristics dealt only with the X chromosome as that which determined the female sex characteristics and the Y chromosome as that which determined the male sex characteristics. When teaching genetics the transfer of characteristics from parent to offspring by genes was discussed. Dominant and recessive

genes and their influences across various generations were also reviewed. The focus in the formal curriculum was on the factual detail located in the content of biology.

I brought to the class newspaper articles (see Appendix 2) on designer babies. This became the basis of the lesson. I then 'unsettled' students by sharing with them my view being that of science assuming and playing the role of God. For students designer babies was a new idea – one they still needed to get to grips with. The class discussion on the transfer of characteristics by genes then shifted in its focus from that on designer babies to sexual preference. Arthur did this by confirming during the lesson that genes were responsible for the transfer of characteristics. Having confirmed this he then questioned whether homosexuality was also a characteristic that was transferred by a gene. I was evasive because I felt threatened and unsettled. On not receiving a direct answer to his query from me, he launched into a tirade against homosexuality. Through Arthur's intervention sexuality became the topic of discussion in the classroom (G15). Kaiser and Anneline made it clear that they found Arthur's view unacceptable and this was also the view of many students; a small group's only contribution was the intent with which they listened to the exchange going on in class; and Naseema was the only student who openly supported Arthur. Homosexuality as a topic for classroom discussion resulted in class chaos – this shed light on how strong the students' views were on the right to choice around sexual preference (G15, G16, G17). Later in a conversation with Anneline it emerged that there was a homosexual student in the class (AN16). The strong reactions of students to homosexuality perhaps was an outcome of personal conflicts. Religion and social mores dictated that homosexuality was taboo and evil. The students though found it difficult to characterise the homosexual student in the class, who was caring and gentle, as evil. It was this that was causing the students the deep distress that then spilled into the strong responses. When Naseema spoke of homosexuality as not what *God and nature intended* she received support from even those who had disagreed with Arthur previously (G18). The classroom interaction on a topic raised by Arthur highlighted the very strong responses amongst students on the right to choice around sexual preference. Anything outside of the 'accepted' heterosexual preference opened itself to discrimination.

Many students were guided by the religious beliefs that prevailed within the wider community when it came to the right to choice around sexual preference. The wider community perspective was what mediated the responses amongst members of the school community. It was this that prompted Chreestheena's declaration that *God created Adam and Eve and not Adam and Steve*; and that her *mother would rather see* her *dead* than in a lesbian relationship which would be *mocking God* (C10). Sexuality defined as heterosexuality was a *teaching from the Bible* for Pretty (P11). Nelisiwe

identified homosexuality as being *against God's law* and therefore we *must reject it* (NF11). Like Naseema, Waseela too found homosexuality *shameful.* Waseela also believed that by being silent and not sharing her *opinion* afforded her the privilege of not discriminating against homosexuals; her silence meant for her that she was granting the homosexual a right to choice (W12). *Homosexuality! It's shameful. It's against God's law ...It's wrong* summed up Arthur's view on the right to choice when it came to sexual preference (A18). Arthur however, was selective about his response to sexual preference – as demonstrated in his 'acceptance' of his bisexual music teacher (A19).

Nolwande was caught between a religious understanding that homosexuality was *shameful* and *against God's law* and a realization that it was not for her to judge the right to the sexual choice made by any individual (N13). It was difficult for Anneline to decide whether she was *against it or not against it* – on the one hand her pastor, whom she looked up to, had shared with his congregation his anger on homosexuality as a preferred choice; on the other hand she knew a student in her class who had made such a choice; and she had also known *Daniel* who had allegedly been murdered because of his preference for males. Her religious environment was at odds with her actual knowledge of people as human beings who had made such choices (AN16).

Homosexuals are human beings and should be treated equally was Kaiser's response; as humans they had to be accepted (K14). The right to choice was what Jameel spoke about – *that is an individual's decision ... you choose to go in that direction* (J11). Both men and women determined what was acceptable when it came to sexual preference. The right to choice was only allowed if the 'right' choice was made. The authority of religion was used to validate the 'right' choice, which was the heterosexual choice, and was also to discriminate against any other form of sexuality. The Bill of Rights in the Constitution of the Republic of South Africa that guaranteed the right to sexual orientation was ignored; it was religion that dictated on this issue.

Sexually transmitted diseases gave further insight to students' perspectives on the relationship between this and race, poverty and wealth. It is to this that the discussion now turns.

7.5 CLASS, POVERTY AND HIV AND AIDS

An optional part of the biology curriculum is sexually transmitted diseases. As explained previously any discussion on sex and related issues is socially taboo and also unacceptable according to prescribed religious understandings. The optional nature of any such study then allows for the preservation of social taboos and religious dogma. Here the teacher, based on the teacher's values

and beliefs, is at liberty to decide whether or not to teach this content. As part of the biology Grade 11 programme the students were introduced to the sexually transmitted diseases gonorrhoea, syphilis and HIV and AIDS with the focus of the lessons on HIV and AIDS. These were the sexual diseases prevalent in the country with the KwaZulu-Natal province having the highest incidence of HIV and AIDS amongst the 15 – 25 year age group. The content on gonorrhoea and syphilis came from the textbook (Ayerst et al, 1989), in the section titled *Veneral Diseases: optional section* (p348), where the development of the disease and its symptoms were described. Information on HIV and AIDS came from that provided on fliers by the various non-governmental organisations. The focus with HIV and AIDS was on how the virus was transmitted, development of the virus in the host together with the development of the acquired immune deficiency that resulted in the host and the effects of AIDS on the host.

Most students admitted to not having heard or knowing of gonorrhoea and syphilis. According to the textbook it was prostitutes who were responsible for the transmission of sexual diseases and this caused concern for some students (STD2). Students had all heard of HIV and AIDS from the numerous advertisements through the media and billboards and shared that they found the advertisements boring. Students also disagreed when it was suggested that there existed an unwillingness amongst people to disclose a positive HIV AND AIDS status (STD9). This silence around the positive status was attributed to males. *It's the boys who do not speak the truth and who sleep around and pass HIV* claimed Nolwande (STD10). Gladys's friend got AIDS from her boyfriend who *did not tell her he had AIDS* (STD11). Most of the class agreed with Kaiser who claimed it was Black people who had HIV and AIDS. Whilst this claim upset Waseela, who knew of Indians with AIDS, Kaiser went on to justify his claim to the class by stating that newspapers speak only of Black people with AIDS (STD13). Whilst a few students agreed with Waseela, the overall belief amongst students in the class was that stated by Kaiser. Within the biology classroom then HIV and AIDS was understood as a sexual disease of Black people. This understanding extended from the wider community into the school community and the classroom.

Within the school and wider community race intersected with gender and class when it came to explaining the existence incidence of HIV and AIDS. Nolwande integrated gender, race and class when she claimed that *It's also true that Black township girls get AIDS* (N10). She went on to share about the time a blood clinic found *80% of student blood donors from a Soweto high school were infected with HIV. Now it's Black people who live in a township* ... (N11). Sandile and Kaiser agreed with Nolwande. ... *Black township girls get AIDS ... most people in the township they too would agree* was Sandile's understanding (S5). *Take Kwa Mashu ... the youth of today ... The girls*

go for... AIDS was Kaiser's contribution to the discussion on AIDS and HIV (K12). Pretty explained away her difficulty with Nolwande's 'truth' by distinguishing between townships and the perceived behaviour of girls from the different race groups. This she achieved by disputing Nolwande's claim when she declared *Maybe it's true for Umlazi ... the girl's in Ntuzuma they behave like Model C's* (White girls/ Black girls who attend schools that were for Whites only during apartheid) (P6).

Nolwande's claim validated Chreestheena's and Anneline's beliefs about AIDS and township girls. Chreestheena attributed Nolwande's claim to a lack of morals, poverty and prostitution that for Chreestheena characterised township life ... *most of them in the township are so poor they become prostitutes to get extra mone*y (C6). For Anneline because it was Nolwande, from a township, who had stated that Black township girls get AIDS - then made the statement a 'truth'. This despite her interaction with Ann, a White woman, with AIDS. Like Chreestheena she too attributed the prevalence of AIDS amongst Black women to a lack of morals and income. Although Arthur spoke of AIDS occurring amongst the various races his focus too was on the *girls ... But then again females should be more aware of AIDS and HIV ... At the end of the day it's her body that's going to be infected* (A11).

Nelisiwe and Jameel were both surprised at and disagreed with Nolwande's claim. Nelisiwe was clear ...*it's not only the Blacks ... (and) Sometimes it's the boy who gives the disease to a girl* (NF7). *Saying that it's Black township girls that get AIDS is like saying Black girls are cheap* stated Jameel. *Everybody gets AIDS ... all the blame is put on the females. The guys are just left out of it.* What he could not understand was this came from Nolwande. *A female discriminating against females. That's so confusing* (J7). When Waseela rejected Nolwande's claim she shared ... *when somebody says (its) Only Black township girls get AIDS ... it's not only how the girls are seen – it's the racism as well* (W7).

The connection between sexually transmitted diseases and race, gender and class became another way of identifying and maintaining oppressive differences between groups of people. Sexual disease was understood to be confined to Black people and Black women specifically. Even when evidence existed to the contrary, as happened with Anneline, it was ignored in favour of the stereotype that associated Black women with AIDS in the school and wider community.

7.6 INSTITUTIONAL POWER AND HIERARCHY

The biology curriculum through cell division, human reproduction, genetics and biological determinism (as already described) contributed both historically and through to the present, towards shaping the identity of both individuals and groups. Gender, sexuality, race and class and religion as constructs were also contained within this biology curriculum. When these constructs became focus areas within the curriculum they engaged with the identity of the student – an identity that was being formed through interactions with the biology curriculum, the biology class, the school community and the wider community.

During the classroom interactions students identified themselves and each other as Indian, Coloured or Black; male and female; rich and poor; and as Muslim, Hindu or Christian. In ascribing to themselves and to each other these various aspects of identity the students shared how they understood each other from the perspective of the constructed and multi-layered identities. These constructed multi-layered identities were constantly influenced by and continued to influence also the student identities that existed within the school and wider community.

Within the school community every student had some interaction with race in the construction of the multi-layered student identity. In some instances gender, in the form of the male, operated overtly with race in constructing identity. These constructions were used to sustain the 'different' and 'separate' identities that existed within the school community. Religion too structured identities as different and separate. Students as institutionally powerless and teachers and management as the institutionally powerful was also part of that which made up the multi-layered student identity at the school. School community interactions had as their basis existing interactions from the wider community.

In drawing attention to the interactions that occurred in the different classrooms in the school, that which contributed to the various layers making up the identity of the student was exposed. The role of race in constructing identity was experienced in several ways amongst the students. Chreestheena was candid about the relationships between Indian and Black students in her class. ... *you get one or two of those who don't get on with the Blacks in the class* (C12). The largest numbers of students in the class were Indians. This was why the Blacks/African students in the class were *intimidated* and *overruled* by the Indian students according to Anneline. It was what gave Indian male students the power to tell Black students in the class that *the Blacks must go and build their shacks outside* inferring that the classroom space was for Indian students only (AN14). Nelisiwe's personal

experiences at school validated Anneline's observations about Black/Indian interactions at the school site (NF14).

Sandile shared that he was *nervous* and *no longer comfortable* in his *new class group* (grade 12 class). For him, even though the different race groups sat next to one another in the class did not mean that integration had taken place (S13). Jameel, a *Coloured*, also knew of a few people in his new class who did not *want to be your friend because of your race* (J17).

It was different backgrounds that was responsible for the different points of view between Black and Indian according to Kaiser (K6). People however, were still not equal in the classroom in his experience. The students in the class who were friendly with him did not hesitate to use the offensive word *kaffir* when angry; they also called him a *Black thing* that came *from the bush*. If he hid a pen when playing a trick on those who were friendly with him in the class it earned him the rebuke of being told that he was *learning to be a thief like the Blacks* (K15). These were the experiences that played a role in shaping race identity in the classroom. Race played a role outside the classroom also.

Many students identified student group patterns at the school as a pattern that was shaped by race. Sandile declared that students were taught to keep the race groups to which they belonged. *...the children they keep to themselves. The Blacks, the Indians and the Coloureds. That's become normal for us* (S13); a sentiment also echoed by other students (C12, AN19, W10, J17). Student response to one another with race as a determinant was raised by Chreestheena's *Like when we're having a competition and a Black person comes and stands next to you ... you just move away* (C12). This was not just her experience. When Black students were together, singing and dancing and having fun Waseela found that the Indian students viewed them as though something was wrong with them and commenting *they think this is their township* (W10). Pretty believed that the Black students in the school were *seen as hooligans* (P14).

Touch for Kaiser became an indicator of race as a determinant in school interactions. He remembered that people were not willing to touch him when he first arrived at the school and *Indian's would dust themselves* if he touched them. He had also experienced *Indians at the school making jokes about the names given to Black people – they laugh at us and use our names for name-calling*. Kaiser also believed that he could not be chosen as a prefect because of his race in the Indian dominated school that he was *privileged* to be at. (K6, K16, K17, K18).

Arthur's 'Blackness' singled him out amongst students. He described himself as an Indian who was *the Blackest kid around* and called *Blackie* by Indian students. For Arthur colour on its own acted as a determinant to separate and also acted as a determinant of identity. Colour determined his oppression by both males and females within his own race group despite him being an Indian male in a context amongst students where Indian males, who functioned from the position of 'whiteness', were the most powerful students. Jameel, who was light-skinned, identified himself as a Coloured who did not *get along with other Coloureds* in the school. He offered no explanation for his alienation from Coloured students (J17).

For Nolwande and Pretty race and gender both contributed towards constructing identity. Indian male students in the school mocked Blacks in Nolwande's experience. Even the Indian males who were always alone spurned the efforts of the Black female students who attempted to befriend them. She reasoned that this was because they *would be mocked for being with Black girls* ... (N21). It was an Indian, male student who pushed Pretty and said *move away you kaffir* eliciting from Pretty a response where she called him a *coolie*. In this interaction Pretty too used race as a determinant to identify the student she was interacting with (P14). Race and gender operated both in the school and in the classroom where Indian males acted from a position of power when constructing Indian and specifically Indian male identity.

Teachers, school management and school administrative staff in their interactions with students contributed too to the student identities being forged within the domain of the school. The identity constructed through these interactions emerged through notions of power (A23, N19, K7, K17, C16, J18, P13). Teachers on their own or with the support of school management and school administrative staff were powerful within the context of the school environment with students being powerless. School management in their relation with teachers emerged as powerful with teachers as powerless. Waseela recognised teachers too as powerless in their relationship with school management. She noted that when it came to prescribed curriculum delivery *Teachers ... They're just interested in finishing the syllabus ... If they don't ... they'll get into trouble with the office. The office definitely exerts a power on the teachers* (W14, W15). Waseela had identified, for herself, the existing hierarchy amongst the educator component at the school.

Teacher power was used by teachers to control students and was operationalised through various teacher strategies. Teachers, through their positions, told students *what to do* because teachers had *the upper hand in everything,* and teachers not communicating with students was how teachers guarded and maintained control and power (N19, C16, A23). Students often found themselves *in*

conflict with teachers and powerless when teachers used teacher power to impose school rules on students (J18). Racism too provided a strategy for teachers to assert themselves as powerful persons. This emerged when teachers marked the same work of Black students differently from that of Indian students; in teachers saying to Black students *you Black thing shut up ...I'll give you marks to pass but make sure you leave this school and never come back ... you shouldn't be talking cause you were born in the bush*; and in how punishment was meted out by teachers to Black students (K17, P13). Here race combined with power and allowed for the teacher to assert control over students. Race and power (of position) was part of the identity claimed by the administrative school staff in their interactions with Black students. When approached by students needing administrative assistance all dialogue was pre-empted by reminders of payment of outstanding school fees; this was different to interaction with Indian students who did not receive such reminders (K17).

Power was not used only to distinguish the hierarchical identity amongst the various role-players in the school environment. Power also served as a signifier of class identity. For students ...*the power of the richest and the poor* ... was used to distinguish between the students or as Arthur put it: *the only time you not equal is when it comes to finance* (W15, A22). Identity for the rich as powerful through *clothes and labels* was how students distinguished between themselves (W15).

Gender, sexuality, race and class and religion operated individually or in various combinations in constructing the multi-layered identity of students. The emergent identity as a function of the specific context of the student in the school environment was the outcome of interactions between a student and other students, teachers, school management and administrative school staff. The wider community in its constant interactions with the school community also contributed continually to the identities that were being shaped within this middle-class Indian school.

7.7 RELIGION AND EXCLUSION

Religion played an equally significant role in the lives of the student. Real-life experiences were mediated through the students' religious beliefs. Religious beliefs that mediated student understandings came to the forefront when abortion (linked to lessons on human reproduction and genetics); homosexuality (linked to lessons in genetics); and the origin of humans (linked to lessons on biological determinism) made up biology lessons.

A pregnancy outside of marriage, even as a result of rape, was for Naseema unacceptable *in a pious Muslim family.* She suggested that an abortion could be a way out of the ensuing disgrace (HR19). Sandile's response, amidst the many vocal rebuttals from students to Naseema's suggestion of an abortion, was that humans had no right to destroy that (a child) which is a gift from God in the manner suggested by Naseema (HR20). Here it was the religious self that guided the response towards a pregnancy outside of marriage. A similar response emerged when the transfer of a gene for an inherited disease became the grounds for an abortion (AB9, AB10). The religious self that subscribed to the understanding that God's decreed intent was heterosexuality was the favoured student position on sexuality (G18).

Anneline's religious beliefs fore-grounded many of her life experiences as was evidenced through her notions on gender, sexuality, AIDS and abortion (AN2, AN5, AN11, AN12, AN16, AN18). She was also sensitive to the religious intolerance amongst students that characterized the classroom environment; an intolerance that made her religious self unwilling to have religion as part of any classroom discourse (AN19). Waseela and Jameel shared how religion was used to maintain and reinforce gendered interactions and relationships. *My religion says that men are supposed to protect the women ... that does not mean women cannot stand up for themselves* (W4); with Jameel his experience of a pregnancy outside of marriage was one where *The Muslim understanding ... puts the girl into exile* ...(J5). Abortion, a taboo, grounded in the belief that a child was a gift from God was premised by religious beliefs (N5, AN12, W11, J6). When asking questions about the origin of humans*: What is the truth? ... the biological point of view or the religious point of view?* Jameel revealed that he was looking for an explanation that would coincide with his religious beliefs (J15). When asserting that people *are all the same ... should not discriminate against anyone*, Nolwande validated her assertion using a religious explanation viz., *the biblical view says God created man and woman* ... (N17). It was her religious beliefs that resolved this understanding for her. Nelisiwe acknowledged at the very outset that *God created me* and all peoples and also that *God created us differently* (NF1, NF2).

It was with sexuality that the religious beliefs of students emerged most strongly. In responding to homosexuality as unnatural and not what God had intended, the students revealed the religious beliefs that went into making up their multi-layered identities. Students accepted that homosexuality was *shameful* and *against God's law* (N13, NF11, A18). The same sentiment although expressed differently was true also for Anneline, Chreestheena and Pretty (AN16, C10, P11). Chreestheena in expressing her understandings shared with great clarity how religious beliefs shaped understandings around sexuality. She said ... *God created Adam and Eve not Adam and Steve ... If I had to bring*

home the same partner my mother would rather see me dead. It's against our religion ...(C10). The religious beliefs of students, as evidenced through these experiences, were beliefs forged both outside the biology classroom and the school. However, the classroom and the school provided a space where the religious beliefs did emerge and were reinforced and/or reshaped through the collective experiences and actions of students and teachers. A diversity of views and beliefs shaped this discussion.

7.8 LANGUAGE AND FAILURE

The language of biology was a foreign language for many students. It was this foreignness that caused confusion in the subject and added to understandings of being not intelligent and failures for some students. The biology curriculum had a language register that contained in it words similar in spelling and/or pronunciation and that explained very different ideas in biology; a word used in everyday language had a specific meaning within the everyday world and the same word in biology had a totally different meaning; and several synonyms existed for the same idea in biology. It was this part of the language of biology that caused confusion and that made the language of biology foreign to students.

Each unit in biology introduced new terms to the students. Cell division introduced to students the terms to describe the various phases of cell division from interphase to telophase; the terms given to various structures such as genes and chiasmata/chiasma – where chiasma was the plural for the feature chiasmata, and synonyms such as somatic and vegetative to describe the same set of conditions within a cell. In human reproduction the language register in biology included the various names given to the different structures found in the male and female reproductive systems such as epididymis and endometrium; and a biological term and its everyday equivalent or synonym such as uterus and womb, and gestation and pregnancy. Genetics came in with its package of terms such as phenotype and genotype, alleles, hybrid, dihybrid, homozygous and heterozygous amongst others. Biology then involved, not only engaging with ideas and processes of biology but also, becoming familiar with a new language register. Familiarity with the language register was what also contributed to success in biology.

Within the biology classroom the mystification and confusion caused by the language of biology made ideas in biology difficult to understand (N18, K8, A7, J16). As a result the subject itself then had little worth for the students who found themselves continuously grappling with the language. Biology where the *vocabulary confuses* ...(and) *does not benefit you in any way* was learned to pass

exams and once the exam was written the *knowledge got from reading the books is forgotten* (N18) – a common understanding expressed by Nolwande. Pretty recognised that success in biology was linked to the language of biology and Pretty believed that ...*We need to use the language of biology. Even the words I don't understand. Words that are biology* (P2). For Pretty success also meant that the teacher, *give notes and everything* ...(and) *for a test we'll learn from the notes and write what you've taught ... rather than writing about our own way of knowing* (P1).

Not understanding biology largely because of its language resulted in failure in biology. This then contributed to ideas of a person as not intelligent and a failure. *If you can't get the language right you feel ...like you not intelligent; like you a bit stupid. It gets to a person* ... was how Chreestheena engaged with her difficulties grounded, in part, in the language of biology (C1). Anneline's difficulties with biology, and specifically with the language of biology which was used *to make biology sound intelligent*, contributed in part to her having to repeat Grade 10 (AN1, AN18). The language too contributed towards reinforcing the differences between different people according to Kaiser who asked *Was this* (language) *invented for the White people who had bigger skulls and were therefore cleverer?* (K8). The elitist, sophisticated language of biology was, for Jameel, perhaps a strategy used by scientists because *scientists believe they are more educated and that you need to be very intelligent to understand information in science;* he also wondered at whether the *sophisticated language* was a tool to *brainwash* peoples understandings in biology (J16). Biology language was so *foreign* to Arthur that even the second language, Afrikaans, he was doing at school was easier for him. For Arthur though it was not just the language of biology – it was all language, which he attributed to his unwillingness to read because he was not a *booky* person; *Language is the root problem to all my struggles*, he recognized (A7). The language difficulties engaged with by his peers had escaped Sandile for whom the language was not a problem. He believed this to be true for most students when he claimed *I'm sure I speak for most of our biology students* (S12). Sandile's assumption was based on him being successful in biology – a success that resided in being competent in the language of biology.

The language of biology in determining success or failure in the subject also determined how the student understood herself/himself within and outside of the school. When the student understood herself/himself as a failure the student also understood herself/himself as stupid, not intelligent etc. These understandings were not used only by the student to characterize herself/himself. They were also the understandings that operated within the school and wider community and served to reinforce understandings of stupid, not intelligent and being a failure.

7.9 CONCLUSION

This chapter has explored from a descriptive perspective the how, the what and the why of discriminatory practice/s. The categories: race and colour; patriarchy and gender; bodies and sexuality; class, poverty and sexually transmitted diseases; power and hierarchy; religion; and language while organized individually continued to intersect and influence in various ways (just as corpuscles do as they pass and bypass each other). Each of these categories, from the position of the oppressed or the oppressor, appeared in the lives of the students at various times. Student complicity too emerged in preserving the discriminatory oppressions and subordinations of their lives. While student complicity contributed to the perpetuation of oppressions and subordinations there were also instances of resistance that emerged as students engaged with how they experienced the oppressions and subordinations in each of their lives.

The ruptures caused by a shift from the traditional contemporary objective biology education to a biology education that placed oppressions, subordinations and discriminatory practices at the centre of the biology class are examined in the next chapter. Such a shift made it possible to make student experiences part of biology education. How the students experienced the oppressions, subordinations and discriminatory practices in their lives and how these were entrenched and perpetuated in and through biology education is focused on. Race, class, gender, language, and power relationships are examined and how they play a role in perpetuating and maintaining discrimination is explained.

CHAPTER 8

A VEXED PROVOCATIVE BIOLOGY EDUCATION

(erythrocytes AND leucocytes... WHAT platelets too!)[6]

No theory can fully anticipate or account for the consequences of its application but remains a living aperture through which specific histories are made visible and intelligible (McLaren and Farahmandpur, 2001, p 148).

8.1 INTRODUCTION

You have journeyed through the capillaries and circulatory system with the corpuscles that make up the lifeblood of my factionalisations – both in the lives of my students and in my classroom. The factionalistions were also fashioned by experiences outside the biology classroom – experiences in the school and the wider community. As the capillaries ruptured apertures, however miniscule, appeared offering glimpses into a society that provided the organisational structurings for the goings-on in my classroom. Through the descriptions provided, how the structures served to dominate and subjugate, privilege and discriminate and create the powerful and the powerless identities became revealed. These were not simple oppostional binaries but, as recognised through the descriptions a complex maze that confounded as it hid. I am also reminded once again that the classroom is but a microcosm of the society that gave birth to it – a society that through my factionalisations begins to reflect back on itself.

Biology education in my class, shifted from a traditional, objective, rational etc. content-based programme to one that taught the content of biology and also named and challenged the oppressions and subordinations in this content. It was this naming and challenging of oppressions and subordinations that vexed and provoked through biology itself. In naming and challenging biology's complicity in validating racism through biological determinism students began to engage with their own preservation of or resistance to racism – an engagement that was accompanied by the pain of marginalisation through racism. Similar engagements on issues of oppression and subordination located in gender, class, religion and language occurred in the biology class as is evident through

[6] Erythrocytes are the red blood cells or corpuscles and leucocytes are the white blood cells or corpuscles that are found in the blood vessels of the circulatory system. Platelets are cytoplasmic cell fragments. Interrelationships between blood cells and fragments and the notion of colour is akin to the interrelationships between the variety of oppressions and discriminations and the notion of race.

the student and lesson stories in chapters 5 and 6. It was this that made it possible for me then to describe how racism/discrimination came to be played out in my biology classroom and the practices engaged with by me, the teacher and the students that made them racist/discriminatory.

This chapter, guided by the critical-race-antiracist-feminist understandings, attempts to explain why oppressions, subordinations and discriminatory practices persist in and through biology education. Traditional contemporary biology education teaches the 'rules' for participating in a world of an objective biology distant from the everyday experiences of the students. Imposing knowledge in this way then raises the question of the legitimacy of such biology knowledge for the students. Efforts involving agency and advocacy towards social transformation must also include student experiences through which students can name and challenge the oppressions, subordinations and discriminatory practices that frame their lives. Science education, and through this biology education, in dealing with issues of race, gender, class, language, religion, power, etc. remains focused on the accessibility to science education through inclusivity and remediation. The complicity of science education and biology education in perpetuating and maintaining these oppressions, subordinations and discriminatory practices remains marginalized. In placing these oppressions, subordinations and discriminatory practices at the centre of biology education with the fore-grounding of the oppression of race, how these oppressive practices come to be entrenched and perpetuated is explained. Biology education's silence around its contribution to the power of Whiteness, and as appropriated by Indianness, is made visible. How biology education has and continues to play a role in determining the identity of women and the roles of women in society as producers, carers and unpaid labourers and the denial of women's ownership of their own bodies through biology's complicity with religious values and patriarchy is also examined. The focus on heterosexuality as the norm in and through biology education serves to also strengthen the strong religious notion of homosexuality as an evil taboo and therefore not acceptable to society. That the specialist language of biology serves to exclude students from biology education and other education and life opportunities and in this way aid oppressive life experiences is also raised. In not questioning the role of biology education in entrenching and maintaining oppressions, subordinations and discriminatory practices in society, biology education through this silence is also given power to continue in its role as an oppressor and a subordinator. In making visible this power of biology education as an oppressor and subordinator, possibilities towards social transformation, through agency and advocacy in and through biology education could be realised.

Naming and challenging of oppressions and subordinations through the content of biology ruptured the equilibrium of the biology class. It ruptured also an understanding of racism as the only

discrimination experienced in the simple Black oppressed – White dominant formula. Oppressions and linked discriminations in areas of gender, class, power, language and religion became visible as they emerged from their coalescence's with race as oppressive and subordinating experiences in our lives. The rupture made for uncomfortable and distressing moments for both students and myself. It was these uncomfortable and distressing moments that provided contact with lived realities that the traditional structured and regimented biology curriculum and teaching practice silenced. The naming and unmasking of oppressions and subordinations in our lives put us into positions where, if we chose to, we could begin to make sense of the oppressions and subordinations and also engage possibilities for transforming existing oppressions and dominations.

8.2 BIOLOGY EDUCATION

8.2.1 Contemporary Traditional Biology Education

I want to say at the outset that the concepts taught in biology and that biology knowledge is important. I must emphasise the importance of biology knowledge as produced by the criteria according to the world of biology and science. What I am concerned with is the ways in which such knowledge is presented – as neutral, factual, rational and objective. This analysis brings into biology education contemporary theories of education in which education is seen as the acquisition of knowledge and consequently power to control the environment, society and one's self; and that a knower is characterized as having conscious and complete control through the will, through intention and through conscious decision over self, environment and nature (Schwandt, 1998). Biology education then exists as an enterprise comprised of a set of controlled activities in which knowledge is acquired – as an instrument of control. Through such control education aims to 'empower' individuals to confront the world, solve problems, increase social mobility, obtain a better job and so on. This 'empowerment' occurs according to the rules of the current capitalist hegemony and serves only the interests of the hegemonic masters who own and run global markets.

In so doing contemporary biology knowledge remains silent about the dominant political discourse that produced it historically – a discourse steeped in challenging the dominance of the Christian Church as the only provider of valid knowledge and at the same time a discourse validating slavery in the New World. This silence serves to perpetuate and reinforce the oppressions that are an inherent part of the dominant discourse – oppressions around race, gender, class, language etc. It is this silence that gives to biology its power of continued oppression in the Foucaldian sense. As Barton and Yang (2000) recognise '*it is important for all students to know and to be able to do*

traditional science (including biology) *since that is what schools and society measure. Yet, ... it is not enough to teach students the practice of science* (and biology) *and the rules for participation in science* (and biology) *if those practices and rules do not connect to the students' out-of-school lives*' (p876). How subjects are taught is seen as associated with the various representations of 'the nation' and its heritage, of how we define ourselves individually and collectively and exactly who 'we' are. In this respect, the organization of school knowledge is treated as equivalent to a representation of social order incorporating principles of inclusion and exclusion, of hierarchy and power. For feminists that organisation has been seen as reflecting principles of patriarchy, and for critical racists/antiracists (and multiculturalists) Eurocentrism, ethnocentrism and White dominance (Moore, 2000).

In biology, the objectivity of biology taught means an omission of historical truths that prevents students from critically exercising their innate ability to opt and to decide - and in this instance the objectivity and non-directivity in biology becomes an imposition on the students. It is this imposition that denies students the critical tools to understand their world and which, according to Freire, prevents their reading of the world as they read the word (Freire and Macedo, 1995). Such impositions occur when one wilfully refuses to present alternatives and multiple points of reference.

Contemporary biology education (and school) produces a disarticulation of a natural object by dislodging it from a critical and coherent comprehension of the world/environment that informs and sustains it. With this disarticulation of knowledge, students can never see reality clearly, rendering students at best, capable of a mere descriptive level reading of the natural object and through the way in which the knowledge forms as concepts are provided. At worst they are unable to link reading the word and reading the world (Macedo, 1999,2000; Schwandt, 1998). Educators who view such linkages as the politicisation of education fail to acknowledge that only a politicised person is able to sort out the different and often fragmented bodies of knowledge contained in reading the word to be able to read the world (Macedo, 1999/2000, p65).

8.2.2 What Counts as Legitimate Biology Knowledge?

The biology classroom was one where the students use of universal scientific ways of knowing (Lewis and Aikenhead, 2000; Stanley and Brickhouse, 2001; Cobern and Loving, 2001) about cell division to biological determinism was extended to begin to know themselves as gendered, raced and classed persons. By repositioning the discourse in biology from the biology concept at the centre to race, gender, class (at both the same and different moments) I was able to, together with

the students, view the world through our oppressions – as raced, gendered, classed, powerless, religioused and languaged persons. These oppressions act as structural realities in society – that is they structure, through their intersections, society and how it functions – from my classroom to the wider community. This also then raised the spectre of what counts as legitimate content/knowledge in the classroom and school. Is legitimate knowledge only the conceptual knowledge of biology or is there more that makes up the knowledge in the biology class? The questioning of facts and how facts were presented was what made a deconstruction of biology possible and it was through this deconstruction that the invisible existing social subordination/s became visible. This made it possible for the students to become co-constructors of knowledge and in this way gave them control over their own learning - through reflection and dialogue with each other and with me, the teacher, in the classroom.

This approach can be seen as that guided also by a Freirean understanding that believes all teaching and learning is political and that the role of the school and teacher is to politicise students through active dialogic engagement (Lynn, 1999). Raising issues of subordination in the classroom around gender, race, class etc. gets students to begin to think around subordinations which then allows them to see how the subordinations of gender, race, class etc. matter in their lives. As Freire observed '*the more people participate in their own education ... the more ... (they are) in the development of their own selves*' (in Gay, p9). Dialogic engagement made student participation a feature of the class. What we know affects who we are and issues of knowledge entail issues of identity (Moore, 2000). Dialogue as a process of learning requires political and ideological analyses with the objective of dismantling oppressive structures and mechanisms prevalent both in education and society (Freire and Macedo, 1995).

8.2.3 Biology Education, Agency and Advocacy

The student stories provide vivid portraits of the complex interplay of interrelationships within the biology classroom with its concomitant biology curriculum, the school, the wider society including the family - and it therefore becomes necessary to view them from a critical perspective (Nieto, 1999, p205). These stories come from the lived experiences and realities of growing up as Indian, Coloured, and Black in Durban, KwaZulu-Natal, South Africa. These experiences come from their personal engagement with race and racism, gender roles, where the students live, etc. The experiences are also shaped by cultural expectations through which students have been socialized into learning particular values, behaviours and ways of thinking and knowing (González, 1999).

From these experiences and realities these students grow up in South African society in Durban, KwaZulu-Natal and develop a consciousness of multiple systems of subordination that includes an awareness of oppression, poverty and racism. Since in racist societies, such as that of the students, where common sense and immediate perception are racialised, education to be meaningful must include learning to question and challenge that which seems obvious. Education must equip students with tools and symbols for pursuing understanding beyond what appears necessary or relevant from the perspective of their own immediate relations and observations (Thompson, 1997, p17). Student stories provide a glimpse of what is possible when such engagements occur. The student stories emerged from critical dialogue that commenced in the biology class (Freire in Apple, 2001, p 218). Critical dialogue using multiperspective critical theory involved bringing people together with various standpoints, articulating their common interests, and respecting their differences.

Tenets of a critical democracy and social justice in education suggests the development of pedagogical practices that use the lived experiences of students as a starting point for developing classroom experiences in which students discover how they can give meaning to their own experiences and become social and moral agents dedicated to questioning, defining and transforming the structured injustices that threaten their community. This then allows schools to become critical democratic spaces, vehicles for social justice and public responsibility, and transformative agencies of social change (Chilcoat and Ligon, 1999). This when applied to the biology classroom made questioning possible; and gave rise to conflict and dissent, vexation and provocation. The conflict and dissent, vexation and provocation in the biology engaged with made possible the recognition the importance of public discourse (on gender, race, class etc) and the potential for action beyond the realm of private disagreement. It facilitated the construction of a more inclusive, comprehensive and accurate portrayal of who makes history and culture; brought multiple viewpoints to bear upon the analysis of social issues and their possible resolution or further entrenchment; and required pedagogical strategies that allowed students and me to have face-to-face encounters with opportunities to practice skills of conflict resolution (Gay, 1997).

The possibilities for an emergent critical-racist-antiracist approach lay in how I conceived teaching of biology itself. I conceived pedagogy as working to create spaces in which the ordinary, everyday meanings given to experience was problematized, revisited as if new and anything but self-evident. In such spaces, the students and I learned how to respond to previously unimagined possibilities (Thompson, 1997). Critical-racist-antiracist education provided for the creation of such working space in the biology classroom and the classroom became a site for taking up possibilities focusing

on the distinction between biology experience and unexamined experience. Biology education provided a way of framing the possibilities so that they could be taken up in embodied experience and yet not be treated as finalities. In the classroom, making the 'familiar' biology problematic, meant teaching students how to see, read and respond to a wide array of texts and also teaching them to practice a text of their own in biology. Presentation of meaning in biology allowed for meaning-making to be foregrounded as an interactive, temporal and emergent enterprise in which the mind engaged. Using the idea of metaphors in biology for critical-racist-antiracist pedagogy accomplished several ends: it pushed at the boundary by focusing on the act of framing meaning rather than on outcomes; it recognized codes and other conventions of meaning-making as tools to play against as well as to invoke; it considered meanings in the form of possibilities to be taken on and inhabited, to be taken up as if they spoke to one's own experience, while recognizing their framing as intentional rather than naturalistic; and thus it treated meaning as something provisional, as something to be invented and experimented with rather than apprehended as either out-there-and-fixed or inherent-and-subjective. The idea was not to build on existing personal experience and meaning but rather to create a counterpoint to ordinary experience and meaning – a distinctive moment in which experience became more focused and concentrated, more alive and awake, more attuned to its own contours and qualities. The value of such experiences was that they shifted our connections to the world, not only providing the occasion for seeing and feeling in ways perhaps not ordinarily available to us, but specifically illuminating experience and meaning as framed by expectations and conventions (Thompson, 1997).

Boyd and Arnold (2000) have drawn attention to how the essential political aims of critical-racist-antiracist education that focus on structural relations among social groups can be occluded by an ethical perspective that centres on the welfare of discrete individuals or could be insidiously reduced to a well-meaning and nice-sounding ethical perspective that focuses on the quality of interaction among individuals. In this a warning is issued as to how any critical-racist-antiracist programme, whether in biology or anywhere else in education, is engaged with. Focus on individual and/or interpersonal relationships that exclude social group experiences will continue to serve prevailing dominant hegemonic individualist enterprise.

While '*activist science education includes as its characteristics exploring ideologies that justify power inequalities, breaking silences, disrupting power relations, daring to decentre science, articulating what is possible and constructing different realities, and experimenting with different ways of learning and knowing*' (WISE in Barton, 1998, p18) this research experience explored how this could be done through the biology curriculum itself. In 'giving voice' to students the content,

processes, style and language of the biology classroom was also shaped by students; and for a restructuring of teacher-student relationships to dialogical relationships where I, as the teacher, together with the students co-constructed the curriculum and instruction (Sleeter and Montecinos, 1999). What this study does is it tries to uncover and **learn** about race, class, gender, religion, language, etc – part of the spectrum of the human condition - and how to **unlearn** subordinations contained within these domains both in biology and in our everyday lives. These identities intersected in shaping structural, political and representational lives of the students as women, men, Black, Indian, Coloured, rich, poor etc. (González, 1999).

In the words of Paulo Freire

> '*It is only when the oppressed find the oppressor out and become involved in the organised struggle for their liberation that they begin to believe in themselves. This discovery cannot be purely intellectual but must involve action; nor can it be limited to mere activism, but must include serious reflection: only then will it be praxis* ...' (Barton, 1988, p108)

- where the identified subordination/s were the oppressors. Through this the oppressed can then be empowered where, according to Lather (1991), empowerment as

> '*a process one undertakes for oneself* (would) *mean analysing ideas about the causes of powerlessness, recognizing systemic oppressive forces, and acting both individually and collectively to change the conditions of our lives*' (p4).

8.2.4 Science Education Research, Oppressions and Subordinations

Research in science education on gender and race/ethnicity looks to the under-representation/exclusion/alienation of women, 'minorities'/races other than White, the poor and the 'language-deficient' (Bianchini, Cavazos, and Helms, 2000) and in South Africa on the majority Black, poor, language deficient. No explanation is provided for - how these represent what exists within the society and thus serves to reinforce the existing status quo; or how this positioning of women, races and classes within the science education socialises students from their point of entry into science classrooms about the positions to be occupied by these groups within communities – regardless of social 'mobility'.

Underrepresentation in school science and biology of subordinated persons is explained away through the culture, language, position and roles of females and males, religious practice, etc. of subordinated groups – what Willis (in Vithal, in press) calls the remedial perspective. The explanations occur around the school science and school biology that exists; there is no examination of the school science and school biology itself as a facet and expression of the discourse of the hegemonic, dominant group. Such explanations then locate themselves in 'deficits' within the culture, language, position and roles of females and males, religious practice, etc. of subordinated groups. In many instances language, position and roles of females and males, religious practices etc are themselves understood as the discrete components of a culture itself (a naïve position taken also by me when I investigated a multicultural science education in a previous study). For me such explanations are located within a 'deficit' notion because it is only the culture, language, position and roles of females and males, religious practice, etc. of subordinated groups that are examined with a view as to how they can be fixed by improving representation of the subordinated groups in school science and school biology.

What the cultural 'differences' do is to replace the historic modernist scientific and socio-biologically constructed racisms with a cultural racism/differential racism. In lauding the significance of cultural difference in the variety of social interactions including schooling and specifically science and biology education, cultural difference theorists continue to serve and legitimate the interests and continued existence of a cultural racism (grounded in cultural differences)/differential racism (grounded in identity differences) (Dei, 1996). Fixing cultural differences then occurs in forms such as working towards obtaining an equal representation of the subordinated in school science and school biology. All this occurs against the loud silence around that which constitutes current school science and school biology – a loud silence that ensures that school science and school biology grounded in the discourse of the hegemonic dominant group is never questioned.

Credence for prevailing deficit understandings is furthered through research focussed on how to teach science and biology better and not why science and biology continues to fail students; theories such as Jegede's (1995) collateral theory and Ogunniyi's (1995) contiguity theory; and a continued belief in a multicultural science education - which as the opiate for the subordinated works well to keep the subordinated – subordinated via cultural racism/differential racism! These theories legitimate the existence of differentiated curricula at schools through which schools then continue to produce and reproduce the educational, social and economic inequalities (Hayes and Deyhle, 2001). As suggested by Flecha, such theories, in focusing on cultural difference, serve only to

further entrench 'postmodern forms of racism' (Flecha, 1999, p151; Mckinley, 2001). A Critical Race/Antiracist approach will begin to unmask supposed deficits of the subordinated – precisely because of its critical perspective which questions the silence surrounding the hegemonic, dominant discourse and the validity of explanations that place the deficit and underrepresentaion (of the subordinated) in science and biology with the subordinated.

Science education research has in the main remained focussed on how to improve access of science to students – from elementary school through to teacher education programmes. A large effort has been put into research into the varieties of constructivism from individual cognitive constructivist orientations through to radical constructivism, critical constructivism and sociotransformative constructivism as strategies for the effective teaching and learning of science to diverse students (Zeidler, 1997; Kelly, 1997; Rodriguez, 1998; Jofili, Graldo and Watts, 1999). Science as ways of knowing has also been subjected to investigation (Smith and Scharmann, 1999; Lee, 2001; Warren et al, 2001). Similar efforts have gone into issues such as science teacher identity and its link to pedagogical commitment (Helms, 1998); the role of science education in the production of rational citizens as part of science's rational view of the world (Longbottom and Butler, 1999); the need for developing a scientific literacy as a part of the enterprise of making science accessible (Kolstø, 2001); and the sociology of science as a way to improve the content, structure and pedagogy of science as part of an authentic and inclusive science education (Cunnigham and Helms, 1998).

Multicultural science education too continues to receive special attention – a special issue of *Science Education* (2001) focussed on this vexed question in the world of science and the role of traditional ecological knowledge/indigenous knowledge, a cross-cultural metacognitive approach through to an epistemological pluralism were shared with science researchers in attempts towards making science education accessible to specifically culturally disadvantaged peoples (Lewis and Aikenhead, 2001; Snively and Corsiglia, 2001; Stanley and Brickhouse, 2001; Cobern and Loving, 2001). The research efforts all focus on how to improve the understanding and learning of science in its present form.

What goes into making up student's prior knowledge specifically the socio-economic-political forces that shape a person are rarely raised by the constructivists; the need for a critical literacy combined with a scientific literacy continues to 'evade' the research because the oppressions and subordinations related to the students themselves are 'evaded' ; indigenous knowledge is appropriated into science education within the hegemonic western science; the cultural Other is who must be also appropriated into the silent powerful and dominant culture through the world of

science and science education. How science and science education discourse is shaped by the existing knowledge-power axis and how this in turn shapes society does not appear to be part of the science research discourse. A review of science education research in South Africa by Malcolm and Alant (2004) has revealed that the same obtains for South and Southern Africa as for the rest of the world. The prevailing discourse of the developed world continues to shape the science discourse of the south – an issue raised by Vithal and Valero (1998).

Research in science, science/biology education and ethics remain confined to issues like global warming through to cloning and the surrounding 'morality' with reference to the world of science in its interaction with humans (Barden, Frase and Kovac, 1997; Rozzi, 1999;Johansen and Harris, 2000). For Kitcher and Cartwright (1996, p152) ethical analyses in science must ask questions about the impact of society on science and science on society with the focus being human well being. The question that must be asked however, is well being of which humans and whose morality. Issues of power and the powerful whose agenda dominate the world of science are rarely questioned by Euro-American science education research. This includes science education research in the developing world guided by Euro-American interests. The issues around oppressions on the basis of race, gender, class, language and religion and their interactions with the world of science is does not appear to be part of the world of science and ethics. I cannot then but question what and whose agenda drives ethics itself in the sciences. Ethics for me, in science, then becomes suspect because of the power that drives it, which ethics never names nor engages with.

A critique of the vocabulary of biology and everyday life revealed the production of meaning that enabled students to name, identify, and perhaps take initial steps towards transforming the source of their oppressions and exploitations. It also encouraged students to analyse the various ways in which the asymmetrical/skewed relations of power were ideologically concealed by the dominant discourses of equality, difference and freedom. This critique of vocabulary made possible for students in the biology class the acquisition of a critical literacy – a literacy which made possible the practice of reflecting, analysing, and making critical judgements in relation to social, economic and political issues. Critical literacy made it possible for the students, as subordinated oppressed persons, to represent through classroom interaction and dialogue their lived reality in relation to objective social structures that shaped their lives. In this way students recognised when their experiences oppressed and subordinated them and also which of their experiences acted to oppress and subordinate (Mclaren and Farahmandpur, 2001).

Critical literacy then gave to the students a window through which they saw themselves as having been born as raced, gendered, classed, etc. which then located them into the various positions as Black, Indian, Coloured, female, male, heterosexual, homosexual, working class, middle class, etc. The meanings ascribed to these positions that served to create both social positions and positions of knowledge also became evident to the students (Tett, 2000).

It is this that then determined student responses to patriarchy, gender, women's bodies, sexuality, race, colour, class, poverty, disease, power, hierarchy, religion, language, the self and the other. The 'self' and the 'other' are constructed socially, politically and economically. Collective identities depend heavily for existence on contrast and negation. Social groups know who they are in large measure by knowing who they are not. Such identities are not necessarily stable. They are constantly being reproduced symbolically and socially by one's daily interactions, interactions that constantly mark the differences between insiders and outsiders, between 'we' and 'they.' In Bourdieu's terms, nearly all cultural symbols and practices act to reproduce distinctions among collective actors and enable identities to be achieved and reinforced (Apple, 2001).

As spelt out by Hird (1998) since '*schooling teaches subjectivities as well as subjects*' it becomes important to try and understand how schooling contributes in the schooled individual's understanding towards '*gender, race, social class, culture and other forms of diversity*' (p518). In the biology class this was attempted through a discourse that engaged a shift from a functional to a critical consciousness. This shift was attempted through hooks's (1998) engaged pedagogy that transgressed what for Meyer (1998) are '*the banking notions of education whereby information is deposited, stored, and recited. For teacher and student, it entails excitement about ideas, collective efforts, participation, engagement, expression, risk taking, and making connections to life experiences, intellectual and spiritual growth*' (p466). Engaged pedagogy provided students with the opportunity to speak in and through a language that made sense to the students in a safe and supportive environment of the biology class – about the facts of biology and the agendas around the facts of biology that perpetuated gendered, raced and classed society. Engaged pedagogy made it possible to identify nuances in the curriculum that mirrored existing discriminations in everyday lives of students as people. It was through an engaged pedagogy that racialized identities, as codified and signified by repeated references to crime, poverty, pregnancy, HIV AND AIDS status etc., were elicited (Dei, 1999).

Were our locations as students, myself as the teacher and the wider school society and community - as gendered, raced, classed, languaged, religioused, powerless persons so entrenched and

maintained by the dominant frameworks that we as perpetrators', victims and bystanders eschewed our subordinations and the subordinations of those around us through what Berlak (1999) calls 'erasure' and Govinden (2000) calls a silent amnesia. Did the engagements in the biology classroom force the students and me into witnessing, bearing witness and becoming witness (Berlak, 1999) to existing subordinations in our lives – individual and collective lives by turning the biology class into a political space? The biology class provided the space that allowed students and myself to interrupt the practice of learning and doing biology in order to uncover the unacknowledged aspects of culture that have historically underwritten and shaped the social practices out of which biology education has been produced through experiences like end of year exams, text books or state and provincial curriculum initiatives. The questioning in the biology classroom pulled into the public discourse student lives, my life and the larger connections between biology, schooling and the perpetuation of inequalities (Barton, 2001).

8.3 RACE AND CLASS

Racial justice, a vision in the 1950's and early 1960's, has been under attack and together with social justice has been excised from public legitimation in Euro-Canada-America (Dei, 1996). It has been since replaced with a language of cultural deficit and pathology, competitive group interests, individual responsibility, and at best, charity towards the unfortunate (Blum, 1999). South Africa's public legitmation towards racial justice lies in post-apartheid's post-1994 democracy. Public racial justice discourse in South Africa, a feature of present day South Africa, occurs in combination with discourses around issues of marginalisation and disadvantaging of the majority Black population, cultural deficit, economic disadvantage etc. as entrenched during apartheid. For this reason race talk/discourse assumes even greater urgency in biology education in my classroom and in education in general. This is why race was placed in the centre of the biology classroom. As hooks (1994) recognises there exists an urgent need to engage in race talk so that we can begin to understand how we come to be subordinated and everyone must be invited to share their stories regardless of race, gender or class.

Although race is centred one needs to remember that the boundaries that contain race are constantly negotiated and transgressed as individuals engage the forces and discourses that shape them. In using Critical-Race-Antiracist theory heed must be taken of the caution sounded by Villenas, Dehyle and Parker (1999) that '*Critical race theory does not provide a new set of methodological tools* (but) *does provide educational researchers with an interdisciplinary, race-based interpretive framework aimed toward social justice*' (p32). This caution lies in the recognition that '*Critical*

race theory borrows from and expands to include a number of other critical epistemologies and seeks intersections and conjunctions with other areas of difference to push a social justice agenda into the public discourse on race, gender and other social divides' (p34).

Critical race theory however, does not explain student experiences in their entirety – as analysed previously critical feminist theory assisted in explaining gendered realities of fe/males in my classroom and the society within which it existed. This points to the need for a comprehensive theoretical model or an empirical examination of the interaction of gender, race, class, power, language and religion in everyday life experiences to replace the current existing linear analyses of these variables (Ruemper, 1996).

Engaging in race talk also requires some understanding of what Whiteness is. Whiteness as a concept remains elusive and slippery. It is however, known to be associated with power and power differences between White people and Other (Coloured) people. Whiteness cannot be separated from hegemony and is profoundly influenced by demographic changes, political realignments and economic cycles. Situationally specific, Whiteness is always shifting, always reinscribing itself around changing meanings of race in the larger society. Whiteness also holds material/economic implications including unearned wages of Whiteness. Objectivity and dominant articulations of masculinity as signs of stability and the highest expression of White achievement still work to construct everyday life and social relations at the end of the twentieth century. Because such dynamics have been naturalized and universalised, Whiteness assumes an invisible power unlike previous forms of domination in human history. Through its relation with Africanism, Whites gained knowledge of themselves as the racial barometer by which other groups were measured (Kincheloe, 1999; Ladson-Billings, 1999; McLaren and Torres, 1999; Mclaren and Farahmandpur, 2001). At the same time diversity in Whiteness must also be acknowledged. For Apple (2001) Whiteness is connected with not being Black.

Whiteness, like other race forms, is a social construction. Thus it is not an unchanging, fixed, biological category impervious to its cultural, economic, political and psychological context. There are many ways to be White, as Whiteness interacts with class, gender and a range of other race-related cultural dynamics. The discourses that shape Whiteness are not unified and singular but diverse and contradictory. One will not find logical consistency in the social construction of Whiteness. The discursive construction of Whiteness aligns in dealings with itself around particular issues of race. In my classroom and at Centennial Secondary School Indians had assumed the mantle of the power of Whiteness. Hence the discourse of White/Indian victimisation through

affirmative action – as expressed by Indian students when comparing employment possibilities of Indians with Blacks and the concerns around Black economic empowerment as understood through ownership of property and cars by Blacks. Here traditional Black victims of oppression become the causes of the problems of present-day society's Indians as perceived and understood as the dominant group by the Indian students.This points to a new White/Indian consciousness emerging from the chaos of White/Indian identity. The social construction of race identities made possible the profound shifts in construction of Whiteness, Blackness and other racial identities. As part of such a shift Indianness at the school assumed the signifiers of Whiteness for students. The greatest power amongst students resided in the Indian male and the least powerful were the Black females as evidenced through the student experiences. These experiences openly located Indian male students in positions of ownership of the school – a position they verbalised by making it known to Black students that they were not welcome and did not belong at the school. Indian students, both male and female, used language offensive to Black students to entrench power and also used such language in 'jest'; through response to the Black touch let Black students know that the Black touch was not welcome; by openly moving away from Black students and in this way making public the preferred separation of Indians from Blacks and through ascribing to Black students criminal behaviours. The Indian teachers at the school also entrenched the powerful position of the Indian by verbalising to Black students that they were not welcome and did not belong at the school on the basis of their race which they characterised as inferior through associations of Blacks as belonging to the 'bush'. Administrative staff, who were Indian, in singling out Black students on the issue of fee payments entrenched through this act the power of the Indian and Indian ownership of the school and at the same time criminalized Blacks. Viewed as a position of power White identity is also sought by those who do not possess it – as evidenced with the pride of Black students in being at an Indian school. Indians too did not hesitate to accord the oppression of powerlessness on one of their own on the basis of colour – those Indians who were very dark-skinned were excluded through the use of language that made very clear the worthlessness of Blackness. Thus any critical pedagogy of Whiteness must separate Whiteness from only White people when examining locations of power (Kincheloe, 1999, p 168 –170; Rassool, 1999, p 26 - 35).

It is the White privilege of universalising its characteristics as the 'proper ways to be' that has constantly undermined the efforts of Others in a variety of spheres. In this lay the student complicity of racism as normal and not aberrant. At times it is such universal norms that has produced self-loathing among individual members of Other groups, as they internalise the shibboleths of White tradition *I wish my eyes were blue and my hair blond and silky*. Invisible White norms in these cases alienate Others to the point that they sometimes come to live 'outside

themselves'. A pedagogy of Whiteness reveals such power related processes to Whites and Others alike exposing how members of both these groups are stripped of self-knowledge (Kincheloe, 1999). In constructing race as a Black phenomenon, Whites create a protective invisibility around themselves (Brieschke, 1998)

According to Bell (1999) racism will always exist because of racial nepotism where Whites treat each other like 'family' when there's a choice between 'them and us'. This was also evident in the relationships between Indians and Blacks in the classroom, the school and in the wider society. Indians chose to treat each other as part of a 'distinct family' separate from other race groups at the school. Racial nepotism favoured Indians at the school because of the history of the school, their larger population and the all-Indian teaching staff the school.

With human cloning as part of a biology college course, as reported by Taras, Stavroulakis and Ortiz (1999), an 'overwhelming' number of students responded by identifying various reservations around cloning including the issue of it being about the *power and authority to create a society. We are not ready for that responsibility. Those with absolute power will absolutely abuse it* (p 342). This student response was set aside in favour of encouraging scientific literacy where the focus was on linking factual information and new material to the students existing body of knowledge in biology. Taras, Stavroulakis and Ortiz (1999) chose not to examine and work with student understandings of a society shaped by oppressions, power and discriminations – because in the biology class scientific literacy is the only literacy of importance; critical literacy has no place.

One of the standards of traditional European education that perpetuates racism is obedience and the slavish pursuit of order – as evidenced in the order of the sequence of events in cell division and in the transfer of characteristics from one generation to the next. The messiness of the process of cell division and gene transfer in never alluded to at grade 11 level. Obedience and order through events in biology then translate into obedience and order in everyday lives as the 'desired' way of life. The obedience and order however, was that determined by White, western male lenses and became the established norm for all. Any deviation from the established obedience and order was not permitted and this included language, religion, skin colour etc. By questioning the established obedience and order in the curriculum there was transgression of prescribed biology; the transgression allowed for chaos, conflict and broken agendas – the vexations and provocations in the biology class (hooks, 1994; Dei, 1996) and made it possible to read the world through biology. The dominant frameworks in biology filter out the painful consequences of racism by privileging rational thought – through focusing on concepts in biology and never on the social messages of privilege and subordination

associated and disseminated through the concepts (Berlak, 1999). The tacit denial of feeling works against awareness of the impact of racism by fixing people of colour as non-feeling beings (Berlak, 1999).

A biology education that focuses on oppressions and subordinations and that centres race at the centre in classroom discussions will begin by rejecting the traditional contemporary structured and regimented teaching practices that constitute current classroom biology environment. It questions what or how it is that teachers are supposed to teach; how it is that the structure of schooling works to silence any critical conversation about what or how what is taught may intersect with the lives of students who are most often on the fringes of biology; and also critically assessing why is it that conversations about power and authority are not allowed in the biology class (Barton, 2001).

Barton (2003) in her work with poor youth challenged the inaccessibility of traditional science education by the youth. Accessibility to science education was her focus as she worked towards a 'liberalised' science education (Barton, 1998). Such a liberalised science education engaged agency through using and producing science in situationally meaningful ways for youth in poverty. The '*practice of science*' (Barton, 2003, p160) for poor youth would occur through youth power as they co-opted spaces for a science that was relevant and meaningful to them in their poverty. This could be achieved through activating resources available to them and this would then make it possible for science to be used as a tool for transformation for the youth. Community support was recognised as essential to such a project for sustaining youth power and the ability to create a relevant science towards transformation. The focus in this enterprise remains on access to science education and the power relationships that govern access to science education itself. How poverty and associated oppressions and subordinations in and through science education contributed to the perpetuation and maintenance of existing discriminations in society are not focused on.

A strategic silence around racism is what contributes to its marginalization in the discourse of everyday existence by dominant frameworks that privilege abstraction and generalization, thus filtering out particular differences between people as well as the complexity and multiple positioning of each of us. The blurring of differences between racism and sexism, by focusing on gender issues, also serves to marginalize racism. Another way of marginalizing racism occurs through focusing on the individual's autonomy and her/his ability to shape her/his destiny serves to filter out the effects of selves, society and history on one another (Berlak, 1999). Although various 'isms' of oppression and subordination, such as being Black, female and poor, were generated through different sections in biology it was possible to keep race at the centre as happened when

teaching biological determination. This fore-grounded race talk in the classroom and prevented the blurring of racism in favour of the other 'isms' that also emerged in the biology classroom. As suggested by Berlak (1999) biology provided opportunities for students '*becoming witness to their own victimisation or the victimisation of others' on issues of discrimination/subordination*' (p114); a discrimination that for Freire and Macedo (1995) is generated by the hegemonic culture.

Putting race at the centre of the biology class makes race talk unavoidable in biology. It removes the accepted public secrecy around race and racism (Berlak, 1999). It demands a (re)visiting of the role of biology in the construction of race groups and the development in scientific racism during the seventeenth and eighteenth centuries. It also forces an examination of contemporary socio-scientific construction of racism such as Herrnstein and Murray's (1996) *The Bell Curve* on intelligence and race. Race talk in the biology class amongst raced subordinated people will provide them with information about what goes into their construction as raced and subordinated persons. In doing so raced and subordinated persons are then in positions to deconstruct themselves as raced and subordinated and allows them to place themselves on the same location as those who have been historically and contemporarily the hegemonically dominant raced persons; thus negating the power of the hegemonic, dominant raced group. This however, does not necessarily remove or transfer the material advantages that came automatically from belonging to the hegemonically dominant raced group to those who were previously raced and subordinated – highlighting then the existence of a capitalist racism – that referred to by McLaren when interviewed by Barton (2001).

One tenant of hegemonic Whiteness is internalised racism where the rent is *to* '*respect White or light skin and devalue Blackness*' (hooks, 1992, p143). This tenancy is what contributes to Black hatred that finds expression in understandings such as Black equals ugly and that light/White is beautiful. Such internalised racism as expressed by some students both Black and Indian is the outcome of an internal dominant colonised discourse. It was this that explained the self-hate, anger and futility in wanting to have straight hair, light skin because such physical attributes would go hand-in-hand with the privileges afforded by belonging to the dominant discourse. Privileges would also include self-confidence, self-esteem and a sense of belonging – attributes that were never allowed to be part of the subordinated discourse and which in turn contributed to Black hatred (hooks, 1992, p4; Berlak, 1999, p103, p 109). Engaging with their own attitudes and feelings about themselves in the biology classroom also then provided the student with the space to engage with the notion of 'who I am' – this became possible through the discourse that emerged from students confronting for themselves biological determinism and public colonialist discourse through politicians using the world of science to validate racism (scientific racism). Through engaging with

the history in which racism was grounded, students were provided with an alternative way of looking into the construction of Blackness/woman/etc. and in this way an alternative way of looking at 'who I am.'

In determining 'who I am' it is important to remember as Reed pointed out:

> *that people see themselves in many ways simultaneously. We all have our own sets of experiences fashioned by our social position, our family upbringing, our local political culture, and our voluntary associations. Each of these goes into the mix, modifying, cross-cutting, even at times overriding identities based on race or ethnicity, gender, (class), sexual orientation* (McLaren and Farahmandpur, 2001, p146).

Engaging with the history of biology and racism in the biology class revealed that the colonial power of Whiteness emerging from the late seventeenth and eighteenth century Western Europe framed itself in rationalistic terms with Whiteness representing orderliness, rationality, self-control and civilization and Others representing chaos, irrationality, violence, the breakdown of self-regulation and savagery – a pedagogy of Whiteness that still continues to operate as it emerged through student understandings of their experiences. It was the notion of Whiteness that presented itself as reason and a non-coloured, non-blemished pure category (Kincheloe, 1999; Semali and Kincheloe, 1999) that was used to validate apartheid's legitimation a racist White power and White rule over a majority of Blacks, Indians and Coloured Others. If reason is a form of disciplinary power as suggested by Foucalt then critical-racists-antiracists-multiculturalists contend that reason can never be separated from power. Those without reason defined in the Western scientific way are thus excluded from power and are relegated to the position of the unreasonable other. Through such positionings, power relations established by Whites with reason were then 'erased' by White claims of cultural neutrality around the transhistorical norm of reason. In this way the invisible power of Whiteness continues to dominate (Apple, 2001).

Biological determinism elicited student representations of Whiteness as intelligent, good, innocent, wealthy etc. against representations of Blackness as stupid, animal-like, dirty, evil, labourers, poor etc. Representations of Whiteness expressed in the biology classroom space resulted in students interrogating the 'normative' representations of Whiteness for validity together with some sharing of the pain and anguish caused by such representations. This in itself was a new engagement in a world where representations of Blackness from the world of White imagination abound; where skin colour linked to intellect is expressed through reference to Black skin only in understandings such

as 'you are a credit to your race.' In this lies the making of Blackness for public stereotyping. Such making of Blackness occurs against a background of silence that makes Whiteness a privilege claimed by White skinned/light–skinned peoples through the silence around what it means to be White (Sleeter, 2002/01).

Representations of Whiteness and Blackness allowed for the 'dilemma of difference' to surface – a dilemma that assumes that to be equal one must be the same (White/Indian), and to be different is to be unequal (Black; Coloured). It was through the unveiling and analysing of these unstated assumptions that there could be any resolution to the dilemma of difference amongst students (Artiles, 1998, p32). Although scientific racism based on biological determinism has been replaced by socio-cultural racism, the student experiences and explanations of socio-cultural racism appears to be still rooted in scientific racism. This is why the historical understanding about the nature of racism together with accompanying prejudice and discrimination would be a necessary prerequisite towards any hope for the combating of racism.

Research in biology education within the field of genetics remains locked within inheritance of characteristics amongst animals and plants. The issues of language enabling or denying access to concepts within biological inheritance, alternative understandings of students, sources of variation, limited understandings around the cell, cell division, fertilization, chromosomes and genes, gene interaction - form the basis of such investigations (Ramorogo and Wood-Robinson, 1995; Chinnici, 1999; Lewis and Wood-Robinson, 2000; Tomkins, 2000). Investigation into biological inheritance around race and human beings continues to be given a wide berth by the researchers in biology education; behavioural genetics is the safer softer option for possible inclusion within the high school curriculum (McInerney, 1998). Using research on genetic inheritance in plants and animals to teach in the classroom teaches the concepts required; it also shares with students the 'mastery' of science in explaining natural phenomena in the lived world. This 'mastery' then legitimises the silence around the non-teaching of genetic inheritance and issues of race amongst humans; this 'mastery' perpetuates the racism of the biology curriculum. Allchin (2000) explores the 'potency' of the metaphor of dominance and recognises that the science views help shape society – however, the research does not move beyond the recognition of the shaping of society by the views of science and slips back into a discussion on the role of recessive and dominant genes.

Years of discourse on the problem of Black student achievement in science education and the visibility once again of supposedly scientific research on genetic differences in mean intelligence between Blacks and Whites such as in *The Bell Curve* by Herrnstein and Murray (1996) once again

provides a science-basis for raced understandings to enter the education space. This understanding about intelligence and race is deeply seated amongst students who see themselves as either intelligent or less intelligent and amongst educators who also understand students as intelligent or less intelligent (Apple, 2001). This discourse allowed for the institutional racism that tracked/graded students and limited their chances of entering into tertiary education institutions - as evidenced in the cases of those students doing the biology on the 'standard' grade and for whom this meant that they could not sit for matriculation exemption/university entrance examination at the end of their schooling in grade 12.

Looking at the situation closely reveals that race as a category is applied to 'Non-White' peoples. White people are usually not seen and named. They are centred as the human norm. Others are raced; Whites are just people. The racing of Whites then is necessary if they are to be dislodged from the positions of power they occupy. Such dislodging should also remove all inequities, oppressions, privileges and sufferings that go with White power. Through this the authority of Whiteness that determines how the world functions can then be undercut (Apple, 2001). Thus part of the pedagogical task then is to make *Whiteness strange*; is to tell myself and teach students that identities are historically conferred – albeit through biology and White hegemony (in its social construction). We need to recognize that identities are produced through multiple identifications and should see the pedagogical project not as reifying identity, but both understanding its production as an ongoing process of differentiation *and* most importantly as subject to redefinition, resistance and change (Apple, 2001, p210). However, we, that is the students and I, must remain on guard that a focus on Whiteness/Indianness does not become one more excuse to recentre dominant voices and to ignore the voices and testimony of those groups of people whose dreams, hopes, lives and their very bodies are shattered by current relations of exploitation and domination (Apple, 2001, p210).

It was Black male and female students, in the biology classroom, who had bought into the understandings that it was young Black males who abused women, were characteristically violent and exhibited rampant consumerism (Thompson, 1997, p13). This was not recognised as a problem of society at large because this stereotype of Black males was accepted as 'normal' and not aberrant (Ladson-Billings, 1999). In framing these characteristics as normal and not aberrant, young men of other races were allowed to enjoy the spectacle of violence against women without realizing their own complicity in the act. In this way, by locating the blame for the unsavoury aspects of a race group away from the dominant race/s, racism undercuts any need to change those aspects of the

dominant group (Thompson, 1997, p13) – and for students in the class the status quo would remain since the accepted notions framing young Black males had never been challenged.

Internalised racism guided the subliminal understanding that it is only Black women in the townships who become prostitutes. Here Black skin and race became the yardstick used to determine where the unacceptable resides. In identifying only Black women as prostitutes students used the *stick that society has used to justify its continued beating and assault on the Black female body* (hooks, 1992, p160). In blaming Black unemployment on laziness and in speaking of unwed motherhood, the talk/speak occurs as if blame is ascribed to 'the culture of poverty'. However, the culture of poverty that is denigrated is linked as something that is inherent to 'Blackness' and that which is inferior – thus implicitly invoking the slaveholder stereotype of Blacks as lazy and immoral (Thompson, 1997). In this understanding space itself becomes racialised and feminised – in locating prostitution within Black townships only. The same racialisation of space pertained to sexually transmitted diseases and with specific reference to HIV and AIDS. Sexually transmitted diseases and HIV and AIDS was a disease of only Black people, specifically women, living in the townships. Prostitution and sexually transmitted diseases including HIV and AIDS as part of all sectors of society was never engaged with – the belief was that it did not occur or exist outside of Black peoples.

At the school, Indianess' functioned invisibly in the classroom and within the school to shape the power relationships at the school. The school's history as a school for Indians during apartheid in an 'Indian' residential area privileged the Indian student population through their 'Indianness' and through their numbers. Indian student discourse was both power-evasive (Banning, 1999) and power-ful in shaping the dominant 'Indian' discourse at the school through making other groups visible while assuming the cloak of invisibility (what Sleeter (2002/01) calls the silence of Whiteness). Racialised power relations in the school resided in the Indian male students who were in positions of power amongst students both in the classrooms and on the school grounds – another instance of masculinized racialistion of space; and in Indian teachers, including Indian male teacher-managers and the Indian male principal of the school, who were in positions of authority in the school and therefore the powerful in the institution – another instance of how institutional racism operated within the school. In this space of Indian power and dominance there existed also the 'contradictory' oppression of Indians on the basis of very dark skin-colour that was used to confer on these Indian students a Black marginalized identity.

In this school environment where Indians assumed the power of Whiteness, the Black students response to racist teachers was '*to look down*' and this then allowed the students to assume a '*mantle of invisibility*' (hooks, 1992, p168) or adopt an '*exit*' strategy (Hesch, 1996, p274). Students had internalised that in this way they became less threatening. Here student action highlighted how teachers were able to control the *Black gaze* and in this way turned students into *object(s) ... (that) lack the capacity to see or recognize reality* (hooks, 1992, p168). Students survived in the knowledge that *safety resided in the pretence of invisibility* (hooks, 1992, p168). The hegemonic racist practices of school officials also instilled in students a sense of inadequacy and in some instances failure.

The 'success' of the new Black middle-class was used by Indians in power at the school to mean that oppression and subordination no longer existed and was now a thing of the past (Bell, 1999). This further widened the gap between the classes of persons that experienced and continue to still experience race, gender, class, power, religious and language subordinations. Affirmative action was, as stated previously, seen to be supporting only Blacks. Indians now became the victims – they were the victims of apartheid and were now the victims of the new 'democracy'. The advantage possessed by Indians as victims of apartheid was now subject to a loss of memory, an erasure, a silent amnesia. This is not to say that all Indians were advantaged victims; the vast majority were very much part of the country's poor. The 'poor' state however, was still less than the 'poor' state of the Blacks. It is this then that shapes the current concern around Indians as victims of affirmative action in the current democracy. Indians are now seen as having no privilege in society and in this emerges a retrogressive Indian identity (Apple, 2001, p208). The Indian identity thus is double-edged and fraught with conflict as the Indian exists as both the oppressor and the oppressed in the wider South African society.

According to Mclaren and Farahmandpur (2001) class realities permeate our society, determining much about our lifestyles and life chances, our capacity to make serviceable things happen, our access to power. There are class interests in how science is studied and funded; how racism and sexism are activated and reinforced, and how social reality itself is defined. Class expresses the relationship between those who have the means of production and those who sell their labour in exchange for wages. Understanding exploitation as embodied in forms of racist and patriarchal social practices should constitute a central focus of critical pedagogy. Although an individual's subjectivity or identity cannot be reduced to class interests, social oppression and economic exploitation are linked to class background and the social relations of production. This is why forms of racial and gender oppression can be understood against a background of class.

8.4 GENDER AND RACE

The metaphors of biology such as mother cell, daughter cell, men as discoverers of, women in photographs as assistants or labourers and men as the scientists engaged in the elitist enterprise of science all work to ensure that '*women's oppression is structured within the patriarchal language that defines us (women) subordinated within the structures of he/man language*' (Jackson, 1997, p461). A typical reality in the world of science is that where, for example, James Watson and Francis Crick are hailed for their work on DNA; to this day texts in biology make reference only to Watson and Crick when introducing DNA; no mention is ever made of Rosalind Franklin the female biochemist whose X-Ray diffraction images of DNA played a central part in the 'discovery' of DNA.

Women, Blacks (women and men) and the poor (women and men) are positioned as the Other by institutionalised White supremacist domination. Acknowledgement of being a woman, Black and/or poor could cause pain and the biology curriculum avoids such pain by presenting 'sanitised' knowledge that excludes these social realities. This research, against this background, tried to understand the experiences amongst male/male, female/male, and female/female that shaped the ideas around masculinity and femininity in this existing dominant discourse through their deconstruction – from the biology classroom through to the wider society. This occurred through challenging existing ideas that students came with into the classroom. Engaging in a critical discourse on gender was facilitated by metaphors within cell division and student ideas linked to reproduction that allowed the students to focus on their own attitudes and feelings. Through this students came to confront and know their own habits of stereotyping around issues of gender. This self-knowledge was necessary before they could begin to make sense about gender stereotypes in the wider society. In this way 'invisible' attitudes on gender became visible and open to scrutiny by students (Maher, 2000). Students were exposed to their own attitudes; whether the attitudes changed within the school and wider society is a matter of conjecture since it was only the biology class where the challenges were being engaged with.

Gender through patriarchal relationships was explored from the perspective of how hegemonic masculinity expresses itself in societal institutions including schools and classrooms. Masculinity as superior, dominant and rational continues to be supported through societal mechanisms such as higher paid male labour, many more males in positions as 'managers' within the workforce, public acknowledgement of male effort and accomplishment, male violence - both real and symbolic, and a socialization of the mind of both men and women of the man as the dominant and superior. While

it appears to be accepted that these social constructions is what constitutes masculinity there exists a paucity of information about the understandings girls and boys come with into school and specifically the biology classroom about what constitutes masculinity. This applies also to femininity. Classroom research has identified boys as the hegemonic male - loud, strong, intelligent, risk-taking achievers, disruptive in the main with girls as quiet, fragile, hard-working, non-risk takers, and with there being a cause for concern if boys 'underachieve' when compared to girls. Gender processes in classroom spaces that according to Reed (1999) '*are active in the construction and sustenance of particular forms of gender identities*' (p105) were engaged with by reconstructing masculinity and femininity by students via the biology curriculum through cell division and human reproduction.

It is the gendered assumptions about where the different sexes' main responsibilities lie that *reflect the societal suppositions about women's role as carers for their children* (and) *where the core work is seen as being focused around the details of maintaining family and community life* (Tett, 2000, p 191). This notion of 'mothering' is reinforced through the biology curriculum in dealing with cell division when the language speaks of mother cell-daughter cell and as exemplified by Arthur's response in the biology class. In the personal lives of several students this notion of 'mothering' as the taken-for-granted, natural state of affairs was that which essentialized female identity. Apple (2001) speaks of the particular constructions of gender and woman's roles that are intricate and integral to the structures of feeling that help establish identities within authoritarian populist religious communities – the communities the students lived their lives in. Within such religious communities the structure of motherhood is a sacred trust and children become the instruments of a guaranteed identity for women who have a deep and realistic fear that without such a guarantee, they will inevitably be judged by men and found lacking. Patriarchy combined with religion to entrench women's identities and designated roles in society. As shared by Maher (1999):

> *...mothering, it is, "natural" and naturalized, something women do instinctively and are instinctively good at, because they "love children". Beneath this appreciation lurks contempt ... for if something is natural rather than learned, if it cannot benefit from education and cultivation, then it cannot be worth much. And within this contempt lies a fear of empowering women as genuine agents in their work with children or in any other profession* (p47).

In accepting the notion of motherhood as a 'sacred trust' female students also accepted their lives as subjects within a patriarchal system. In doing so they accepted their positions as being 'not worth

much' and thus licensed their continued disempowerment. It was this license that gave rise to the vexations and provocations in the biology class when pitted against constitutional rights for women in a post-apartheid South Africa - that had come to their notice via the media and a National Women's Day. Both males and females in the biology class recognised that there was the possibility of more than mothering for women.

Research into cell division has focused on how to teach the process of cell division better (Krauskopf, 1999; Smith and Kindfield, 1999;Stencel, 1995; Lewis and Wood-Robinson, 2000). Gendered understandings that are inherent to the language of cell division are never raised as part of the classroom discourse – this is because such understandings are never recognised as a valid part of biology understandings in the biology curriculum and the biology class. It is this lack of 'scientific' validity that reinforces notions of women as 'nurturers' both in nature and thus in society.

The notion of 'mothering' as a gendered division of labour was evident also in how students understood the notion 'mother' where the labour provided was located within that world of *private, reproductive, unpaid women's labour* (Bray, 1999, p7of14). In the world of such labour relations men were understood as providing *productive paid men's labour* (Bray, 1999, p7 of 14). The experience of men's labour as paid and providing the capital for living purposes and making women economically dependent on men further entrenches gendering through a classed masculinisation of the patriarchal hegemonic male and violence perpetrated against women. The violence against women is what restricts women at home, in instances of unmarried pregnancy. It is a violence that also continues to exist because women remain *restricted in their own minds* as expressed by the female students in their response to unmarried pregnancies as shameful, disgraceful and to be done away with through abortion (Bray, 1999, p8 of 14). In this instance a tension existed between teenage pregnancy and abortion as the solution since students were against abortions. The mother-role of caring and nurturing emerges from the mother/female whose task it is to stay at home and rear the children – a task that is historically related to the reality that it was women who, when employed, earned a lower salary and therefore it became economically viable that the woman stayed at home to bring up the children – a situation which contributes to furthering male dominance in the world of male/female interactions (Bray, 1999, p8 of 14). '*Gender differences emerge(d) in the emphasis placed on the domestic domain*' (Tett, 2000, p188) as the domain occupied strictly by females - by female and male students in their lives. Engaging with unmarried pregnancies and children from such liaisons highlighted the recognition amongst students that men needed to recognise and accept as a responsibility 'mothering' as part of masculinity.

In the Black context gender is seen as a force, which influences one's relation to labour, to performance, to authority and to sexuality. 'Becoming gendered' therefore involves both the likelihood that a woman will be expected to perform the bulk of reproductive labour in her community and the likelihood that she will be expected to direct her sexual interest towards men. Rebellion against either of these norms may well be experienced as threatening to the overall well-being of the community. Unqualified adherence to the norms will, however, ensure that gender remains a critical force of constraint in a woman's daily life under patriarchies, post-colonial and traditional (Bennet, lead7.htm, p3 of 4). Students in the biology class, both male and female, had subscribed to the required unqualified adherence expected of them. Even where the female students, within themselves, resented this acceptance they believed themselves powerless in the existing set patterns that subsumed their existence. It was while engaging in discussions of sexuality, gender, culture and ways that could grapple with the permissions of the tradition, the challenges of post-colonial-apartheid democratisation, the transformation of rigid identity politics, and the new 'right-to-life' of Blacks and South Africans being born daily that the unqualified acceptance and powerlessness of students as persons came to the fore (Bennet, lead7.htm, p 3 of 4).

The female body and female sexuality provide a symbolic space through which asymmetrical power relations between (Black) men has been discursively articulated, secured and contested. The (Black) female body is represented as a passive, pristine space acted upon by men to carry out the task of creating national culture and to produce sons of the nation and agents of the body politic. In the biological division between men and women - women are exclusively identified with their reproductive capacities as mothers and wives and not thought of as active participants in the struggle against dominant colonial imposition. This does not mean that women have not participated in the struggle or contributed substantially to the culture or politics of the group. Patriarchy ensures that women enter the environment not as subjects with political goals of their own but as mothers of the religious or group structure's children and men who are the real political subjects (Mire, 2001, p1). Despite South Africa's acknowledgement of women in the collective struggle against apartheid, and not withstanding the 'large' number of women in political leadership since 2004, their inclusion is at best a conditional, tactical manoeuvre that have as yet not led to the full participation of women in the private and public sphere (Mire, 2001,p 2).

Phallocentric patriarchy is used to keep women in submission (hooks, 1992). Male dominance was asserted through their sexuality, a masculinist culture of violence and their ability to provide materially. hooks (1992) speaks of the misogynist representation of women within phallocentrism

when women as prostitutes are identified *as 'evil ... who see their sexuality solely as a commodity to be exchanged for hard cash'* (p103). This representation is alive and real for the students in the biology classroom – both male and female. This is another illustration of how the dominant male discourse pervades not only male understandings but also takes up residence within the female psyche from where it continues to preside over how the human condition will be understood and interpreted in the everyday lives of people. Hegemonic phallocentric masculinity in school space was located in how males spoke of women – as objects that existed solely for the pleasure of males. The first sexual encounter for the female became the male strategy for enslaving the female and keeping her within his control as warranted by his needs.

Studies of what gives rise to gendered understandings of masculinity and femininity have paid scant attention to women's bodies. Married women's bodies as reproductive uterine urns have merited attention. The same unwedded bodies with uterine urns rich in progeny have not been explored with regard to how it is that they are placed within societies that regard unmarried pregnancies as taboo. The classroom experiences and narratives of students in the previous chapter provide an insight into femininity through responses to an unmarried pregnant female as unacceptable and not to be allowed and that justified the 'taking of life' through an abortion an otherwise reprehensible practice that was not 'permissible'.

Despite the political legislation about the right to choice on the issue of abortion, woman's agency, in determining for her body and her foetus, is viewed as a threat to morality – a morality defined primarily through the existing religious prescriptions, Christian and Muslim, or through group identity, as with Blacks – a patriarchal 'religious' or 'group' morality. Reproduction provides the medium through which religious and group identity and self-determination are imagined and expressed. The anti-abortion (and anti-homosexual) position imply a desire for the reproduction of a particular kind of religious or group structure – one that contains that religious or group structure in a tightly circumscribed patriarchal, heterosexual family narrative (Conrad, 2001).

The discourse pointed to 'woman' and 'mother seen as interchangeable terms with mothers as the only women worthy of acknowledgement. The combination of pro-natalist religious, Christian and Muslim, and Black group structures and domestic patriarchy ensured that the concerns of reproducing the religious and group subjects rested firmly on the shoulders of Christian, Muslim and Black women. Debate around abortion was framed in terms of the immorality of the individual reproductive choices of these women. The choices were clearly circumscribed by the religious or group structure and were clearly more than just personal, private choices given the structures

investment in maintaining a specifically religious/group population. This highlights the naivety of the idea that women have agency within the private sphere and foregrounds the reality that privacy is not a gender-neutral concept (Conrad, 2001).

Anti-abortion discourse highlights the foetus and the male partner in the relationship as of primary concern. The reproducing woman is seen as potentially productive only in regard to procreation; her capacity for other kinds of creative agency becomes an obstacle for religious and group structure reproduction. This discourse presents the foetus as an autonomous entity outside the womb of the woman. The foetus is taken out of the context of the narrative of the pregnant woman of which is inextricably a part and re-narrativized as an autonomous subject, in its amniotic sac, floating in empty space – as in the Vodacom advertisement on SABC (South African Broadcasting Corporation) television. Such technology reduces the pregnant woman to 'the maternal environment' – a kind of passive landscape of foetal growth and life. Female agency locates the threat to the foetus in the maternal landscape, which becomes constructed as a hostile environment. The foetus is constructed in the language of the marginalized as the unprotected baby and this further heightens the threat to it by female agency. The male partner in the relationship is also constructed as the outsider from the context of female agency – the outsider with rights located in the dominance of a patriarch in a normative heterosexual familial paradigm. Female agency interferes with and negates the male patriarchal position. Thus making the male the primary concern reaffirms patriarchy and does away with the threat of female agency and its threat to religious and group structures (Conrad, 2001).

The woman's body then is useful only insofar as the woman's body reproduces stable identities that are Christian, Muslim or Black. The pregnant woman becomes an identity machine for others. Women occupy the position of being either the landscape for unborn members of the religious or group structure or women are the primary enemy of the foetus - in this way the woman's agency is either erased or seen as threatening.

Within a dominant patriarchal heterosexual hegemony social discourse disallows unmarried pregnancies, abortion and homosexuality. This state of disallowance is ensured through policing – to ensure that all conform. The policing extends from external expressions of non-acceptance and disapproval to a policing that resides within the minds of both female and males as evidenced in student responses to these human conditions. The policing is what Foucault (1974) speaks of when he talks of power relationships that condition human engagement and experience. In this way the dominant discourse continues – unfettered and unchallenged.

Africa's representation at Beijing as a conservative block of voices connecting dismay at the notion of women's rights to reproductive freedom with disgusted objection to the idea that gay and lesbian people have civic and human rights was mirrored in my classroom context (Bennet, lead7.htm, p 1 of 4). South Africa's constitution guarantees such civic and human rights; these constitutional rights exist against the constraint of realities identified by Bennet – within the wider community of which my classroom represents just the microcosm.

One way of dealing with homosexuality within a dominant heterosexual environment was to remain publicly silent. This was regarded as a positive response and 'public acceptance' of homosexuality. Being publicly silent allowed individuals to think positively about themselves - whilst dismissing the presence and experiences and the very existence of homosexuals – responses largely shaped by notions of 'political correctness' and what was constitutionally legal in South Africa. In this way homosexuality was not a public issue for students. The public silence denied the homophobia within the individuals.

Homosexuality remains a threat to the sacred family and to the God-given gender roles that constitute the family (Apple, 2001). It can pollute children's minds and their religious identities. Schools are sites of danger if they are allowed promote a gay agenda. Resources desperately needed elsewhere in the school if used to support sex education would support an agenda of immorality – that is what would happen if gay became part of school agenda. Gender relations in the school remain defined by compulsory heterosexual norms and values (Apple, 2001). Any focus on queers in the school would be interpreted as an attack on religious rights. Since the Constitution of the Republic of South Africa granted religious freedom to all South Africans, this religious freedom then served to protect religious denunciation of homosexuality. Silence around homosexuals in schools reinforces the idea that homosexuality is taboo – in direct contradiction with legislation that purports a democratic justice towards all citizens. Apple's (2001) understanding of homosexuality as a threat to the sanctity of the family and by extension of the society was also the understanding expressed by students in my classroom.

Within the world of biology education efforts at dealing with homosexuality emerge from the biological position of explaining homosexuality as natural and as residing within the genes. The process of becoming male as a result of the Y in the XY gene combination requires that both body and brain must become defeminized and masculinized. Male homosexuality is the outcome of biological masculinization of the brain but not its defeminization. It is acknowledged that the

origins of sexual orientation are biological and that the expression of traits of sexual preference can be altered by the environment including society. Good, Hafner and Peebles (2000) suggest that as the '*biological origins of human nature become better understood by the scientific community, biological literacy will need to be redefined to include this new knowledge of ourselves*' (p327). This focus on biological explanation continues to be silent about the dominant heterosexual norm. Alteration by society then would be in accordance with the dominant practice of heterosexuality and the taboo status of homosexuality would continue to remain unchallenged. Other suggestions for the teaching of human genetics as part of high school biology remains confined to behavioural genetics (McInerney,1998).

With reference to STD's and HIV and AIDS any acknowledgement of the man's agency threatens the dominant patriarch in the heterosexual familial paradigm. Hence, the need to silence and erase male complicity and agency in this regard. By placing the onus purely on the woman the man's dominance and patriarchy remain intact and unsullied. The woman's body becomes the seat of the disease and the vehicle of transfer. The woman's body is constructed as a hostile environment to the man – threatening his position as head of family within religious and group structures and as head of the structure itself. Biology furthers such notions by the descriptive passages in the biology text that locates STD's and HIV and AIDS in the domain of woman's actions and their bodies while the man's role is seen as incidental and he is portrayed as a victim.

The patriarchal representation of masculinity in all its various forms excluded a construction of the male as gentle, caring and sensitive – qualities that characterized male students in the biology classroom. Masculinity ignored these qualities that are inherently 'female' and in this way excluded such males from existing masculine discourse. Such males then occupied positions on the periphery of hegemonic masculine-controlled spaces – as evidenced by gentle males in their interactions with 'masculine' male students and Black female attempts to befriend 'lonely' Indian male students. 'Gentle' males existed in the school by either hiding their 'feminine' side or by remaining within a close confined group at the school. It was this patriarchal understanding that would brook no space for the understanding of a 'mothering' male; a caring masculinity.

8.5 LANGUAGE

As stated by Moraes (1999, p 46) language is more than just a vehicle of communication. This is so because it is language that plays a critical role in shaping, oppressing, helping, destroying, forming, deforming, constructing and teaching. Learning language and becoming literate then are closely

intertwined with social eligibility and struggle. How language is accessed will provide either only a functional literacy or both a functional and a critical literacy. Functional literacy on its own deludes in that it spells the death knell for any transformative possibilities. For transfromative possibilities to be realised acquisition of hegemonic language, such as the specialist language of biology that mystifies and confuses, becomes an imperative. Once hegemonic language is accessed and also understood as that which confers the hegemonic status then the critical consciousness begins to engage with conditions of privilege, power, oppression and discrimination as occurs in biology through its language. It is this socially transformative and emancipatory possibility that becomes possible through a critical literacy.

Where students are denied their own knowledge and ways of using language they are also denied their rights of being and becoming – a notion of concern to Freire (Moraes, 1999, p46). In denying students through stigmatising their language and using the facility of language as a benchmark of students' capacity/incapacity oppression, subordination and discrimination are legitimated and in this way continue to be maintained and perpetuated. Language then is crucial to forging identities and differences.

Institutional racism also operated through English as the language of instruction and assessment at the school. As bell hooks(1994) shared about learning the '*oppressors language*' through which one is forced to experience subordination in speaking it,' *it is not the English language that hurt me, but what the oppressors do with it, how they shape it to become a territory that limits and defines, how they make it a weapon that can shame, humiliate, colonize*' (p 168). The language of instruction together with the language of biology acted in concert to also oppress students. This occurred through a language register used in the subject and in the textbooks that was outside the student's daily experience. Students in order to be successful needed to be proficient in the language of instruction and biology. Reading the word ensured success. Understanding the word was of no concern. The banking concept of education remains the norm for biology education. Banking education provides access and success; in this world there is no place for any critical literacy or critical consciousness – a dialogic conversation is never possible.

Access of opportunity through the language and discourse of biology would guarantee success in the subject. As noted by Meyer (1998) '*Within the learning context are situated constructions of meaning that are dependant upon the surrounding discourse (and) access hinges on taking up, becoming fluent in the discourse. A transparent obstacle to scientific discourse is its formal nature, the vernacular unheard of, and* (where) *comfortable patois has no place* (p467). For some of the

biology students the language of biology was a real obstacle that hindered or prevented success in the subject. It was this obstacle that vested in the language of biology is a *culture of power* (Barton and Yang, 2000, p884) that excluded several students from biology. For them this culture of power of language contributed to their 'failure' within the school system. Belief about exclusion was echoed in the student disbelief that she would be interviewed although the student herself had in fact herself volunteered for the interview – her 'self-knowledge' of non-success being part of her make up.

> It is *traditional in science education to ignore personal, idiosyncratic and emotional associations and even to attempt to suppress/eliminate them. Hence the use of specialised scientific terms and the insistence on a formalised linguistic code* ... (where) *jargonization increases difficulty and decreases interest* (in science). *It may even alienate some children from science* (Hodson, 1999, p221). *Given this sociocultural location of language, and its accompanying socio-political cargo of meaning, important questions of authority, culture and power are raised. Whose view of reality is being promoted? Whose voices are heard? And why? ... school science* (too, through its language) *becomes implicated in a continuing suppression of opportunity and perpetuation of privilege* (Hodson,1999, p234).

The ideological coded language of science does serve to further marginalize the subordinated for whom the English language already serves to act as a pedagogy of exclusion (Macedo, 2000). Such language-based racism in 'bleaching' issues of access and social oppression (Freire and Macedo, 1995) licensed institutional discrimination (Macedo, 2000) and furthered student belief in themselves as non-intelligent, non-capable persons in those instances where language, together with other oppressions, formed a barrier to 'success' in the regimented schooling process that controlled and determined how students lived and would continue to live their lives in the wider society.

At the school English was the language of communication, instruction and assessment. For Black learners to be acknowledged they had to be heard in English. The English though that accorded acknowledgement and acceptability amongst the dominant school population had to be specifically that dialect of English spoken by the Indian students at the school. The ownership of the dialect of English spoken by the Indian students conferred on them and consolidated their privileged and powerful positions and also furthered the difference and separation between the Indian students and their Black and Coloured counterparts. Where students possessed the required language facility they were allowed to buy into the dominant group and afforded an 'honorary' Indian status. This status operated only within the precincts of the school. Outside of the school it conferred no advantage.

English second language students, where the preferred language of communication in peer-group interactions was the home language isiZulu, remained at the margins both in the classroom and within the school precincts. These students did not exist. When acknowledged it was to reinforce the positions of privilege and power of the Indian group through language. This privilege and power of 'Indian English' was brought to bear on Coloured English first language students as well. The dialect of English spoken by the Coloured students was different. The different dialect was used to separate between Indian and Coloured identities conferring privilege and power on the Indian and subjugation on the Coloured. The marginalized Black and Coloured identities as outcomes of language gravitated towards one another as they consolidated themselves as a minority group within the student population.

What still needs to be explored is how the language of communication lends itself to meaning-making in framing privilege and oppressions in the classroom, in the school and in the wider community. The role of language in making biology accessible/inaccessible was minimally explored in this study. What has been ascertained though is that language in both biology and science education serves to successfully separate the privileged from the oppressed and through this maintain the privilege-oppressed divide in the world of biology and science. This divide then continues through into the world of careers accessed by students – further separating the privileged from the oppressed. The privileged in this instance are those with the required facility and capacity in and through English who then make it to the inner sanctum. English second language speakers find themselves on the periphery where they remain marginalized and discriminated against.

8.6 POWER

Gender, race, class studies in science education have focused on where the inequities prevail and on how to **fix** the inequities by making science curricula **more** inclusive, increasing intake, etc. There has been little, if any, effort to provide the subordinated with the tools to understand what constitutes subordination, and through understanding, overcoming their subordination. The **fix-it** response leaves the subordinated with no knowledge of their subordination and how then to work to changing it. The **fix-it** response remains a patronisation by those in power – including academia – and allows for the undisturbed prevalence of the dominant discourse. Identifying parallels in biology curriculum and everyday lives of students around the domains of oppression and subordination allowed students to begin to understand what their oppressions and subordinations were made of and in this way equipped them with a means of dismantling the oppression subordination – if the student chose to do so.

The uncritical acceptance of the curriculum, classroom and school practices will continue to perpetuate existing injustices and subordinations – in the school and the wider society. Employing a critical perspective provides for the possibilities of transformative change – as suggested by the experiences of teacher and students in this study. This occurred through, as also suggested by Nieto (1999):

- *affirmation of who the student was without trivialising the student with reference to gender, race, class, etc;*
- *challenging hegemonic knowledge;*
- *complicating pedagogy;*
- *problematising a simplistic focus on self-esteem;*
- *encouraging 'dangerous' discourses; and*
- *recognising that education cannot effect possible transformation by itself and that students need to become agents of change* outside the biology classroom – in the school and the wider community itself (p207 – 209).

In going beyond biology Grade 11 students learned to read the world with and through biology – through a classroom culture that incorporated the world, reading injustice and oppression, and normalizing politically taboo topics (Gutstein, 2001).

Unless students come to understand the structures of inequity and oppression that cause the differences in what different groups of students bring with them to the biology classroom, their teachers will not be able to provide them with the intellectual and moral framework that will enable them to see the human equity amid the social and economic inequity and oppression (Blum, 1999). This is what the biology programme attempted – to get students to understand the structures of inequity and oppression that shaped their lives and lives of others around them. Freire's notion of 'historical conditioning' (Freire and Macedo, 1995) will persist if students do not recognise the social and historical construction of their subjectivity; then they can neither recognise that their own views of race have been shaped by social experience, nor that their views affect and shape the experiences of others (Berlak, 1999).

What the students did was to highlight that in their South African context, in Durban – KwaZulu-Natal, race, gender, class, religion, language etc. was present and part of every institution, every relationship, every individual (Apple, 2001). This was not only for the way society was organised – spatially, culturally and in terms of stratification, but also for their and my perceptions and

understandings of personal experience. This happened with my knowing that I could and did force the students to engage with what I believed were existing oppressions and discriminations that shaped our daily lives both within and outside the biology classroom. I was able to engage in this pedagogy by the power vested in me as the teacher and the authority in the class. Some of the students chose to ignore my 'madness' of raising oppressions, subordinations and discriminations in the biology class. But others were drawn into and became the critical dialogue of the biology classroom. Does this mean that when the dialogue is close to the lived oppressive realities of persons including students they will, from having lived those realities, become participant to such dialogue?

Students made the invisible visible through the dialogue in the biology classroom. This study reveals that a political awareness can be developed through the biology curriculum. The emerging political clarity then becomes the means through which according to Freire '*the less coherent sensibility of the world begins to be surpassed and more rigorous intellectual pursuits give rise to a more coherent comprehension of the world*' (in Macedo, 1999/ 2000, p66). In short, literacy for social justice means moving beyond the mere acquisition of reading skills. Adopting a critical posture helps teachers advocate for their students. Teachers and students can move beyond the present to imagine a future where social justice and humanity are always present in the classroom (Macedo, 1999/2000, p66).

In transforming their lived experiences into knowledge and using their already acquired knowledge as a process to unveil new knowledge, students were able to participate rigorously in a dialogue as a process of learning and knowing (Freire and Macedo, 1995) – through biology. This then has implications of what may be possible not only in biology classrooms but in all classrooms in a school.

The potential for social and educational change lies in the ability of critical practitioners to relate knowledge creation to actual lived experience in the community … unless critical practice is integrated with home and family life, as well as with social practice in schools, places of religious worship and workplaces, all that can be hoped for is a fragmented, hierarchical approach to social change (Dei, 1996). In other words one must accept that critical practice in just one class will not necessarily effect desired social transformation.

If, as Apple (2001) says, the task of critical education is an empirical one then the experiences of my biology classroom can but contribute to such an empirical enterprise. In making these

experiences public it can contribute to interrupting the dominant discourse – even when the interruption is miniscule since it heralds the onset of an interruption. This actual classroom experience provided real meaning to that glibly used empty truism of a critical education. I say a glib empty truism because the notion of critical education shared by the various theorists including Apple, Giroux and McLaren amongst others is born, raised and continues to dwell in that paradise of theory. Consequently translations of the suggested theory into actual classroom experience, such as in my biology classroom, become nothing more than a paradise lost. The experiences within my biology classroom then suggest possibilities towards a paradise regained.

8.7 CONCLUSION

This chapter shows how biology education can play a role when the focus becomes the act of framing meaning. The framing of meaning is not confined only to the concepts and facts of biology and biology education itself but also to how it is that biology derives. Biology as an outcome of the various natural sciences accepts into it the concepts and the language that frames these concepts so that it meets the requirements for it to exist as an acceptable and respected science. The acceptance and respect is garnered also from its stance of neutrality, objectivity and a rationalism – benchmarks of a good, true and valid science. Hidden, invisible meaning in the 'neutral' language is never biology's concern. It is this lack of concern that precludes involvement; it is this lack of involvement that then perpetuates invisible positions of privilege and power; and it is this lack of involvement that gives credence and validity to the visible oppressions and discriminations. What this experience did was in rupturing capillaries and getting closer to the corpuscles, it revealed how biology education too contributes in and through itself to existing social meanings; it also revealed how these meanings when framed and focused on can, if so desired, be turned in upon themselves; it served to both vex and provoke.

In the next chapter what teaching biology differently in the classroom means and what is required to prepare biology teacher educators is examined. This requires including all voices, as well as the silent voices, when oppressions, subordinations and discriminatory practices are named and challenged. In this way how current biology silences critical discourse is also challenged. Teaching biology differently acknowledges that the biology classroom and biology teacher-educator classroom as a political space that could also be explosive as crises are engaged with in efforts at agency towards transformation. Science education research efforts are also explored. Science education research emerges as being located in either a remedial perspective, an inclusive perspective or in a socio-cultural-political perspective. These perspectives focus on how to make

science education accessible to students. Science and biology education remain silent about their complicity in perpetuating and maintaining social oppressions and subordinations. The contribution of this study as a socio-critical engagement of oppressions, subordinations and discriminatory practices towards social justice is examined.

CHAPTER 9

TOWARD A CRITICAL BIOLOGY EDUCATION: PRACTICE, RESEARCH AND POLICY

scratching at the scab, peering beneath the clot

9.1 INTRODUCTION

I have journeyed in and through my biology classroom to who it is that I teach and who it is that I am. Through this journey I traversed to those corpuscles that framed the lifeblood of this enterprise. As the corpuscles revealed of themselves they also provided for possibilities in how change could be effected – change that would take us closer to social justice. I say closer to social justice because I now know that attaining social justice in its critical form is that towards which one will need to continually strive - since each injustice overturned leads to another injustice revealed.

In this chapter how biology education in the classroom can be used to make visible oppressions, subordinations and discriminatory practices is examined. This requires the involvement of all present in the biology class, including the 'silent' voices. Challenging current biology education makes for explosive classroom interactions as crises are confronted as part of that required for an agency towards transformation. This is what is required also for a biology teacher education engaged in preparing socially critical teachers. Science education research remains being mainly located in the remedial-fix-it perspective and more recently in the perspective of inclusivity but hardly ever engages the socio-cultural-political perspective. The focus of research in these perspectives is on how to improve access to science education. This study points to the possibilities for a biology education and science education from a socio-critical perspective with a focus on making visible existing oppressions, subordinations and discriminatory practices towards transformation. How this study could influence policy and practice for biology education and science education in efforts towards social justice is also considered.

9.2 A CRITICAL BIOLOGY EDUCATION: TEACHING AND LEARNING BIOLOGY DIFFERENTLY

If the classroom is a microcosm of the wider socio-political and educational environments then the challenge becomes that which will stimulate students as critical thinkers, social activists and agents

of change (Sanchez and Fried, 1997). How then can one make the prescribed biology curriculum a curriculum that frames and gives meaning to student and educator experiences in ways that enrich their lives by making explicit their role as agents of change? At present biology curricula incorporate difference to increase access to biology. Teaching in common-sense ways as prescribed, accepted and demanded by institutional school beaurocracies serve only to maintain existing inequities – in the biology classroom, the school and the wider society. This is true also for science and biology curricula and science and biology classrooms. What such incorporations do however, is perpetuate existing hegemony and through this concomitant oppressions. This study shows how by including student voices and experiences and making visible the silent Other voices, students together with the educator begin to engage with the stories being told through the biology curriculum. Adding these various voices will change that which occurs in the biology classroom. The voices bring in difference and difference is engaged from and through its historical present to challenge difference itself. It is through this challenging that existing oppressions in their various individual and intersecting forms that the oppressions themselves are engaged with. As shared by hooks (1994) in denying student voices marginalisation and domination processes become replicated and through that perpetuated. The focus is not just access to biology but instead to biological knowledge, skills and values that give access towards an 'oppression-free' life in society. Such a classroom discourse will begin to challenge the existing status quo. It will challenge the marginalization of certain groups and identities in society. It will be through this that both the educator and students together will begin to reflect on and look beyond ways in which *what they learn* makes different knowledges, identities and practices possible.

McLaren in an interview with Barton (2001) asks how it would be possible to teach science and biology differently in teaching towards social justice. This study begins to show educators how it becomes possible to teach biology differently within a context where educators can remain accountable to state standards and expectations from prescribed curricula, assessment practice and tracking or grading of learners and responsible to students as well within given policies and practices foundational to set standards. Teaching differently does not only speak to questioning what or how the educator is supposed to teach biology . Teaching differently as suggested by this study speaks to questioning how the structure of biology education and schooling has served to silence any critical discourse about what we as biology educators are supposed to teach. Teaching biology was not only about biology education as prescribed; it also allowed for the intersections with the lives of the students in and through the variety of discriminations that played themselves out in various ways in the students' lives. This made it possible to raise issues of identity. In and through questioning identity, individual identities were no longer '*sacrosanct and inviolable*' (Lal,

2000, p13). It was this that gave students the chance to critically engage with conversations around privilege, power and oppression – conversations not generally a part of the biology classroom.

Turning the biology classroom into a political space made it possible for both the students and myself as the educator to connect the purposes of learning and the goals of biology to issues of social control and human welfare at the expense of social justice. It became possible for us to uncover how hegemonic control was located within the construction of biology and biology education itself. The required biology was taught; responsibilities to the students were met. What teaching differently allowed was for students and myself to learn about who each of us was in the greater scheme of agendas set by the privileged and the powerful in society through, in this instance, biology education. For me, this teaching of biology differently is essential if the goal of biology education and education itself is to move towards social justice. What this study points towards is that it is possible for educators to create classrooms as places of hope, where students together with educators can begin to gain glimpses of the kind of society we could live in with students learning and possessing both academic and critical skills that could make such a society a reality.

This study shows the possibilities for naming race, gender, class, language and power as that which contributes to oppression and subordination in and through a critical biology education without reneging on the responsibility of teaching the required biology to students. A critical biology education has the space, as shown through this study, for such naming and challenging. In naming race and racism in the biology classroom, biology education's complicity in validating the social construction of race and through it racism cannot continue to be ignored or denied. Bringing racism to the fore then demands that it be challenged. Challenging racism makes possible its interrogation as an oppressive and subordinating force that operates both overtly and covertly. Interrogation provides for a variety of understandings about racism that highlights also the notion of Whiteness as a powerful force that operates together with class occupying different times and different spaces amongst people of all races. It is through such explorations that oppressions such as racism together with class, in its various guises, begins to be unmasked, unpacked, understood and debunked; it is through such understanding and debunking that such oppressions and subordinations can begin to be disempowered and social transformation can begin to be realised.

A critical biology education also has the space for naming and challenging gendered roles and stereotypes as shown through this study. Biology education's complicity in subversively perpetuating the role of women as carers and reproducers has been raised in this study. Biology

education's complicity lies in its silence, as patriarchal power aided by religious values becomes the strident powerful voice in deciding the fate of women and homosexuals. This study highlights possibilities for empowering women and homosexuals in and through a critical biology education. In recognising specific instances of stereotyped roles through metaphors in biology or through highlighting strategic silences in this regard, biology education can also contribute towards social transformation in the area of gender oppression and subordination.

Language too plays a role in oppressing and subordinating through biology education. In employing a specialist language and in using everyday-language in a specialised way, the language of biology mystifies large numbers of students of biology. This specialist language serves a twofold purpose. It gives to biology an elitist status that alienates students from biology education as was evidenced in this study. This elitist status operates in conjunction with and reinforces class positions within the wider society. The specialist language also serves to exclude those without that cultural capital that facilitates the development of such specialist language. In alienating and excluding, the language of biology too serves to oppress and subordinate. A critical biology education makes the agenda of such language use available to students. In making such an agenda available, students get to know where exclusionary mechanisms are located – and then can choose to be agents of change towards social transformation.

Through naming the oppressions and subordinations, biology education can be taught differently. In such an insurgent biology education the agenda is explicitly critical-political and is aimed at working towards social transformation. Through such an insurgent biology education students are exposed to how power structures operate within society – in and through all classroom, the school and within the wider society. Such exposure provides students with possibilities for reading both the word and the world and in so doing also providing them with opportunities as agents of change.

Contemporary traditional biology education remains almost exclusively focused on scientific literacy. This focus on scientific literacy translates into a biology education that remains almost exclusively assessment driven where perfomance in assessments determines the level of success in biology. Very little space exists for a biology education connected to broader social realities and social relationships are ignored and denied in favour of an objective scientific literacy. Through this study it became clearer that any effort at human rights and social justice in biology and Life sciences education would remain but a myth if the focus in biology education is exclusively a focus on scientific literacy.

Teaching differently also requires that classrooms like that in this study have to be co-created with students over time (Gutstein, 2003). Social issues around racism, gender, class, religion, language and etc. that are located within the context of power, privilege and oppression are explosive issues. Such issues cannot just be thrust upon students. They need to be prepared to take as serious their roles as the constructors of knowledge besides that as learners. They also need to be prepared to hear other students in the classrooms and also to find their own voices. Creating such a classroom both daunts and challenges – and as this study shows it is possible. It requires setting ground rules together with the students and highlights also that the educator never truly abdicates her/his position of power and authority. To do so could result in anarchy. It requires that the educator use power and authority only in those circumstances that could degenerate into disrespect and anarchy and to prevent that from occurring – this too is part of the educator's required role in teaching that rights go with responsibility in social contexts where human dignity is prized.

The task may appear daunting to the educator since it also requires that the educator declare herself/himself to the students with regard to where the educator is located on the variety of oppressions that may emerge in such an engagement. As identified by Soudien (1994) teachers prefer to steer clear of the problematics of oppression and discrimination and do this successfully by turning such problematics into taboos in the classroom. This is daunting in that it could be seen as that road that leads to unequal power relationships in the classroom with the shift to power towards students and educators are unwilling to relinquish such power since is akin to control – a necessity in ever-increasing larger classroom containing a diversity that terrifies – as also recognised by hooks (1994). The task may even be viewed from the perspective of a crisis that learning about oppression and unlearning that regarded as normal and normative can unleash. The crisis is also located in the disruption of classroom hegemonies amongst students. Yet such a crisis through an anti-oppressive education is desirable if it will lead to disruptions of common-sense views held of the world towards change (Kumashiro, 2001).

Embarking on such a process will quickly inform the educator that desired change will not happen through predictable, controllable lessons. The risks of unpredictability and lack of control engaged with could create additional fears for the educator. It is not a risk-free pedagogy. The educator, if seriously committed to effecting change towards social justice, will however, recognise and work from a starting point which recognizes that that anti-oppressive education is not an easy, rational, straightforward process. The demand will be on the educator to create spaces in the existing curriculum that will make it possible for students together with the educator to enter and work

through emerging crises – crises linked to social change around issues of privilege, power and oppression.

Kumashiro's (2001) recognition that teaching involves a great deal of unknowability was also borne out by this study. Since we can never know fully who our students are we cannot then control what it is they learn or know with any certainty what it is that they actually learn. We cannot also be certain or assume that what we want them to learn is in their best interests to learn. In recognising this unknowability of teaching we, as educators, acknowledge also that we cannot say ahead of time what we want students to learn, how we will get them there and how we will determine they got there – it is in through using the official biology and science knowledge to move beyond it into realms of unknowabilty that educators and students can begin to work towards change. What will also be an unknowable given is that the kind of change/s occurring will also remain within the domain of the unknown.

For biology educators willing to work from the perspective of a critical pedagogy the only 'knowability' will be that the educator will do things differently. It will require a moving away from 'known' ways of teaching – of teaching without being reliant on or being 'dictated' to by existing standardised curricular 'recipes' and/or through following the 'biblicised' textbook/s (Moraes, 1999). This will require a deliberate awareness of and organisation against isolation/marginalisation, promotion of student-adult alliances whenever and wherever possible, building inter-racial/intercultural alliances, an active opposition of 'isms' overt and covert, an examination of personal practice, holding high expectations for all students and a commitment to social justice and peace. For such an educator the focus will then become the principles of dialogue, dialectic, praxis and reflection – principles of a critical pedagogy (Thousand, Diaz-Grenburg and Nevin, 1999).

Gutstein's (2003) efforts in mathematics education provides for possibilities for social justice – through the teaching and learning of mathematics. His efforts focused on developing in students a sense of agency through mathematics education. The mathematics that students engaged with allowed for interactions with existing social conditions. Through this students became not only mathematically-able but also aware of the socio-political conditions that allowed for progress and also constrained in their immediate and within the wider environment. This gave students a sense of how they needed to act to ensure that constraints could begin to be turned around in efforts towards progress and success for especially those that were oppressed. Biology education and science education, indeed all areas of education, can also gain by giving serious attention to Guttstein's

work. The gain would lie in students getting the knowledge as required within the subject discipline while at the same time working as agents towards social justice through the subject discipline itself. This will require that all involved in education remove the blinding masks of prevailing dominant technicist rationalist worldviews governing education delivery at institutions of higher learning and at schools. The disruptions caused by such a bold and daring stepping-out will require deskilling from currently held perspectives and development and (re)development from a critical socio-political perspective. The process will be painful. However, if social justice is a desirable and worthwhile goal then the pain must be engaged with.

As public school educators we must acknowledge that we are agents of the state (Kohli, 1996). This means that we are tasked with carrying out policies of the state or risk never being 'promoted' or even losing our jobs. The administrators within the school and outside, in the form of 'subject advisors', colleagues, students and parents create 'surveillance' teams to prevent any disruptions through ensuring that normative teaching-learning boundaries remain intact. Improving teaching for access to all learners through educator-peer development workshops, outcomes-based education and further professional development is how as educators we remain within the fold as agents of the state. We accept and operate within the dominant discourse of what it means to be a 'professional' educator and we 'fear' being labelled 'unprofessional'. It is this fear that the state, interpreted in the dominant culture of schooling, capitalises on and uses to silently coerce educators from taking risks. It is these chains too that educators need to break if they wish to engage, together with students, with issues of privilege, power and oppression in efforts to expose and through that begin the process of redress if possible.

9.3 (RE)SEARCHING BIOLOGY EDUCATION

Biology education is informed by three research perspectives that guide development within the larger discipline of science education. These include the remedial perspective with a fix-it approach; the inclusive perspective that has a cater-for-all approach; and a socio-critical-political perspective that is located within a reform-science education approach. All three perspectives remain focused on making science education accessible or towards improving access to science education i.e. the focus is strictly science education.

9.3.1 Remedial Perspective

In Southern Africa research in science education remains within the dominant movements of constructivism, STS and multiculturalism (Malcolm and Alant, 2004). Research within the political arena in science education and specifically biology education is an area that has as yet not been pursued. In this way science and biology education can remain safe, maintain its respect and through this continue to be accepted by the hegemonic North within the current dominant technicist, rationalist view of science and science education clothed by a social constructivist politically-correct agenda. The social constructivist agenda makes visible that learning is constructed as a process of social interaction and occurs within a framework of participation through which learners acquire the necessary tools, skills, knowledge and values to actively participate in the community with a view of eventually becoming the 'master'(sic) in the community (Lauzon, 1999).

The concern with this worldview in science education is one of access to science and science education including biology education based on the belief that science remains inaccessible to persons on the basis of teachers and teacher training, language, race, gender, culture, nationality and continent. The focus then is on how to fix this up – a remedial focus. What these categories do when exploring inaccessibility to science, through science education and biology education, is that they mask the notion of deficit - which is where the research problem remains grounded. The hegemony of the current dominant rational and technicist production of science and biology knowledge that is the basis of science and biology education remains invisible and through that inviolate. Improving access to science education and biology education is a worthwhile and desirable goal. The issue is how the problem is understood. However, this must not happen at the expense of excluding other equally significant political contributions made by science education and biology education to the current stratifications and existing inequities within society in efforts towards realising social justice. How science education and biology education lend themselves to perpetuating existing social patterns that include the various interacting oppressions has yet to be challenged.

9.3.2 Inclusive Perspective

Schools and teachers do determine the nature and extent of socialisation processes (Gilbert and Yerrick, 2001). Science classrooms do represent complex interactions of society, identity and power and the challenge for educators' is in developing a common language and constructs among science education practitioners, researchers and reformers to find ways to re-define success in school

science. Existing oppressions located in identity of the Black and raced Other were tacitly acknowledged as limiting success within the realms of academic achievement – specifically achievement in science (and biology) education. The link between school science and economic stratification is specifically acknowledged and through a science for all such discriminations can begin to be addressed. This view is inherently the same as that expressed by Moje *et al* (2001) in their exploration of project-based science pedagogy embedded in various discourses and located within the sociocultural domain. Lemke's (2001) offering within the sociocultural perspective is in tandem with these views. Science and biology education's role in producing and perpetuating social inequity remain invisible in the sociocultural's research tradition's search for 'success' in school science education and biology education.

The sociocultural perspective in science education does not examine science and biology teaching from the experiences and standpoint of the science and biology student who spends most of her/his day outside of a science and/or biology classroom. Such a student's experiences are in the course of the day obtained from classes in other subject/discipline areas, in social interactions in the school outside of the formal curriculum and in life outside of the school itself (Lemke, 2001). Lemke believes that these experiences must be researched to work out the best ways to integrate science and biology teaching that serves the needs of all students amongst whom differences exist. The focus here is towards the delivery of a science and biology to all i.e. the diverse and hence the different! This is what makes this an inclusive perspective and not a socially-critical perspective. Differences in positioning the privileged and oppressed remain ignored by such a focus. This sociocultural perspective speaks thus only to a selective and specific sociocultural notion of science education and biology education. What this perspective does is that it brings in marginal science and marginal students but fails to question the power and hegemony of the dominant science

9.3.3 Socio-Critical-Political Perspective

An education for critical scientific literacy for Hodson (1999) is inextricably linked to an education for political literacy towards social reconstruction. This can be achieved through an issues-based curriculum via four levels of sophistication that moves from the first level of an awareness of the societal and environmental impact of science and being alerted to alternative practices. The second level would create sensitisation to the socio-political nature of scientific practice. At the third level the commitment to fight for the establishment of just environmental sustainable practice would be obtained. Knowledge and skill acquisition for effective intervention in the decision-making processes and for ensuring that alternative voices and underlying interests are brought to bear on

policy decisions would be engaged with at the fourth level of sophistication. The social reconstruction envisaged would include the confrontation of and the elimination of racism, sexism, classism and various forms of discrimination. This for Hodson can be achieved through an education in and through the environment grounded in a critical multicultural science education. However Hodson's theorisations in the re-shaping of science education and biology education does not interrogate what is contained within science and biology that serves to perpetuate privilege and oppression.

For Bloor (2000) a feminist science, *which philosophically cannot exist any more than 'pure', perfect science can* (p11 of 13), could draw on Haraway's 'positional' rationality that would encourage the development and understanding of 'partial' knowledges. This in turn would provide for access through interdisciplinary teaching. In this way examination of and connections between the disciplines involved could be demonstrated such as between biology and social science. Social science together with biology would allow for explorations between cultures and link to biology. This would lead to an altering of biology and science in the light of such challenges posed by a feminist science. Such interdisciplinary possibilities would allow for marginalized viewpoints to enter the discourse. The limitations of such a feminist science though would lie in the perspective being grounded within the socio-cultural and the exclusion of the critical socio-political.

For Kyle (2000, 2001) education in science (and biology) should be oriented towards the purpose of fostering critical and participatory democracy so that students can change, transform and reinvent their worlds. For him domains of research in science education must be re-formed and this can be attained through the curriculum, instruction and assessment. In this way a comprehensive, intellectually honest and pedagogically valid image of reform will emerge through ensuring the development of a scientific literacy for social and self-empowerment; addressing the wider socio-cultural, economic and political contexts in which schooling occurs and; ensuring that there is scientific literacy for all.

Kyle's (2001) recognition of the need for a political philosophy of science education would look to how knowledge and science knowledge in particular is legitimised in society to create opportunities for self-empowerment and social empowerment. The role of indigenous knowledge within this enterprise must be also acknowledged and realised for Kyle. Exactly what this empowerment, a 'changing the reality' entails, and how it is obtained needs further elucidation. Legitimisation of knowledge and its consequences for society in the perpetuation of privilege and oppression needs also be part of any such enterprise. Further, how such a political philosophy could be translated into

a possible series of sustained empirical experiences would need to be explored. What Kyle suggests remains located at the nebulous perimeter of possible research agendas. How this translates into actual research and practice as informed in and through cycles of research and practice require developing. This study suggests how some of what Kyle advocates could begin to be obtained in and through both research and practice.

Research in science education looks to re-shaping the disciplines in science education. Through this science could become available to all in ways relevant to them. Barton's work with high-poverty urban youth revealed the importance of power and co-opting science spaces, relevant science and activating resources for transformations: science as a tool for change and community as the main themes characterizing youth's practice of science (Barton, 2003). Barton acknowledges that science is political in its promotion of power, knowledge and values and in its rewarding of particular forms of individual and institutional behaviour. This work however remained located at how these youth accessed relevant science into their lives to fix-up their lives and through it that of the community. In this way real science entered the lives of the youth and the community. The focus remained a democratic, authentic and inclusive science and science education. The political dimensions of how science could be used to make meaning of their high-poverty, marginalized lives of oppressions outside of science within the wider community were not engaged with. Any possibilities then for shifts in existing social lived realities of privilege, power, oppression and discrimination were annihilated at the very outset.

Rodriguez (1998) speaks of Barton's efforts in terms of a *truncated agency* where the socially transformative impact remains elusive. The issue of a truncated agency for him, however, remains within the sociocultural and its engagement with transformation. Locating efforts within the sociocultural and ignoring the socio-political will perpetuate truncated agency rather than active agency. The truncated agency will lead to 'pockets' of change – 'pockets' linked to eroding the privilege, power and authority vested in science solely for the purpose of accessing science only. What this would do is allow for confidence in science within the invisible existing entrenched social discriminations. The 'science' life of the person will thus continue to remain disconnected from the 'whole' person and in this way limit or truncate agency or what I believe will be an annihilated agency.

Work in progress by Keane and Malcolm (Malcolm and Alant, 2004) that involves participation in engaging the actual and hypothetical situations that allowed for the emergence of arranged situations in researching 'relevant science' in a rural village in KwaZulu-Natal in South Africa. The

implications of this project for 'relevant science' and for possibilities of emancipatory societal engagement need pursuing if participation is understood as contributing in making visible the multitude of 'actual oppressions' in efforts towards turning them upon themselves.

Feminist theories in examining oppressions in education and institutions of education look to oppression from gender at the centre and the link between gender, class, race sexuality etc. and also to the production of meaning (Jackson, 1997). It is this that, according to Jackson, will lead to emancipatory change. A feminist science for Mies (1995) needs an alternative scientific paradigm – one that does not limit emancipatory movements the way dominant science does. This for her can be effected through the use of 'feminine' qualitative research methods. However, if such research methods do not engage with emancipation from and through 'non-emancipation' then emancipation will in the actual world remain located within research paradigms and rhetoric. The qualitative will also take on the mantle of the hard or 'masculine' that for Mies will limit emancipation. There is also at the same time a need to be vigilant as to the contributions of research methodologies – both quantitative and qualitative. Both can and do contribute towards meaning-framing and meaning-making in the quest towards social justice. What the feminist theories fail to address is how the suggested feminist perspective can begin to be actualised and operationalised within science education and biology education specifically. It is this failing that can leave the suggestions of the feminist perspective at the level of rhetoric. It is also biology education's narrow gaze that has not appropriated critical feminist perspectives, theories and practices. The research reported in this study perhaps provides the beginnings of such actualizations and operationalisations within the real-lived social world of people who possess agency to effect emancipation from the multitudanal oppressions that abound.

An outcome of research in science education and biology education that favours the technicist, rational approach continues to be evidenced through textbooks – in South Africa and elsewhere. The textbooks present the science knowledge and biology knowledge through their content and form as particular constructions of reality – a reality informed by the paradigms within which research in these disciplines are carried out. Here too the political nature of science education and biology education is never alluded to with the textbooks remaining silent on how science and biology have contributed to and continue to contribute to existing privilege and oppression within society. Fix-ups have occurred – as evidenced in photographs and illustrations used; in the names of persons where learner-centred activities have to be engaged with; and in the cultural contributions now making an appearance within the text. This is where re-shaping science education and biology education as a discipline begins and ends.

Science and biology education can draw from research in mathematics education if there is a commitment towards redress in areas of privilege, power and oppression. Vithal's (2003) work offers possibilities for how research could be (re)thought in design and intent by viewing research from hypothetical and actual situations and through them the arranged situation. Theories, values, people, structures and perspectives interact in conflicting and harmonious episodes as they make up actual and hypothetical situations and it is on this that the arranged situation in the form of the research is brought to bear. Issues from authority through to structure then become issues that need addressing from the socio-critical perspective as engaged with by Vithal in making visible privilege, power and oppression. This visibility then provides for possibilities of engagement with privilege, power and oppression in the quest towards social justice.

9.4 A SOUTH AFRICAN RESPONSE

Carrim (1998) highlights that the research in education has focused on macro interventions that have remained structuralist in nature. He identified the gap as one where there exists no nationally or provincially coordinated programmes for students to develop a critical anti-racist, anti-sexist, anti-discrimination awareness or consciousness in the formal operations that occur in the school. Carrim and Soudien (1999) in their engagement with desegregation at schools in South Africa focused on what it meant to 'desegregate'. Based on their experiences the suggestion from them is for the need to be more sophisticated through incorporating a more complex view of the various identities that exist. Through such a critical antiracist approach the notion of difference would be acknowledged and incorporated within and among people to ensure a 'de-essentialised' sense of identity. No suggestions or references are made as to where this could be located and how it could be operationalised and actualised within the school curriculum and in science education and biology education. My study located within the formal school biology programme highlights the possibilities for internalising within the consciousness and through that the possibility of actualising an agency towards an anti-discriminatory social justice approach.

Motala (2001) in reviewing that, which has in the main guided research in education in post-apartheid South Africa, has recognised that focus has been on 'quality' education. She does point out that there exists no clear conception of what 'quality' is or implies – this remains elusive. She does however, recognise that the notion of 'quality' that frames and guides the research is located in the notion of deficit. The deficits that required addressing and which research has targeted included the development of an integrated approach to education and training based on a national

qualifications framework; the restructuring of school ownership; governance and finance; the change in curriculum to one underpinned by an outcomes-based philosophy; ten years of compulsory education for all children; establishment of new management structures and the alteration of the governance and the financing of the higher education system – what Carrim (2001) identified as structuralist, systemic interventions at the macro-level.

If the focus remains grounded in deficit and especially within curriculum then the possibility of shifts from power, privilege and oppression to a system that works towards that which is socially just will be nothing more than elusive myth. The notion of deficit constantly guided by financial imperatives will further serve to cement power, privilege and oppression. Add to this Carrim's (2001) recognition that identities continue to be ignored in the notion of 'educator' that is part of a research outcome to deal with deficits located in the teacher/educator component. What this does is to homogenise teachers in a way that it is hoped will make all teachers the 'same' so that the desired 'quality' education then can be achieved. Who or what the teacher is as a raced, gendered, classed, religioused and etc. professional and worker and how the teacher delivers or shares the desired curriculum can be comfortably ignored with the homogenous educator label.

A socio-critical perspective informed by a critical pedagogy of science will have no choice but to address questions asked by McLaren in an interview with Barton (2001) when evaluating policy and practice in science education. His questions include examining what it is that places science education and biology education in a subordinate partnership with existing 'ruling' social structures. Does the science education and biology education promote unity of political purpose within the diversity of race, gender, class, religion, language, and etc. experiences? Does science and biology education promote race equity and dismantle the hegemony of powerful White privilege? Does science education and biology education promote gender equality and work towards the destabilization of patriarchal structures of oppression? Does science education and biology education improve the overall lives of people in areas they are discriminated against and oppressed? Does science education and biology education provide leadership in challenging the injustices that are constitutive of the accumulation of privilege and power? Does science and biology education provide opportunities for the analysis of the contradictions between the forces and the relations of power, privilege and oppression. I believe that this study points to possibilities for existing policy and practice in biology education and suggests ways that can attempt to illuminate McLaren's concerns about how students and educators can begin to address issues of 'truth to power' in efforts towards social justice through biology education.

As shared by Motala (2001) current policy and emergent practice reflect both continuities and ruptures with apartheid South Africa. In its attempts to 'reform' education for a post-apartheid state the current policies find themselves hamstrung within and dictated to by fiscal constraints. Human resource development through education is governed by the primary need to support economic growth for the country. This has resulted in the tension then between education for the purpose of serving the global economy and local economic growth and education for citizenship, democracy and social justice. This tension is further exacerbated by the disjuncture between national policy and its interpretation and implementation at the provincial and at the classroom level. The understanding that the policy to practice process occurs in a smooth linear fashion with regards to development, adoption and implementation is selectively naïve in that it ignores the existing complex disparities that shape the functioning of macro-micro relationships within an education that is itself governed by fiscal determinants. It is this that has shaped both the continuities and ruptures in education in the post-apartheid state.

Research in South Africa has influenced the policy in science education as contained within the Revised Curriculum 2005 and Further Education and Training policy documents (Malcolm and Alant, 2004). However, research's focus on constructivism, Science, Technology and Society and multiculturalism has stymied policy development with regard to privilege and oppression i.e. the political dimensions of science education and biology education. As shared by Carter and Smith (1998) the proposed outcomes-based understandings, notions of science for all and the desire for changes in economic and social conditions that have resulted in new curricula in Life Sciences (biology) education offers limited substantive change because the curriculum still remains framed within a highly selective and conceptual body of knowledge. The claims of a transformative outcomes-driven agenda in education pays lip-service to National Curriculum Policy Principles of promoting human rights, inclusivity, social justice and environmental justice and remains nothing more than a claim since the actualised practice in science and biology classrooms remain locked within just teaching the core 'content' as guided by the assessment standards as set out in policy documents or within the fix-it mode of 'improving' science and biology learning in the classroom. This is the real outcome of an outcomes based education governed by fiscal determinants for education and education's role for the South African economy as allowed for by the dominant global economy – the production of human resources to support local economic growth as required and governed by the hegemonic capitalist global economy.

The new curriculum however provides an environment that legitimates a socially critical biology/ life sciences education. With the new curriculum there are three intended results of teaching and

learning, that is, three learning outcomes in the life sciences. These are Learning outcome 1 which engages with 'Scientific Inquiry and Problem Solving'; Learning Outcome 2 that engages with the 'Construction and Application of Life Sciences Knowledge' and; Learning outcome 3 that engages with ' Life Sciences, Technology, Environment and Society' (National Curriculum Statement, Life Sciences, 2003). The intended results for learning outcomes 1 and 2 through inquiry, problem solving, construction and application of knowledge from the life sciences are results that must focus on solutions to problems in everyday life. This study shows how critical inquiry of existing knowledge within the life sciences in and through problem solving, construction and application of such knowledge can work towards addressing some existing 'problems' of knowledge production and power, privilege and oppression in everyday life. Life science learning outcome 3's intended result is obtained through a recognition of how existing social, religious and political forces act to shape 'accepted' knowledge, beliefs, ethics, attitudes, values and biases from a historical past through to a historical present – that which this study has spoken to throughout.

What this study also does is it actualises what the national policy speaks to in the critical outcomes contained in the national curriculum statement. The high knowledge and high skills, integration and applied competence and progression - some of the nine principles of the national curriculum statement are not compromised. Neither are the principles of social transformation and human rights, inclusivity, environmental and social justice compromised through the focus on race, gender, class, language and power in and through biology education. This study then gives direction towards possibilities for the transformative notions contained within current policy dictates. This study points to the need for the trialling and reporting of similar practices. More trialling and reporting will give further guidelines as to how a human rights curriculum could be realised.

9.5 BIOLOGY TEACHER EDUCATION

If teaching differently means that educators need to take cognisance of their roles in efforts towards social justice what does this mean for teacher-education? Current teacher education programmes do not promote the development of teachers as critical agents of social justice (McLaren and Fischman, 1998). As Sclering (1997) stated teacher-education remains located within the technocratic, deterministic perspective that suits current global agendas. McCall and Andringa (1997) recognised the political conservatism of teacher educators as evidenced in the development of teacher education programmes based on the 'scientific study of teaching'. The use of the three process-oriented models, viz. Helms's Racial Identity Theory Model, Banks's Typology of Ethnicity Model and Milton Bennett's Developmental Model of intercultural Sensitivity, as suggested by McAllister

and Irvine (2000) in the development of both pre-service and in-service educator programmes would in effect assimilate teacher education into the existing hegemonic agendas of power, privilege and oppression. The suggested use of Helm's Racial Identity Model, Banks's Typology of Ethnic Identity Model and Bennett's Developmental Model of Intercultural Sensitivity does not move beyond 'fix-up' strategies to assimilate identity differences through teacher-education programmes. The programme for democracy, diversity and social justice for elementary education put forward by Beyer (2001) espouses its location within critical teacher education. The critical nature of the programme however becomes limited by the integrationist approach of the suggested teacher education programme. For Banks (2001) a reformed teacher education located in a multicultural citizenship education should have as its major goal the acquisition of a balance between cultural, national and global identifications that would allow teachers to know, to care and to act as they are taught to read the word and the world. This programme remains within socio-cultural precincts and ignores the socio-political through which agency towards change in and through teacher education may be achieved.

Ladson-Billings (2000) suggestion of anti-racist teacher education programmes that use autobiography, restructured field experience, situated pedagogies and returning to the classrooms of experts being confined to reforming teacher education towards an understanding of the African American cultural experience needs to move beyond the constraints of the African American cultural experience if it is to be used towards a programme that begins to address power, privilege and the multitude of oppressions that govern daily experiences.

Nieto (2000) has expressed concern for the slow pace of reform in teacher education programmes. For her, teacher education programmes with a social justice orientation need to take a stand on social justice and diversity by preparing teachers to work with students to face the challenges of pluralistic and rapidly changing societies. Such programmes also need to make social justice ubiquitous in teacher education in a reformed teacher education curriculum through critically examining why schools are unjust for some students through analysing school policies and practices through the privileging some identities and subordinating others. Teacher-education also needs to promote teaching as a life-long journey of transformation through preparing prospective teachers by facing and accepting their own identities, becoming learners of their students' realities, developing strong and meaningful relationships with their students, becoming multilingual and multicultural, learning to challenge racism and other biases and through developing a community of critical friends. Yost, Sentner and Forlenza-Bailey (2000) also see the teaching of critical reflection skills as part of reformed teacher education programmes. Whilst acknowledging that teaching such skills

will not be easy because of the complex nature of critical reflection they do believe however that such skills can be taught to prospective teachers. The need for this skill lies in its value in preparing novice teachers to challenge the existing status quo and through this possibly effect meaningful change in schools and through schools in society.

For McLaren and Fischman (1998) the global neo-conservative (within which the neo-liberal has become assimilated) discourse in education has led to a reforming of the education sector that involves greater accountability for the purposes of de-skilling, standardization and changing rationales of the teaching profession with teacher-education becoming a sub-sector of the economy. A 'revolution' in teacher-education curriculum then becomes a necessity if classroom practice is seen as contributing towards social justice. What would such a revolution entail? McLaren and Fischman (1998) suggest five requirements that could contribute to a revolutionised teacher-education curriculum. These include programmes where prospective teachers could be actively involved in teacher education and mentoring activities in activist-oriented teacher programmes grounded in local community struggles in the schools themselves; programmes be framed within the context of antiracist, anti-class/capitalist and feminist pedagogies; these perspectives of antiracist, multicultural and gender education be linked to current global patterns of capitalist, privilege and power accumulation; programmes become actively linked with new social movements involved with advocating human rights both locally and internationally to ensure that method classes are grounded in well-articulated political projects aimed at the transformation of asymmetrical relationships of privilege, power and oppression; and a media literacy curriculum as part of the programme to critically engage in the production of counter-hegemonic discourses through print, television, film, photograph and computer technologies. A revolutionised reformed teacher-education supportive of educators willing to risk a critical approach in classrooms will work towards alleviating some of the fears, risks and isolations of perceived 'unprofessionalism' contained in the disruptions and crises that such teachers engage with in their efforts towards social justice.

Teaching for social justice means that teacher education must involve both teacher-educators and prospective educators. Teacher education must create an active engagement with existing 'savage inequalities' (Kozol, 1991) for causes and possible solutions to inequalities to become part of teacher education programmes. It must prepare educators to engage with everyday actions that support and challenge social injustice (Guyton, 2000; McCall and Andringa,1997). A teacher education for social justice will be one where students will have voice and equal access to resources and opportunities to explore issues grounded in social experiences and teaching and learning that

allows for the construction of rather than the transmission of knowledge as part of a desired transformational orientation.

Kumashiro (2000) found that when he proceeded rationally as a teacher-educator and assumed to know the students he 'missed' many of his students. This precipitated a crisis for him as a teacher-educator that then guided his engagements for an anti-oppressive education. For him an anti-oppressive teacher education programme must also recognize unknowabilty of where and who students are in efforts towards anti-oppressive education. Teacher-education programmes should contain understandings that recognize that what students' learn can never be controlled and that programmes should have in them spaces to allow for discomfort and crises as students challenge their own locations within privilege, power and oppression.

This study too provides possibilities for insurgent teacher education programmes through engaging students at both pre-service and in-service levels in continually developing teacher-education curricula that includes identities grounded in privilege, power and oppression. A critical exploration of identity, difference, power and the production of knowledge as an inherent part of the teacher education programme, even in method courses, are essential towards realizing the goals of social justice.

9.6 CONCLUSION: GAINS AND LIMITATIONS

My study too provoked, vexed and caused pain. The critical examination of the student experiences in and through biology education require that experiences of subjugation be shared to begin that exploration of that which is accepted as normal. Critical research traditions that drew from critical-race-antiracism-feminist research guided this research. This foregrounds clearly that just one research tradition does not suffice – of the various frameworks within the critical tradition each has something to contribute. The critical ethnography employed made possible an interrogation and the disruption of the 'normal' that included within it existing subjugation in its various individual and interacting forms and it recognised and accepted that much of what occurred in the classroom as 'normal' was unknowable – both to me as the educator and to the students in the class. The critical-self ethnography used gave me a glimpse of myself and gave students glimpses of themselves. There is no denying that the glimpses obtained were framed within the context of power, privilege, discrimination and oppression – as determined by my agenda. It is these glimpses though that provide possible directions as to how biology education can teach not only biology but also teach to the identities that frame who and what constitute existing social frameworks and how these then

organise and sustain themselves through knowledge production and social positions to maintain and perpetuate without question privilege, power, oppression and discrimination. It is only through making visible the 'unknowable' that change can be effected, if desired, towards establishing social justice. What this study shows is that using research traditions outside of constructivism (social and any other form) and science, technology and society and multiculturalism reveals aspects of the 'unknown' – it is through this unknown that 'gain' from such teaching and learning will become possible; perhaps it is the continued refusal to recognise the unknown and its role that has both prohibited social transformation and limited access to science education itself despite the multitudinous efforts of the existing research traditions in fixing-up existing identified deficits. Non-willingness to identify and engage with the unknown will continue to limit research and the teaching and learning in biology education.

In interrogating experiences of marginalisation and normalisation, the socio-historic political processes that produce standards of normalisations have to be acknowledged (Filax and Shogan, 1999). In the process it makes students aware of the self as conditioned by society and further perpetuated and maintained through the discourse of biology education – in its present format. Both the students and I developed a sense of ourselves in how it was that each of us had been shaped as raced, gendered, classed religioused, languaged and powerless persons at various moments in the multitude of intersections in each of our lives. The role of 'power' in producing knowledge and through this producing and maintaining subjectivities, institutions and social practices as spoken of by Foucalt (1974) is what we had to confront. What this study is saying is that it is possible to use an existing discipline, even one from the world of a 'neutral, value-free, objective, rational' science, such as biology to transgress into the socio-political and engage with resistance to power as part of the essential development of the self as a contributing member of society – contributing towards and sustaining social justice within the environment.

The transgressions in the biology classroom in and through biology did allow for an exposure of the limits that framed the many lives in the classroom and the impositions of these limits in maintaining existing social advantage and oppressions that students came with into the classroom. It is this experience that challenges Filax's (1997) notion that the classroom is an unlikely site for transgressions through limited experiences and that the classroom experience is limited to exposing limits of identity. Experiences from my study says that classroom transgressions to explore and through that to resist power in the production of normative and opressed identities is possible.

Sociocultural perspectives do identify socio-cultural-political categories such as gender, race, class language and peoples identities as African, Japanese etc. as that inextricably linked to science education and biology education. The categories are then interrogated from the perspective of how belonging to such categories, either individually or interlinked, contributes to success through access or marginalisation through lack of access to science education and biology education. The acknowledgement of the political as a category is at best a tokenist acknowledgement in the 'fix-up' goal that drives the sociocultural research perspective. Perhaps a shift from the sociocultural to a socio-critical perspective will seriously focus attention on the political in science education and biology education. Such attention will demand that science education and biology education begin to look into themselves to elucidate and make visible their contributions in perpetuating and maintaining privilege, power and oppression. The political must be defined to include also empowering students towards becoming change agents. It must engage with developing in students' intellectual activism that will allow for risk-taking through students challenging dominant narratives in science and biology education. Such a political perspective will allow both educators and students to question knowledge production in science and biology education and the relationship between such knowledge production and power, privilege and oppression (Sanchez and Fried, 1997). The challenge then becomes the combining of the personal, the political and the intellectual (Lal, 2000).

Once the contributions are visible science education and biology education research will then have to make decisions about whether such issues are equally significant and worthwhile in efforts towards social justice or whether the importance of these issues lies only in improving access to science education and biology education for all to the exclusion of all else that makes up the fabric of society. If science education and biology education research accept that science education and biology education has a contribution to make in working towards social justice then the movement towards a critical socio-political perspective in science education and biology education will begin to influence research in this arena and through it social interactions.

As Kumashiro (2001) recognises that any effort at an anti-oppressive/anti-discriminatory education will make possible working against only some forms of oppression while at the same time becoming complicit with others and that in every practice some changes will become possible whilst rendering others impossible. This then makes clear no one approach towards emancipatory anti-oppressive education will ever be fully inclusive of all oppressions and that any approach including mine must be seen as a partial response. By its very nature then such approaches understood as partial responses will need to be reworked constantly as new challenges and

oppressions come to the fore. Only then will it be possible to move from current modes of miseducation and noneducation that allows education to invisibly and visibly perpetuate positions of privilege, power, oppression and discrimination.

Biology education has never acknowledged its contribution to the consolidation of race and gender as biological categories used to validate superiority and inferiority. It was this scientific validation that made real notions of the oppressed and the oppressor in the forms of Black/White and woman/man. 'Irrefutable' science data from biological determinism and genetics, amongst others, were used to entrench multiple positions of power and oppression – from the privileged powerful White male to the completely subjugated powerless Black female. In continuing to ignore biology's historical contributions to current social understandings and identities, biology and biology education remain politically silent – a strategic silence in a context of oppressions still perpetuated and validated by biology's history. Biology and biology education continue to enjoy this strategic silence because biology is seen only as that discipline emerging the great variety of natural sciences. Focus on how these various natural sciences contribute to that, which makes up biology allows for biology's continued evasion around its direct contributions to existing social injustices. The current preferred view is of biology and science as disciplines where *things* (are seen) *as static, dualistically ahistorical, mechanical and additive* (Mies, 1995). Additive contributions to biology from the various natural sciences acquire validity on the basis of their universal applicability. That which lacks universal applicability does not qualify for inclusion. In this way biology and biology education's contribution to existing social selves in the form of the oppressed and the oppressor can be expediently eliminated from the discourse of biology. Also, the 'natural' and 'pure' sciences that contribute to and constitute the world of science are further indemnified from having contributed to and continuing to contribute to those identities that make up the oppressed and the oppressor by virtue of existing within the realm of the rational and the objective – within institutions at all levels of "education".

Biology education, in its present form, together with the school curriculum in other subject disciplines can be regarded as racist miseducation. Biology education misprepares students for the actual social conditions that they are likely to encounter; it misrepresents knowledge; it narrows or cuts off opportunities for growth; it lies to students about who they are or what their society is like. Biology education is racist miseducation because it ignores the social fact of racism in society – a racism that is historically rooted in biology. In doing so it teaches students not to think about race, promoting ignorance as if it were innocence. Biology and biology education does so in collusion with prevailing power relations, thereby reinforcing racist social structures (Thompson, 1997).

Biology education is also non-educative. Current coursework merely keeps students busy by parroting sophisticated intellectual skills without promoting intellectual understanding or by fragmenting and mystifying knowledge. Such racist-non-education provides students with irrelevant skills tied to reified conceptions of knowledge such as 'generic' science skills, mystified and fragmented in ways that discourage any inquiry into current controversies in research concerning issues such as race and IQ (Thompson, 1997). The shift from the traditional behaviourist non-educative paradigm to an Outcomes Based Paradigm does not change the non-educative nature of school biology. This is because the new paradigm, despite its legitimation of education as a socio-critical enterprise, remains a panacea designed to remove the discrimination of the previous paradigm – without asking what such an education means in a still racist South African society. Existing power relations continue to be perpetuated by this form of racist-non-educative school biology.

REFERENCES

Aikenhead, G S (2001): *Cross-Cultural Science Teaching*; Paper presented at National Association for Research in Science Teaching; St. Louis; pp 1 -18

Allchin, D (2000); Mending Mendelism; *The American Biology Teacher*; Vol. 62; No. 9; pp 633 - 639

Apple, M W (2001): *Educating The "Right" Way: Markets, Standards, God and Inequality*; RoutledgeFalmer, New York

Apple, M W (1998): Knowledge, pedagogy and the conservative alliance; *Studies in Literary Imagination*; Vol. 31; No. 1; pp 5 - 23

Applebaum, B (2001): Raising Awareness of Dominance: does recognising dominance mean one has to dismiss the values of the dominant group?; *Journal of Moral Education*; Vol. 30; No.1; pp 55 - 70

Artiles, A J (1998): The dilemma of difference: enriching the disproportionality discourse with theory and context; *The Journal of Special Education*; Vol. 32; No. 1; pp32 - 36

Attwater, M W (1996): Teacher Education and Multicultural Education: Implications for Science Education Research; *Journal of Science Teacher Education*; Vol. 7; No. 1; pp 1 – 21

Ayerst, P W; Green-Thompson A L; Pellew, V W; Thienel, A and Larsen, S E (1986): *Exploring Biology 9*; Shuter and Shooter; Pietermaritzburg; South Africa

Banks, J A (2001): Citizenship education and diversity: Implications for teacher education; *Journal of Teacher Education*; Vol. 52; No. 1; pp 5 - 16

Banning, M (1999): Race, Class, Gender and Classroom discourse in *Race Is ... Race Isn't Critical Race Theory and Qualitative Studies in Education;* edited by Parker, Dehyle and Villenas; Westview Press; Perseus Books Group; Colorado

Barden, L M; Frase, P A and Kovac, J (1997): Teaching Scientific Ethics: A Case Studies Approach; *The American Biology Teacher;* Vol. 59; No. 1; pp12 - 14

Barone,T (1995): Persuasive writings , vigilant readings and reconstructed characters: the paradox of trust in educational storysharing in *Perspectives on narrative and teaching* edited by H McEwan and K Egan; Teachers College Press; New York; pp 64 – 74

Barone, T (2001): Pragmatizing the Imaginary: using life narratives as fiction; *Annual Meeting of the American Educational Research Association*; Sec. 44.28: The Educated Imagination: Fiction and Knowledge

Barone, T (2001): *touching eternity: the enduring outcomes of teaching*, Teachers College Press, New York

Barton, A C (1997): Liberartory Science Education: weaving Connections Between Feminist Theory and Science Education; *Curriculum Inquiry*; 27:2; pp141 - 163

Barton, A C (1998): *Feminist Science Education;* Teachers College Press; New York

Barton, A C (2001): Capitalism, Critical Pedagogy, and Urban Science Education: An Interview with Peter McLaren; *Journal of Research in Science Teaching*; Vol. 38; No. 8; pp 847 - 859

Barton, A C and Yang, K (2000): The Culture of Power and Science Education: Learning from Miguel; *Journal of Research in Science Teaching*; Vol. 37; No. 8; pp871 - 889

Barton, A C (2003): *Teaching Science for Social Justice*; Teachers College Press; New York

Beauboeuf-Lafontant, T (1999): A Movement Against and Beyond Boundaries: "Politically Relevant Teaching" Among African American Teachers; *Teachers College Record*; Vol. 100; N0. 4; pp 702 - 723

Bell, D A (1999): The power of the narrative; *Legal Studies Forum*; Vol. 23; No. 3; pp 315 - 348

Bencze, L and Hodson, D (1999): Changing practice by Changing Practice: Toward More Authentic Science and Science Curriculum Development; *Journal of Research in Science Teaching*; Vol. 36; No. 5; pp 521 - 539

Bennet, J (Dec.): Thinking Sexualities; *http://web.uct.ac.za/org/agi/pubs/newsletters/vol7/lead7.htm*; printed 2004/01/17; pp1 - 4

Berlak, A (1999): Teaching and Testimony: Witnessing and Bearing Witness to Racisms In Culturally Diverse Classrooms; *Curriculum Inquiry*; Vol. 29; No. 1; pp 99 - 127

Beyer, L E (2001): The value of critical perspectives in teacher education; *Journal of Teacher Education*; Vol. 52; No. 2; pp 151 -163

Bianchini, J A and Colburn, A (2000): Teaching the Nature of Science through Inquiry to Prospective Elementary Teachers: A Tale of Two Researchers; *Journal of Research in Science Teaching*; Vol. 37; No. 2; pp 177 - 209

Bianchini, J A; Cavazos, L M; and Helms, J V (2000): From Professional Lives to Inclusive Practice: Science Teachers and Scientists' Views of Gender and Ethnicity in Science Education; *Journal of Research in Science Teaching*; Vol. 37; No. 6; pp 511 - 547

Beyer, L E (1996): Teacher's reflections on the struggle for democratic classrooms; *Teaching Education (Columbia, S C)*; Vol. 8; pp 91 - 102

Bleakley, A (1999): From Reflective Practice to Holistic Reflexivity; *Studies in Higher Education*; Vol. 24; No. 3; pp 315 - 330

Bloor, K (2000): Feminist Analysis of Science and the Implications for Higher Education; *Sociological Research Online*; Vol5; No. 1; pp 1 – 13; http://www.socresonline.org.uk/5/1/bloor.html

Blum, L (1999): Race, Community and Moral Education: Kohlberg and Spielberg as civic educators; *Journal of Moral Education*; Vol. 28; No. 2; pp 125 - 143

Bonilla-Silva, E (1996): Rethinking Racism: Toward A Structural Interpretation; *American Sociological Review*; Vol. 62; pp 465 - 480

Bonilla-Silva, E and Forman, T A (2000): "I am not a racist but ...": mapping White college students' racial ideology in the USA; *Discourse and Society*; Vol. 11; No. 1; pp 50 - 85

Boyd, D and Arnold, M L (2000): Teachers' Beliefs, Antiracism and Moral Education: problems of intersection; *Journal of Moral Education*; Vol. 29; No. 1; pp23 – 45

Bray, C (1999): Transnational Teaching and the Invention of Unity: examples from a course on gendered violence; *Education Research and Perspectives;* Vol. 26 (1)/ http://www.ecel.uwa.edu.au/gse/erp/vol26no1/26-1.6.bray.html

Brieschke, P (1998): One Beige Crayon: Rethinking the Social Construction of Racism; U*rban Education*; Vol. 33; No. 1; pp 50 - 70

Carrim, N (1998): Anti-racism and the 'New' South African educational order; *Cambridge Journal of Education*; Vol. 28; No. 3; pp 301 - 320

Carrim, N (2001): From teachers to educators: homogenising tendencies in contemporary South African educational reforms; *International Journal of Educational Development*; Vol. 21; pp 45 – 52

Carrim, N and Soudien, C (1999): Critical Antiracism in South Africa in *Critical Multiculturalism : Rethinking Multicultural and Antiracist Education*; edited by Stephen May; Falmer Press; London

Carspecken, P F (1996): *Critical Ethnography in Educational Research: A Theoretical and Practical Guide*; Routledge; New York

Carter, L and Smith C (1998): *The Role Of Research In Reconceptualising Science Education For The 21ST Century*; Paper presented at the Australian Association for Research in Education Conference; Adelaide

Carter, R T (2000): Reimagining Race in Education: A New Paradigm from Psychology; *Teachers College Record*; Vol. 102; No. 5; pp 864 – 897

Chilcoat, G W and Ligon, J A (1999): "Helping to make democracy a living reality": the Curriculum conference of the Mississippi freedom schools ; *Journal of Curriculum and Supervision*; Vol. 15; No. 1; pp43 -68

Chinnici, J P (1999): Using the Biochemical Pathway Model To Teach the Concepts of Gene Interaction & Epistasis; *THE AMERICAN BIOLOGY TEACHER*; Vol. 61; No. 3; pp 207 - 211

Clough, P (2002): *Narratives and Fictions In Educational Research*; Open University Press; Buckingham and Philadelphia

Cobern, W W (1998): The Cultural Study of Science Education in *Socio-Cultural Perspectives in Science Education* edited by W W Cobern; Kluwer Academic Publishers; Dordrecht; Netherlands; pp 1 - 7

Cobern, W W and Loving, C C (2001): Defining "Science" in a Multicultural Way: Implications for Science Education; *Science Education*; Vol. 85; pp 50 - 67

Cole, M (1998): Racism, Reconstructed Multiculturalism and Antiracist Education; *Cambridge Journal of Education*; Vol. 28; N0. 1; pp 37 - 48

Conrad, K (2001): Fetal Ireland: national bodies and political agency; *Journal of Irish Studies*; http://www.findarticles.com/cf_dls/m0FKX/2001_Fall-Winter/83447253/print.jhtml; printed 2004/01/17; pp 1 - 13

Costa, V B (1995): When Science is "Another World": Relationships Between Worlds of Family, Friends. School and Science; *Science Education*; Vol. 79; No. 3; pp 313 - 333

Cotton, T (1998): *Towards a mathematics Education for Social Justice*; Unpublished Doctoral Thesis; University of Nottingham.

Cunnigham, C M and Helms, J V (1998): Sociology of Science as a Means to a More Authentic, Inclusive Science Education; *Journal of Research in Science Education*; Vol. 35; No. 5; pp 483 - 499

Delpit, L (1995): *Other People's Children: Cultural Conflict in the Classroom*; The New Press; New York

Dei, G J S (1996): Critical perspectives in antiracism: an introduction; *The Canadian Review of Sociology and Anthropology*; Vol. 33; pp 247 – 267.

Dei, G J S (1999): Knowledge and Politics of Social Change: the implication of anti-racism; *British Journal of Sociology of Education*; Vol. 20; No. 3; pp 395 – 409.

Denzin, N K and Lincoln Y S (2000): Introduction: The Discipline and Practice of Qualitative Research in *Handbook of Qualitative Research*; edited by Denzin and Lincoln; Sage Publications; California

Dolby, N (2000): Changing Selves: Multicultural Education and the Challenge of New Identities; *Teachers College Record*; Vol. 102; No. 5; pp 898 - 912

Duesterberg, L M (1999): Theorizing Race in the Context of Learning to Teach; *Teachers College Record*; Vol. 100; No. 4; pp 751 - 775

elrc (2003): *Policy Handbook for Educators*; The Education Labour Relations Council; Centurion; Pretoria

Feagin, J R (2001): Social Justice And Sociology: Agendas For The Twenty-First Century; *American Sociological Review*; Vol. 66; pp 1 - 20

Fernández-Balboa, J-M (1998): The practice of critical pedagogy: critical self-reflection As praxis; *Teaching Education (Columbia S C)*; Vol. 9; No. 2; pp 47 - 53

Filax, G (1997): Resisting resistors: resistance in critical pedagogy classrooms; *Journal of educational Thought*; Vol. 31; pp 259 - 269

Filax, G and Shogan, D (1999): Problematics of interrogating experiences into Classrooms; *Journal of Educational Thought*; Vol. 33; No. 3; pp 291 - 304

Fine, M (2000): "Whiting Out" social justice in *Addressing cultural issues in organizations: Beyond the corporate context* edited by R T Carter; Thousand Oaks; SAGE; CA; pp 35 -40

Flecha, R (1999): Modern and Postmodern Racism in Europe: Dialogic Approach and Anti-Racist Pedagogies; *Harvard Educational Review*; Vol. 69; No. 2; pp 150 – 171

Freire, P and Macedo, D P (1995): A Dialogue: Culture, Language, and Race; *Harvard Educational Review*; Vol. 65; No. 3; pp 377 - 402

Foucalt, M (1974): Excerpt form *Power: Essential Works of Foucalt, 1954 –1984: Volume Three*; Translated by Robert Hurley; The New Press

Foucalt, M (1980): *Truth and Power in Power/Knowledge*; Pantheon books; New York

Gay, G (1997): The relationship between multicultural and democratic education; *The Social Studies (Washington, D. C.)*; Vol. 88; pp 5 -11

Gergen, M M and Gergen, K J (2000): Qualitative Inquiry Tensions and Transformations in *Handbook of Qualitative Research*; edited by Denzin and Lincoln; Sage Publications; California

Gilbert, A and Yerrick R (2001): *Same School, Separate Worlds: A Sociocultural Study of Identity, Resistance and Negotiation in a Rural, Lower Track Science Classroom*; Journal of Research in Science Teaching; Vol. 38; No. 5; pp 574 - 598

Giroux, H A (1999): Corporate Culture and the attack on higher education and public Schooling; *Phi Delta Kappa Fastbacks*; No. 442; pp 7 -55

Giroux, H A (1998): Education incorporated?; *Educational Leadership*; Vol. 56; No. 2; pp 12 - 17

Giroux, H A (1996): Democratic education and popular culture; *International Journal of Social Education*; Vol. 11; pp 59 - 69

Giroux, H A (1988): *Teachers as Intellectuals: Towards a Critical Pedagogy of Learning*; Bergin and Garvey Publishers Inc.; New York

Good, R; Hafner, M; and Peebles, P (2000): Scientific Understanding of Sexual Orientation; *The American Biology Teacher*; Vol. 62; No. 5; pp 326 - 330

Gough, N (1994): Narration, Reflection, Diffraction: Aspects of fiction in educational enquiry; *Australian Educational Researcher*; Vol. 21; No. 3; pp 47 - 76

Gould, S J (1981): *The Mismeasure of Man*; WW Norton and Company; New York

Govinden, D (2000): *"Sister Outsider" – The Representation Of Identity And Difference In Selected Writings By South African Indian Women*; Unpublished Doctoral Thesis; University of Natal, Durban, South Africa

González, F E (1999): Growing up Mexicana in *Race Is ... Race Isn't Critical Race Theory and Qualitative Studies in Education;* edited by Parker, Dehyle and Villenas; Westview Press; Perseus Books Group; Colorado

Gutstein E (2001): Math, Maps, and Misrepresentation; *Rethinking Schools Online;* Vol.15; No.3; Spring

Gutstein E (2003): Teaching and Learning Mathematics for Social Justice in an Urban, Latino School; *Journal of Research in Mathematics Education*; Vol. 34; No. 1; pp 37 - 73

Gutstein E (2003): Home Buying While Brown or Black; *Rethinking Schools Online*; Vol. 18; No. 1; Fall

Gutstein, E (2004): "And That's Just How It Starts": Teaching Mathematics and Developing Student Agency" – pers. comm.

Guyton, E M (2000): Social justice in teacher education; *The Educational Forum*; Vol. 64; No.2; pp 108 - 114

Harding, S (2000): Feminist Philosophies of Science; *APA Newsletters*; Volume 99; No. 2; pp 1 - 5

Hayes, M T and Dehyle, D (2001): Constructing Difference: A Comparative Study of Elementary Science Curriculum Differentiation; *Science Education*; Vol. 85; pp 239 - 262

Helms, J (1998): Science-and Me: Subject Matter and Identity in Secondary School Science Teachers; *Journal of Research in Science Teaching*; Vol. 35; pp 811 - 834

Herrnstein, R and Murray, C (1994): *The Bell Curve: Intelligence and Class Structure in American Life*; Free Press; New York

Hesch, R (1996): Antiracist Educators *Sui Generis?* The Dialectics of Aboriginal Teacher Education; *The Canadian Review of Sociology and Anthropology*; Vol. 33; No. 3; pp 269 - 289

Hird, M J (1998): Theorising Student Identity as Fragmented: some implications for feminist critical pedagogy; *British Journal of Sociology of Education;* Vol. 19; No. 4; pp 517 - 527

Hodson, D (1993): In Search of a Rationale for Multicultural Science Education; *Science Education*; Vol. 77; No. 6; pp 685 - 711

Hodson, D (1999): Critical Multiculturalism in Science and Technology Education in *Critical Multiculturalism: Rethinking Multicultural and Antiracist Education*; edited by S May; Falmer Press, London

Hodson, D (1999): Going Beyond Cultural Pluralism: Science Education for Sociopolitical Action; *Science Education*; Vol. 83; pp 775 - 796

hooks, b (1994): *Teaching to Transgress: Education as the Practice of Freedom*; Routledge; New York

hooks, b (1992): *Black Looks: race and representation*; South End Press; Boston, MA

Jackson, S (1997): Crossing Borders and Changing Pedagogies: from Giroux and Freire to feminist theories of education; *Gender and Education;* Vol. 9; No.1; pp 457-467

Jegede, O J (1999): Science Education in Nonwestern Cultures: Towards a Theory of Collateral Learning in *What is Indigenous Knowledge: Voices from the Academy* edited by L M Semali and J L Kincheloe; Falmer Press; New York; pp 119 – 142

Jofili, Z; Geraldo, A; and Watts, M (1999): A Course for Critical Constructivism through Action Research: a case study from biology; *Research in Science & Technological Education*; Vol. 17; No. 1; pp 5 - 17

Johansen, C K and Harris, D E (2000): Teaching the Ethics of Biology; *The American Biology Teacher;* Vol. 62; No. 5; pp 352 - 358

Kanpol, B (1997): Reflective Critical Inquiry on Critical Inquiry: A critical Ethnographic Dilemma Continued; *The Qualitative Report*; Vol. 3; No. 4; http://www.nova.edu/ssss/QR/QR3-4/kanpol.html

Kailin, J (1999): How White Teachers Perceive the Problem of Racism in Their Schools: A Case Study in "Liberal" Lakeview; *Teachers College Record*; Vol. 100; No. 4; pp 724 - 750

Kelly, G J (1997): Research Traditions in Comparative Context: A Philosophical Challenge to Radical Constructivism; *Science Education*; Vol. 81; pp 355 - 375

Kincheloe, J (1999): The struggle to define and reinvent Whiteness: a pedagogical Analysis; *College Literature*; Vol.26; No. 3; pp162 - 194

Kincheloe, J L and McLaren P (2000): Rethinking Critical Theory and Qualitative Research in *Handbook of Qualitative Research*; edited by Denzin and Lincoln; Sage Publications; California

Kitcher, P and Cartwright, N (1996): Science and Ethics:Reclaiming Some Neglected Questions; *Perspectives on Science*; Vol. 4; No. 2; pp 145 - 154

King, J E (1991): "Dysconscious Racism: Ideology, Identity, and the Miseducation of Teachers; *Journal of Negro Education*; Vol. 60; pp 133 - 145

Kohli, W (1996): Teaching in the danger zone: democracy and difference; *International Journal of Social Education*; Vol. 11; pp 1 - 17

Kolstø, S D (2001): Scientific literacy for Citizenship: Tools for Dealing with the Science Dimension of Controversial Socioscientific Issues; *Science Education*; Vol. 85; pp 291 - 310

Kolstø, S D (2000): Consensus projects: teaching science for citizenship; *International Journal of Science Education*; Vol. 22; No. 6; pp 645 - 664

Krauskopf, S (1995): Doing the Meiosis Shuffle; *The American Biology Teacher*; Vol. 61; No. 1; pp 60 - 61

Krugly-Smolska, E (1995): Cultural influences in science education; *International Journal of Science Education*; Vol. 17; No. 1; pp 45 -48

Kumashiro, K K (2000): Teaching and learning through desire, crisis and difference: perverted reflections on anti-oppressive education; *Radical Teacher;* No. 58; pp 6 - 11

Kumashiro, K K (2001): "Posts" Perspectives on Anti-Oppressive Education in Social Studies, English, Mathematics and Science Classrooms; *Educational Researcher;* Vol. 30; No. 3; pp 3 -12

Kyle, W C Jr. (1998): Untracking Science Education; *Journal of Research in Science Teaching*; Vol. 35; No. 10; pp 1065 - 1067

Kyle, W C Jr. (1999): Science Education in Developing Countries: Access, Equity and Ethical Responsibilty; *Journal of the Southern African Association for Research in Mathematics and Science Education*; Vol. 3; No.1; pp 1 - 13

Kyle, W C Jr. (1999): Science Education in Developing Countries: Challenging First World Hegemony in a Global Context; *Journal of Research in Science Teaching*; Vol. 36; No. 3; pp 255 - 260

Kyle, W C Jr. (2000): *Critical Issues of School and Teacher Education Reform: Transforming Science Teaching and Learning for a new Millennium*; Keynote Address at the second Sub-Saharan Conference on Public Understanding of Science and Technology; University of Botswana; pp 1 - 22

Kyle, W C Jr. (2001): Toward a Political Philosophy of Science Education in *Teaching Science in Diverse Settings: Marginalized Discourses and Classroom Practice* edited by A C Barton and M Osborne; Peter Lang; New York

Ladson-Billings, G (1994): *The Dreamkeepers; Successful Teachers Of African American Children*; Jossey-Bass; San Franciso; CA

Ladson-Billings, G (1999): Just What Is Critical Race Theory in *Race Is ... Race Isn't Critical Race Theory and Qualitative Studies in Education;* edited by Parker, Dehyle and Villenas; Westview Press; Perseus Books Group; Colorado

Ladson-Billings, G (2000): Racialised Discourses and Ethnic Epistemologies in *Handbook of Qualitative Research*; edited by Denzin and Lincoln; Sage Publications; California

Ladson-Billings G (2000): Fighting for our lives: Preparing teachers to teach African American students; *Journal of Teacher Education*; Vol. 51; No. 3; pp 206 -214

Lal, S (2000): Dangerous silences: Lessons in daring; *Radical Teacher*; No. 58; pp 12 - 15

Lather P (1991): *Getting Smart Feminist Research and Pedagogy With/in the Postmodern*, Routledge; New York

Lather. P (1986): Research as Praxis; *Harvard Educational Review*; Vol. 56; No. 3; pp 257 - 277

Lauzon, A C (1999): Situating cognition and crossing borders: resisting the hegemony of mediated education; *British Journal of Educational Technology*; Vol. 30; No. 3; pp 261 - 276

Lee, O (2001): Culture and Language in Science Education: What do we Know and What Do We Need to Know; *Journal of Research in Science Teaching*; Vol. 38; No. 5; pp 499 - 501

Lemke, J L (2001): *Articulating Communities: Sociocultural Perspectives on Science Education*; Journal Of Research in Science Teaching; Vol. 38; No. 3; pp 296 - 316

Lessing, D (1962): *The Golden Notebooks*; McGraw Hill; New York; pp xxiii - xxiv

Lewis, B F and Aikenhead, G S (2001): Introduction: Shifting Perspectives from Universalism to Cross-Culturalism; *Science Education*; Vol. 85; pp 3 - 5

Lewis, J and Wood-Robinson, C (2000): Genes, chromosomes, cell division and Inheritance – do students see any relationship?; *International Journal of Science Education*; Vo. 22; No. 2; pp 177 - 195

Lincoln, S L and Guba, E G (2000): Paradigmatic Controversies, Contradictions And Emerging Confluences in *Handbook of Qualitative Research*; edited by Denzin and Lincoln; Sage Publications; California

Longbottom, J E and Butler, P H (1999): Why Teach Science? Rational goals for Science Education; *Science Education*; Vol. 83; pp 473 - 492

Luttrell, W (2000): "Good Enough" Methods for Ethnographic Research; *Harvard Educational Review*; Vol. 70; No. 4; pp 49 - 523

Lynn, M (1999): Toward a Critical Race Pedagogy: A Research Note; *Urban Education*; Vol. 33; No. 5; pp 606 - 626

Macbeth, D (2001): On "Reflexivity" in Qualitative Research: Two Readings, and a Third; *Qualitative Inquiry*; Vol. 7; No. 1; pp 35 -68

Macedo. D P (1999/2000): The illiteracy of English-only literacy; *Educational Leadership*; Vol. 57; No. 4; pp 62 - 67

Macedo, D P (2000): The Colonialism of the English Only Movement; *Educational Researcher;* Vol.29; No. 3; pp 15 - 24

Maher, F A (1999): Progressive Education and Feminist Pedagogies: Issues in Gender, Power, and Authority; *Teachers College Record*; Volume 101; Number 1; pp 35-39

Malcolm, C and Alant, B (2004): Finding Direction when the ground is moving: Science Education research in South Africa; unpublished paper; UKZN

Marable, M (2000): We Need New and Critical Study of Race and Ethnicity, *The Chronicle of Higher Education;* B4 – B7; February 25

Maxwell, J A (1992): Understanding and Validity in Qualitative Research; *Harvard Educational Review*; Vol. 62; No. 3; pp 279 - 300

Mayberry, M (1998): Reproductive and Resistant Pedagogies: The Comparative Roles of Collaborative Learning and Feminist Pedagogy in Science Education; *Journal Research in Science Teaching*; Vol. 35; No. 4; pp 443 - 459

McAllister, G A and Irvine, J J (2000): Cross cultural competency and multicultural Teacher education; *Review of Educational Research*; Vol. 70; No. 1; pp 3 -24

McCall, A L and Andringa, A (1997): Learning to teach for justice and equality in a multicultural social reconstructionist teacher education course; *Action in Teacher Education*; Vol. 18; pp 57 - 67

McCormick , T (1994): *Creating the non-sexist classroom*; Teachers College Press; New York

McInerney, J D (1998): Genes, Behaviour & High School Biology; *The American Biology Teacher*; Vol.60; No.3; pp168 - 172

Mckinley, E (2001): Cultural Diversity: Masking Power With Innocence; *Science Education*; Vol. 85; pp 74 - 76

McLaren, P and Fischman, G (1998): Reclaiming hope: teacher education and social justice in the age of globalization; *Teacher Education Quarterly*; Vol25; No. 4; pp 125 - 133

McLaren, P and Torres, R (1999): Racism and Multicultural Education: Rethinking 'Race' and 'Whiteness' in Late Capitalism in *Critical Multiculturalism : Rethinking Multicultural and Antiracist Education*; edited by Stephen May; Falmer Press; London

McLaren, P and Farahmandpur, R (2001): Teaching against globalization and the new imperialism: toward a revolutionary pedagogy; *Journal of Teacher Education;* Vol.52; No. 2; pp 136 - 150

Meyer, K (1998): Reflections on Being Female in School Science: Toward a Praxis of Teaching Science; *Journal Of Research In Science TeachinG*; Vol. 35; No.4; pp 463 - 471

Mies, M (1995): Women's Research or Feminist Research? The debate surrounding Feminist Science and Methodology in *Beyond Methodology: Feminist Scholarship as Lived Research*, edited by M M Fonow and J A Cook; Indiana University Press, Bloomington and Indianapolis

Milne, C E and Taylor, P C (1998): Between a Myth and a Hard Place: Situating School Science in a Climate of Critical Cultural Reform; *Socio-Cultural Perspectives on Science Education: An International Dialogue*; edited by Cobern, W W; Kluwer Academic Publishers; Netherlands

Mire, A (2001): In/through the bodies of women: rethinking gender in African politics; *Polis/R.C.S.P./C.P.S.R.*; Vol.8, Numèro Spècial, pp 1 - 19

Moje, E B; Collazo, T; Carrillo, R and Marx, R W (2001): *"Maestro, What is 'Quality'?": Language, Literacy and Discourse in Project-Based Science*; Journal of Research in Science Teaching; Vol. 38; No.4; pp 469 - 498

Moore. R (2000): For Knowledge: tradition, progressivism and progress in education - Reconstructing the curriculum debate; *Cambridge Journal of Education*; Vol. 30; No. 1; pp 17 - 36

Moraes, M (1999): Brazilian teachers meet the Bakhtin Circle and Paulo Freire; *International Education*; Vol. 29; No. 1; pp 43 - 53

Motala, S (2001): Quality and indicators of quality in South African education: a critical appraisal; *International Journal of Educational development*; Vol. 21; pp 61 - 78

Mule, L (1999): Indigenous Languages in the School Curriculum: What Happened to Kiswahili in Kenya in *What is INDIGENOUS KNOWLEDGE? Voices from the Academy*; edited by Semali, L M and Kincheloe, J L Falmer Press; New York

National Curriculum Statement (2003): Grades 10 – 12 (General); *PHYSICAL SCIENCES*; Department of Education; Pretoria; South Africa

National Curriculum Statement (2003): Grades 10 – 12 (General); *LIFE SCIENCES*; Department of Education; Pretoria; South Africa

Nieto, S (1999): Critical Multicultural Education and Students' Perspectives in *Critical Multiculturalism: Rethinking Multicultural and Antiracist Education*; edited by S May; Falmer Press, London

Norman, O (1998): Marginalized Discourses and Scientific Literacy; *Journal of Research in Science Teaching*; Vol. 35; No. 4; pp 365 - 374

Ogunniyi, M B (1995): *World View Hypothesis and Research in Science Education*; A paper presented at the Third Annual Meeting of The Southern African Association for Research in Science and Mathematics Education, University of Cape Town; South Africa

Patel, F (1996): *Teacher and student perceptions of teaching and learning science in a Changing cultural milieu in some schools in KwaZuluNatal*; unpublished Masters Dissertation; University of Durban Westville; South Africa

Peshkin, A (2001): Angles of Vision: Enhancing Perception in Qualitative Research; *Qualitative Inquiry*; Vol. 7; No. 2; pp 238 - 253

Peterson, E A (1999): Creating a culturally relevant dialogue for African American adult Educators; *New Directions for Adult and Continuing Education*; Vol. 82; pp 79 – 91

Pomeroy, D (1994): Science Education and Cultural diversity: Mapping the Field;*Studies In Science Education; Vol. 24; pp 49 – 73*

Proweller, A (1999): Shifting Identities in Private Education: Reconstructing Race at/in the Cultural Center; *Teachers College Record*; Vol 100; No. 4; pp 776 - 808

Ramorogo, G and Wood-Robinson, C (1995): Batswana children's understanding of Biological inheritance; *Journal of Biological Education*; Vol. 29; No. 1; pp 60 - 71

Rassool, N (1999): Flexible Identities: exploring race and gender issues among a group of immigrant pupils in an inner-city comprehensive school; *British Journal of Sociology of Education*; Vol. 20; No. 1; pp 23 -36

Reddy, S (2003): Troubling Sexualities: *Young adults' sexuality constructions within the contexts of HIV AND AIDS*; unpublished doctoral dissertation, University of Durban Westville, South Africa

Reed, L R (1999): Troubling Boys and Disturbing Discourses on Masculinity and Schooling: a feminist exploration of current debates and interventions concerning boys in school; *Gender and Education;* Vol. 11; No. 1; pp 93 -110

Richardson, L (2001): Getting personal: writing stories; *Qualitative Studies In Education*, Vol. 14; No. 1; pp 33 – 36

Rizvi, M (2002): Educating For Social justice And Liberation: An Interview with Peter McLaren; Znet | Interviews | Educating For Social justice and Liberation; p 1 – 6; *http://www.zmag.org/content/showarticle.cfm?SectionID=36&ItemID=2229*

Roberts, P (1999): A Dilemma for Critical Educators; *Journal of Moral Education*; Vol. 28; No. 1; pp 19 - 30

Rodriguez, A J (1998): What is (Should Be) the Researcher's Role in Terms of Agency? : A Question for the 21st Century; *Journal of Research in Science Teaching*; Vol. 35; No. 9; pp 963 - 965

Rodriguez, A J (1998): Strategies for Counterresistance: Toward Sociotransformative Constructivism and Learning to Teach Science for Diversity and Understanding; *Journal of Research in Science Teaching*; Vo. 35; No. 6; pp 589 - 622

Roman, L G (1994): The political Significance of Other Ways of Narrating Ethnography: A Feminist Materialist Approach; in *The Handbook of Qualitative Research in Education* edited by LeCompte, M D, Millroy, W L and Preissle, J;Academic Press, Inc.; San Diego; pp 555- 594

Ropers-Huilman, B (1999): Troublesome Texts: Re-searching, Re-reading and Re -telling Hard Data; *Journal for a Just and Caring Education*; Vol.5; No. 2; pp183 - 195

Rosser, S (1995): *Teaching The Majority: Breaking the gender barrier in science, mathematics and engineering;* Teachers College Press; New York

Rozzi, R (1999): The Reciprocal Links Between Evolutionary-Ecological Sciences and Environmental Ethics; *Bioscience*; Vol. 49; Issue 11; pp911 -922

Ruemper, W (1996): Models for change: antiracist education for universities and Colleges; *The Canadian Review of Sociology and Anthropology*; Vol. 33; pp 317 - 335

Sanchez, W and Fried, J (1997): Giving voice to students' narratives: cultural criticism and education in the helping/service professions; *College Teaching*; Vol. 45 (Winter); pp 26 - 31

Scering, G E S (1997): Themes of a critical/feminist pedagogy: teacher education for democracy; *Journal of Teacher Education*; Vol. 48; No. 1; pp 62 - 68

Scheurich, J J and Young M (1997): Colouring Epistemologies: Are Our Research Epistemologies Racially Biased; *Educational Researcher;* Vol. 26; No. 4; pp 4 -16

Schwandt, T A (1998): The Interpretive Review of Educational Matters: Is There Any Other Kind; *Review of Educational Research*; Vol. 68; No. 4; pp 409 - 412

Schwandt, T A (1999): On Understanding Understanding; *Qualitative Inquiry*; Vol. 5;No. 4; pp 451 - 464

Scott, J (1995): Multiculturalism and the politics of identity in *The identity in question* ed. by J Rachman; Routledge; London; pp 3 -12

Semali, L and Kincheloe J, eds. (1999): *What is Indigenous Knowledge? Voices from The Academy*; New York; Falmer Press

Simon, R and Dippo, D (1986): On Critical Ethnographic Work; *Anthropology and Education Quarterly*; Vol. 17; No. 4; pp 195 -202

Sleeter, C (2002/01): Diversity vs White Privilege; *Rethinking Schools Online*; Vol. 15; No. 2; Winter

Sleeter, C and Montecinos, C (1999): Forging Partnerships for Multicultural Teacher Education in *Critical Multiculturalism: Rethinking Multicultural and Antiracist Education*; edited by S May; Falmer Press, London

Smith, M U and Kindfield, A C H (1999): Teaching Cell Division Basics & Recommendations; *The American Biology Teacher*; Vol. 61; No. 5; Pp 366 - 371

Smith, M U and Scharmann, L C (1999): Defining versus Describing the Nature of Science: A Pragmatic Analysis for Classroom Teachers and Science Educators; *Science Education*; Vol. 83; pp 493 - 509

Snively, G and Corsiglia, J (2001): Discovering Indigenous Science: Implications for Science Education; *Science Education*; Vol. 85; pp 6 - 34

Sökefeld, M (1999): Debating Self, Identity, and Culture in Anthropology; *Current Anthroplology*; Vol.40; No. 4; pp 417 - 447

Solomon, R P and Levine-Rasky, C (1996): Transforming teacher education for an antiracism pedagogy; *The Canadian Review of Sociology and Anthropology*; Vol. 33; pp 337 –59

Soudien, C (1994): Dealing with race: Laying down patterns for multiculturalism in South Africa; *Interchange*; Vol. 25; No. 3; pp 281 - 294

Stake, R E (2000): Case Studies in *Handbook of Qualitative Research*; edited by Denzin and Lincoln; Sage Publications; California

Stanley, W B and Brickhouse, N W (2001): Teaching Sciences: The Multicultural Question Revisited; *Science Education*; Vol. 85; pp 35 - 49

Stencel, J (1995): A String & Paper Game of Meiosis that Promotes Thinking; T*he American Biology Teacher;* Vol. 57; No. 1; pp 42 - 45

Taras, L; Stavroulakis, A M; and Ortiz, M T (1999): Human Cloning Let's Discuss It; *The American Biology Teacher;* Vol. 61; No. 5; pp 341 - 344

Taylor, E (2000): Critical race theory and interest convergence in the backlash against affirmative action: Washington State and Initiative 2000; *Teachers College Record*; Vol. 102; No. 3; pp 539 -560

Taylor, P and Cobern, W W: Towards a Critical Science Education; in S*ocio-Cultural Perspectives on Science Education: An International Dialogue*; edited by W W Cobern; Kluwer Academic Publishers; The Netherlands

Tett, L (2000): I'm Working Class and Proud of It' – gendered experiences of non - traditional participants in higher education; *Gender and Education;* Vol. 12; No.2; pp 183 - 194.

The International Development Research Centre (1993): *Towards a Science and Technology Policy for a Democratic South Africa*; Ottawa, Canada

Thomas, J (1993): Doing Critical Ethnography; *Qualitative Research Methods*; Volume 26; SAGE Publications; Newbury Park; California

Thompson, A (1997): For: Anti-Racist Education; *Curriculum Inquiry*; Vol 27; No. 1; pp 7 - 44

Thousand, J S; Diaz-Greenberg, R and Nevin A (1999): Perspectives on a Freirean Dialectic to promote inclusive education; *Remedial and Special Education*; Vol. 20; No. 6; pp 323 - 326

Tomkins, S P (2000): Ornamental gourds help thinking about genetics; *School Science Review*; Vol. 81; No. 296; pp69 - 77

Triclogus, G (2001): Living the Theoretical Principles of Critical Ethnography in Educational Research; *Educational Action Research*; Vol. 9; pp 135 - 148

Trueba, E T (1999): Critical ethnography and a Vygotskian pedagogy of hope: the empowerment of Mexican immigrant children; *International Journal of Qualitative Studies in Education*; Vol. 12; No. 6; pp 591 - 614

Valero, P and Vithal, R (1998): Research method of the "North" revisited from the "South"; In *Proceedings of the 22nd Conference of the International Group for the Psychology of Mathematics Education*; Vol. 4; Stellenbosch University; 12 –17 July

Vally S and Dalamba Y (1999): *Racism, 'Racial Integration' and Desegregation in South African Public Secondary Schools*; a report on a study by the South African human Rights Commission

Villenas, S and Dehyle, D (1999): Critical Race Theory and Ethnographies Challenging the Stereotypes: Latino Families, Schooling, Resilience and Resistance; *Curriculum Inquiry*; Vol. 29; No. 4; pp 413 - 445

Villenas S, Dehyle, D and Parker L (1999): Critical Race Theory and Praxis: Latino/a and Navajo Struggles in *Race Is ... Race Isn't Critical Race Theory and Qualitative Studies in Education;* edited by Parker, Dehyle and Villenas; Westview Press; Perseus Books Group; Colorado

Vithal, R (in press): Gender Justice, Human Rights and Measurement in the Mathematics Classroom; International Journal of Mathematics Education in Science and Technology

Warren, B; Ballenger, C; Ogonowski, M; Roseberry, A S; and Hudicourt-Barnes, J (2001): Rethinking Diversity in Learning Science: The Logic of Everyday Sense-Making; *Journal of Research in Science Teaching*; Vol. 38; No. 5; pp 529 - 552

Weiler, K (1991): Freire and a Feminist Pedagogy of Difference; *Harvard Educational Review*; Vol. 61; pp 449 - 474

Winant, H (2000): Race and race theory; *Annual Review of Sociology*; Vol. 26; pp 169 – 185

Yost, D S; Sentner, S M and Forlenza-Bailey, A (2000): An examination of the construct of critical reflection: implications for teacher education programming in the 21st century; *Journal of Teacher Education*; Vol. 51; No. 1; pp 39 - 49

Zeidler, D L (1997): The Central Role Of Fallacious Thinking in Science Education; *Science Education*; Vol. 81; pp 483 - 496

Appendix 1

LEARNER PROFILE

NAME: Waseela Naizamuddin

AGE: 16 GENDER: Female

RELIGION: Muslim (Islam) 'RACE': Indian

MOTHER'S OCCUPATION: Housewife.

FATHER'S OCCUPATION: Cabinet maker

(if parent is not known to you write unknown in the space provided; if parent is deceased/dead write deceased in the space provided)

TELEPHONE NUMBER: (031) 2080111

ADDRESS: 46 Brick court, 13 Nagina Road, Durban, Overport, 4001.

May I telephone you and set up an appointment to interview you during the holidays?
~~YES~~/NO *(mark your choice with a cross or tick)*

LEARNER PROFILE

NAME: Ronald Arthur

AGE: 18 GENDER: Male

RELIGION: Christian 'RACE': "Indian"

MOTHER'S OCCUPATION: director clothing Industry

FATHER'S OCCUPATION: Craftsman

(if parent is not known to you write unknown in the space provided; if parent is deceased/dead write deceased in the space provided)

TELEPHONE NUMBER: 2083039

ADDRESS: 66 Protea Road
Springfield
Durban
4091

May I telephone you and set up an appointment to interview you during the holidays?
✓ YES/~~NO~~ *(mark your choice with a cross or tick)*

The Mercury

THURSDAY, OCTOBER 5, 2000

Baby bred to give his sister life

MARK HENDERSON

LONDON – The first test-tube baby to be genetically selected so that his cells can be harvested to save his critically ill sister has been born to an American couple.

Adam Nash was conceived after tests to ensure that his cells were suitable for a lifesaving transplant for his six-year-old sister, Molly, and his birth five weeks ago has provoked unprecedented debate among British doctors about the ethics of "designer" babies.

Last Thursday Molly received a transplant of stem cells from Adam's umbilical cord, an operation that could offer her a 90% chance of a cure for Fanconi anaemia, an inherited bone marrow disease that kills most sufferers by the age of seven. The operation is Molly's only chance.

The procedure has divided experts on medical ethics, some of whom believe it could pave the way for the creation of "designer" babies chosen for a range of genetic traits. Adam is the first baby to be born from an embryo that has been screened for anything other than genetic abnormalities.

No British in-vitro fertilisation clinic has yet applied for permission to use the technique. The authority said it would consider any application on its merits, with particular regard for the welfare of the child.

But Mr Paul Veys, a consultant in stem cell transplants at Great Ormond Street Hospital, said the conception of children for use as donors was in general unethical and wrong.

Screening

"This is a very difficult issue and it raises questions about where the cut-off line should be in genetic screening," he said.

"It is a start towards being able to choose the right coloured eyes and the right intelligence."

In this case, the use of the technology "might possibly be justified" because the elder girl would otherwise have died, he said.

Other British experts said the procedure was a humane use of a medical advance to save a girl's life.

"This is precisely the sort of case in which this technique could and should be used," said Ms Juliet Tizzard, director of the Progress Educational Trust, an in-vitro fertilisation charity.

Mr John Gillott, of the Genetic Interest Group, said: "This is clearly a child that is wanted, and there is no reason to assume that they are instrumentalising the second child," he said. "This is something that should be allowed."

The use of stem cells from Adam's umbilical cord rather than his bone marrow, he added, would mean that he would not have felt any pain from the transplant.

Fanconi anaemia is a bone marrow condition that can cause bleeding disorders, immune system problems and leukaemia, as well as anaemia.

Molly's parents, Lisa and Jack Nash of Englewood, Colorado, had been trying for another child since the disease was diagnosed. –

'Molly and Adam are teaching the world a lesson'

Damian Whitworth speaks to the parents who used science to save their daughte

MRS Lisa Nash believes that there was always a bond between her sick daughter and the baby brother who was created to provide a cure.

"If he was jumping around inside me, she would sing to my stomach and calm him down," says the mother whose determination to save her daughter, Molly, has put the family in the forefront of the biotechnology revolution.

Molly, aged six, is now recovering from the cell transplant from her five-week-old brother Adam's umbilical cord, her greatest hope against bone marrow failure caused by her condition, Fanconi anaemia. She rests in a sealed room in University Hospital, Minneapolis. Adam sleeps in a carry cot on a bedside table beside her.

Adam was created through pioneering IVF treatment and genetic screening to be born free of the condition and able to provide his sister with fresh blood.

As Mrs Nash, a neonatal nurse, and her husband, Jack, a hotel manager, pop out of the room to talk they look tired but upbeat.

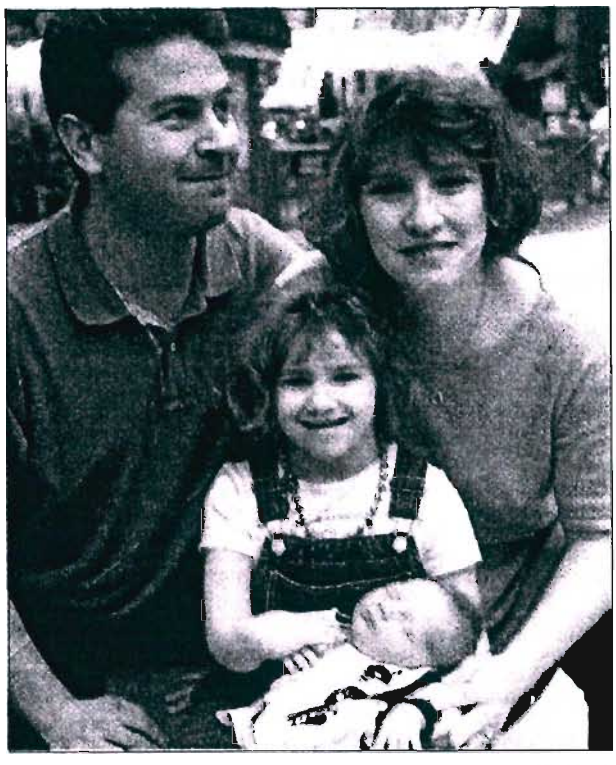
"Things happen for a purpose and this was meant to be," Mrs Nash said. "Molly and Adam are teaching the world a lesson, so that other children won't have to suffer like she has."

The Nashes are certain that they did right in using modern technology to create Adam in order to help his sister.

Mrs Nash said: "We wanted more children anyway and this was the best possible action for our family as a whole. It was what would help Jack and I and Molly the most. It didn't hurt him but it helped Molly."

Critics have accused scientists of playing God in marrying genetic testing and IVF in this way. Mrs Nash said: "Everyone is entitled to their own opinion.

"People who have been in the same boat as us believe that we have done the right thing. And unless you have been through this and watched your children suffer, until you have been there, you can't know what you would do."



PICTURE: AP

BROTHERLY LOVE: Six-year-old Molly Nash holds her brother, four-week-old Adam, with her parents Jack and Lisa Nash while at Camp Snoopy at the Mall of America in Bloomington, Minnesota.

A baby conceived normally would have had a one in four chance of being afflicted by Fanconi anaemia. Tests would have revealed the condition when the foetus was about 20 weeks old.

MRS NASH, 34, said that she would have had to terminate the pregnancy. "I could not bring another baby into the world to go through what Molly is going through," but abortion was not something they wanted to do.

"At that age it's a baby, it looks like a baby," she said.

The process of creating a healthy embryo, free from Fanconi anaemia and with bone marrow that matched Molly's, was a race against time. The couple went through IVF and the genetic tests four times at a cost of $80 000 (R580 000), putting considerable strain on their finances.

But they could not produce a suitable embryo that would implant successfully.

"Molly was getting sicker. Her blood counts were getting worse," Mrs Nash said.

Child sufferers undergo bone marrow failure by the time they are seven, and doctors decided at the end of last year that they would have one last chance at creating a sibling before they would have to give Molly a transplant using bone marrow from a stranger.

Such transplants have a 30% to 40% chance of success compared with the 85% chance with a brother or sister.

On their fifth attempt, one of 15 embryos was both healthy and a bone marrow match. Mrs Nash heard that she was pregnant on Christmas Eve.

Adam was born on August 29 and the transplant took place last week. Molly was holding Adam as the cells that might save her life were pumped into her body. "It was the most amazing thing I have ever seen," Mrs Nash said.

"There were no thunderbolts or lightning . . . She held him and it was really calm and peaceful."

For Molly, the future is still far from certain. Within a couple of weeks doctors will carry out tests that will give their first indication of whether the treatment has been successful, but they will not know for sure for some time.

The couple still have several frozen embryos that are healthy but did not provide a bone marrow match. They hope one day to have another child.

MOLLY was told about her rare genetic illness from an early age. "We have told her everything from the beginning. She has known all along that we wanted a brother or sister for her with the same bone marrow as her."

When Molly is awake, the mop-headed, grinning girl "is just like any six-year-old".

"She has tantrums and strops," said Mrs Nash.

There are some things Molly does not quite comprehend. When she went to a camp for other sick children, "she noticed that some of the kids went away and didn't come back", said Mr Nash.

The little girl has never been to school because of the danger of picking up infections with which her weak immune system cannot cope.

"All she wants to do is go home and ride the school bus," her father added.

Her parents are convinced she will and that one day they will tell Adam of his origin.

"We will tell him that we had him through IVF in order to save his sister," says Mrs Nash. And he will probably have to be told that he is famous.

"It's still going to be news in years to come, like the first test-tube baby. Molly and Adam's legacy is that kids won't be born to suffer the way Molly has." – The Times, London

Appendix 3

SYLLABUS FOR BIOLOGY HIGHER GRADE

STANDARD 9

INTRODUCTION

1. OBJECTIVES OF THE SYLLABUS

The objective of the syllabus is to provide a course which will develop in pupils the following important attributes:

1.1 an understanding of fundamental biological principles based upon a study of living organisms;

1.2 an awareness of biological relationships;

1.3 an ability to make critical, accurate observations of biological material, and to make meaningful records of such observations;

1.4 an ability to analyse and evaluate biological information, to formulate hypothesis and to suggest procedures to test them;

1.5 an ability to communicate clearly when reporting information and expressing ideas,

1.6 a respect for all living things and an urgent awareness of man's responsibilities in the preservation of life, particularly in the S A context,

1.7 a love and appreciation for the South African fauna and flora and a recognition of the urgent need for nature conservation

2. APPROACH TO THE SYLLABUS

The approach to the course should, as far as possible, embody the following important principles.

2.1 pupils should make their own observations of specimens and experiments,

2.2 pupils should learn how to handle and set up apparatus correctly,

2.3 organisms should be observed in their natural environments;

2.4 constant emphasis should be placed upon facts being understood, interpreted and applied rather than being merely memorised

3. THE SYLLABUS

3.1 No particular system of taxonomy is prescribed. Candidates will be expected to know only those group names which appear in the syllabus.

STANDARD NINE (GRADE ELEVEN)

SYLLABUS CONTENT	ELABORATION OF CONTENT TO PROVIDE GUIDELINES FOR THEORY AND THE RELEVANT PRACTICAL WORK
1. CELL DIVISION AND GENETICS	
1.1 THE ROLE OF THE NUCLEUS	
1.1.1 Structure and functions	(a) Revision of: Functions of nucleus to control structure and metabolism of cell and to provide a mechanism, through cell division, for the transmission of hereditary characteristics
	(b) Structure of: Nuclear envelope with pores; nucleoplasm, chromosomes (chromatin network), nucleolus. Seat and manufacture of ribosomal RNA
1.1.2 Nucleic acids: DNA, RNA	
(a) Practical study of DNA-structure	Prepare / Build units (nucleotides) that make up a DNA-molecule (i.e. with paper, clay, wood, etc.); build a DNA-molecule and explain (diagrammatically) DNA structure: nucleotide composition, complementary nitrogenous bases linked by hydrogen bonds; successive nucleotides linked by sugarphosphate bonds; resulting molecule having double helix configuration; location of DNA molecules
(b) replication	Use DNA-model, explain replication - the mechanism by which a DNA molecule can make an exact copy of itself, occasional upset of this mechanism resulting in the formation of "new" DNA molecules (mutation)
(c) Role of protein synthesis	Introduction of RNA-structure, different types of RNA (ie, m-RNA; t-RNA; r-Rna), functions of RNA; Nature of a protein as a specific sequence of amino acids nature of m-RNA, ceding of m-RNA by DNA; m-RNA as a template for assembling amino acids in specific sequence to form a protein, specific roles of t-RNA, and r-RNA in protein synthesis Explain process of protein synthesis by drawing analogies
1.2 CELL DIVISION	Make use of prepared slides, diapositives and / or models to explain mitosis and meiosis
1.2.1 Mitosis	The process of mitosis. The significance of mitosis. It should be emphasised that additional cells are required by multicellular organisms for growth, for repair and for replacement and that, to become effectively integrated into an organism, such new cells should contain genetic characteristics which are identical to those of the existing cells of that organism. Attention should be directed to the way in which mitosis meets these requirements. The DNA molecules, which are the sites of the genes, make exact replicas of themselves prior to mitosis
1.2.2 Meiosis	(a) The process of meiosis. (Names of stages during the first prophase are not required)
	(b) The significance of meiosis. Emphasis is required on the importance of meiosis in the reduction of chromosome number and as a mechanism for the introduction of genetic variation. The importance of the role of meiosis in alternation of generations should also be stressed

1.3 GENETIC MECHANISMS. MECHANISMS INVOLVED IN INHERITANCE

Practical Introduction of genetics	Use videos on genetic mechanism / invite speakers/ experts on topic
1.3.1 Introduction and terminology of genetic mechanisms	Define genetics; genes; gametes, alleles; hybrid; heterozygous, homozygous, phenotype, genotype; recessive; dominant; filial generations, mutations, segregation (with reference to meiosis).
1.3.2 Gametes as vehicles of inheritance	Each gamete carrying only one of each pair of alleles present in the somatic cells of a parent
1.3.3 Monohybrid crosses	At least one example to be considered, including diagrammatic representation. Crosses between pure bred (homozygous) stocks differing in a pair of contrasting characters will produce a heterozygous generation showing only one character, the dominant, and not the other, the recessive (eg in garden peas, yellow peas dominant, green peas recessive. mention of incomplete dominance)
1.3.4 Dihybrid crosses	At least one example to be considered, including diagrammatic representation. Discuss independent inheritance of various characteristics resulting from the random positioning of homologous chromosomes during metaphase of meiosis, leading to the random distribution of alleles during gamete formation
1.3.5 Sex determination	Brief explanation of determination of sex in humans in terms of X and Y chromosomes
1.3.6 Gene mutation, Natural selection, Practical application	Explain - gene mutation and natural selection Gene mutation. A gene mutation can occur by the alteration, of a single base-pair of a DNA double-helix. An example of a gene mutation. Significance of mutations for natural selection Natural selection. Consideration of the genetic basis of natural selection in terms of the gradual increase in the gene pool of a population of those genes which produce favourable characteristics, and the corresponding decrease of alleles that result in less favourable features. Use examples such as albinism, etc to promote class-discussions, refer to some practical applications of genetics. Consideration of an example of plant or animal breeding which has resulted in increased productivity, heterosis. inheritance of blood groups and of Rhesus factor in humans genetically predictable, and the importance of such predictions. Other applications may be mentioned, but will not be examinable

2. A STUDY OF VIRUSES AND BACTERIA

2.1 APRACTICAL INTRODUCTION OF VIRUSES AND BACTERIA	Use prepared slides, videos, embark on field trips, invite speakers / experts on topic, prepare own slides
2.2 Viruses	Structure, biological importance. Emphasis on acellular nature only
2.3 Bacteria	Structure; prokaryotic organisms. Reproduction, binary fission only. Ecological role, widespread occurrence. Role as decomposers, in nitrogen cycling, as pathogens; as symbionts

3. A STUDY OF SOME PLANT TYPES

In making this study, emphasis should be placed on those structural and physiological features of the examples which promote their success in their specific habitats. (Taxonomic relationships and general characteristics of groups not required)

5.3 A LIZARD

5.3.1 Practical study of a lizard

(a) habitat (b) external features (c) locomotion	Use an adult lizard to explain / discuss habitat, external features, locomotion (based upon sinuous movement of entire body, positioning of limbs)
5.3.2 Gaseous exchange	Lungs well formed; ventilation aided by movements of rib cage. (Study of organs not required)
5.3.3 Nutrition	Nature of food and the manner in which it is obtained; (no study of organs required)
5.3.4 Reproduction	Sexual; separate sexes (study of organs not required); mating resulting in internal fertilisation; ovipary

5.4 A DOVE OR PIGEON

5.4.1 Practical study of a pigeon

(a) habitat (b) external features (c) locomotion	Use an adult pigeon / dove / bird to explain / discuss habitat, external features and locomotion (Hind limbs for walking; fore limbs as wings flight muscles, structure and insertion of quill feathers; hollow bones and air sacs
5.4.2 Gaseous exchange	Lungs well formed, ventilation aided by movements of rib cage, role of air sacs (detail of organs not required)
5.4.3 Nutrition	Nature of food and the manner in which it is obtained, (No study of digestive system required)
5.4.4 Reproduction	Sexual, separate sexes (details of organs not required); mating following courtship and resulting in internal fertilisation; ovipary; structure of a newly fertilised egg and of an egg in which embryo, yolk sac, amnion and allantois can be seen; functions of these parts, (study of embryonic development not required); incubation of eggs and parental care of young

5.5 MAMMALS

5.5.1 Practical study of mammals	Use pictures, videos, etc to illustrate all the different types of mammals - high light external features and general characteristics
5.5.2 Reproduction	Distinguishing features only; internal fertilisation, presence of placenta, suckling

6. SOME ASPECTS OF THE ANATOMY AND PHYSIOLOGY OF MAN (Use charts and pictures to discuss and explain this section)

6.1 Reproduction

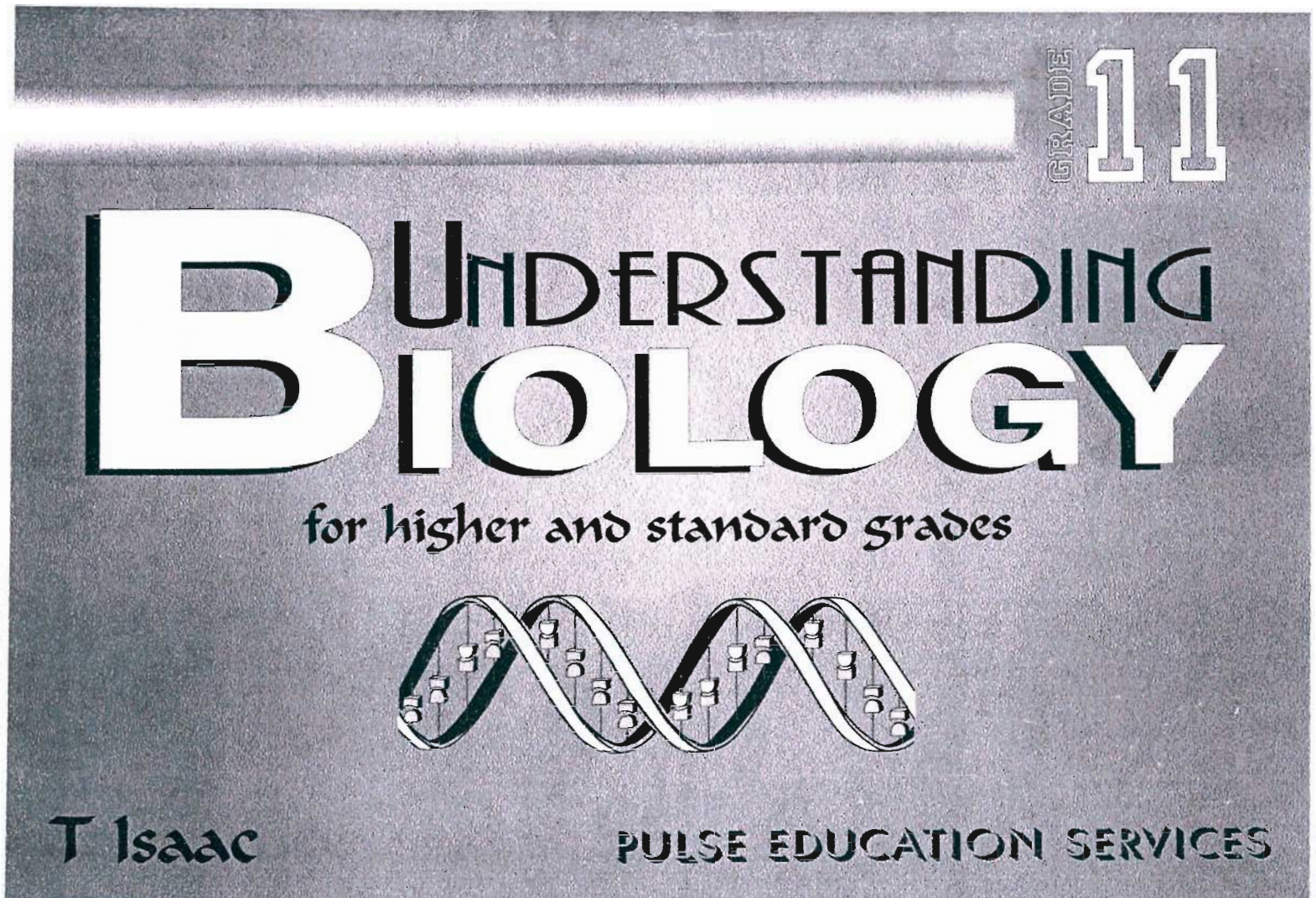
6.1.1 Reproductive organs	Structure and functions of organs. Male organs: testes, including seminiferous tubules with germinal epithelia and associated cells; scrotum, epididymis, sperm ducts; prostrate gland seminal vesicles; penis, the main functions of the parts listed Female organs: ovaries, including follicles and corpus luteum; fallopian tubules; uterus; vagina; the main functions of the parts listed

6.1.2 Gametogenesis

(a) Spermatogenesis	Cells of germinal epithelium divide repeatedly to produce spermatozoa, storage of spermatozoa; activation and suspension of spermatozoa in seminal fluid prior to their discharge
(b) Oogenesis	An ovum forms in an ovarian follicle which enlarges and eventually bursts, liberating its ovum from the ovary into a fallopian tube; conversion of empty follicle into a copus luteum (No further details required, though a simple account of the hormonal regulation of ovulation cycles and of menstrual discharge of the lining of the uterus may be included)

6.1.3 Ferilisation and development

(a) Fertilisation	Fusion of a spermatozoa from a male with an ovum while the latter is in a fallopian tube, thus forming a zygote which contains genetic material derived in equal parts from the male and female parents
(b) Embryonic development and implantation	Zygote divides repeatedly as it travels towards the uterus, becoming a small hollow sphere (blastula) that may become implanted in the wall of the uterus where it develops into a foetus - (No further details of embryonogical development, nor of formation of foetal membranes required)
6.1.4 Gestation	Brief review of the functions of: placenta and umbilical cord, amnion and amniotic fluid. (No further details required).
6.1.5 Post-natal care	Following birth (the result of muscular contractions of the uterus), the offspring are fed (mammary glands) and protected by the parents until they become self-sufficient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4.2

Contents

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20 MITOSIS

1. THE NEED FOR MITOSIS

- Organisms produced by sexual reproduction start of as a **zygote** with a definite number of **chromosomes**, half of which comes from one parent and the other half from the other parent. For example, the human zygote contains 46 chromosomes, 23 coming from the mother's egg cell and 23 from the father's sperm cell.
- The cell has to grow in such a way that it becomes **multicellular** with each cell containing exactly the same genetic material (DNA) as the zygote.
- Cells that die (e.g. skin cells) need to be replaced by new cells, and for the new cells to become effectively integrated into the organism, they must have the same genetic make-up as the cells they replace.
- Similarly, when cells are destroyed through injury, they need to to be replaced by cells with identical genetic constitutions.
- The process by which one cell is able to give rise to two cells with identical genetic make-up to the original and to each other is called **mitosis**.

2. THE PROCESS OF MITOSIS

Mitosis takes place in the body or **somatic** cells.

Mitosis is the division of ordinary somatic cells in such a way that one cell gives rise to two daughter cells with identical genetic material (on chromosomes) to each other and the parent cell. The nucleus divides first and then the cytoplasm divides.

2.1 Division of the nucleus

The process is a continuous one, but for convenience it can be divided into five phases viz. Interphase, prophase, metaphase, anaphase and telophase.

(a) Interphase

- In preparation for the nuclear division DNA replicates so that the genetic material is doubled.
- Ribosomes, mitochondria, centrioles (in plant cells) also duplicate themselves.

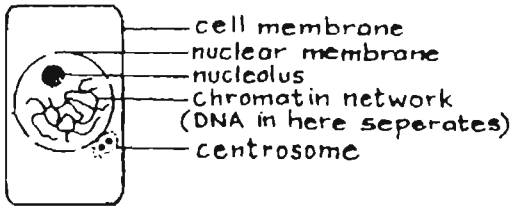


Fig. 20.1 Interphase

(b) Prophase

- The chromatin network unwinds to form **chromosomes**.
- Each chromosome is made up of two identical chromatids (because of DNA replication in interphase) held together by a **centromere**.
- The nucleolus and nuclear membrane begin to disappear.
- A spindle forms from the poles to the equator of the cell.

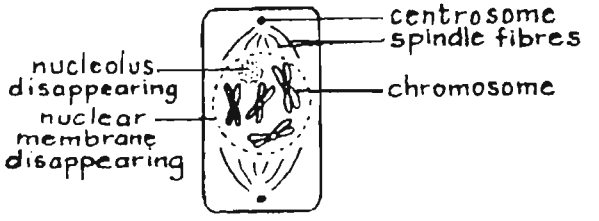


Fig. 20.2 Prophase

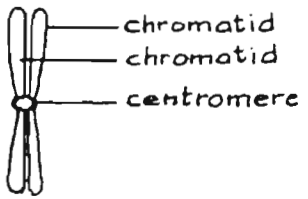


Fig. 20.3 A single chromosome

(c) Metaphase

- The chromosomes become arranged along the equator of the cell **singly**.
- Each chromosome becomes attached to a spindle .
- The **nucleolus** and nuclear membrane completely disappear.

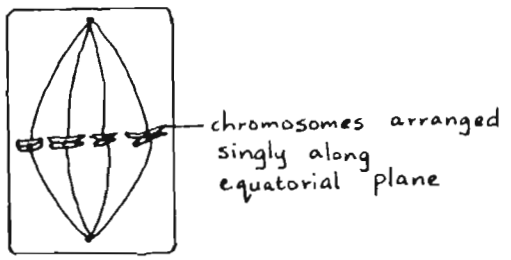


Fig. 20.4 Metaphase

(d) Anaphase

- The **centromeres split**.
- The chromatids making up each chromosome are pulled apart towards opposite poles by shortening of the spindle fibres.
- Each chromatid is really a single-stranded chromosome since DNA replication took place in interphase.

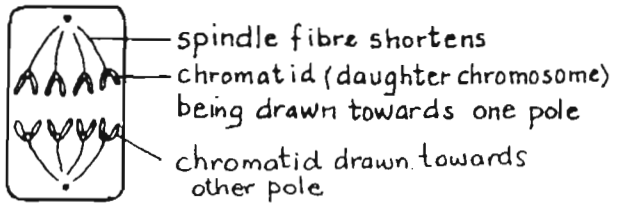


Fig. 20.5 Anaphase

(e) Telophase

- Two groups of chromosomes occur - one at each end of the cell.
- Each group has the same number and kind of chromosomes as the original parent cell.
- Each group is surrounded by a nuclear membrane within which a nucleolus reappears.
- Thus we have two nuclei within which we have the same number and kind of chromosomes as the original.
- Eventually within each nucleus the chromosomes entangle to form chromatin networks once more.

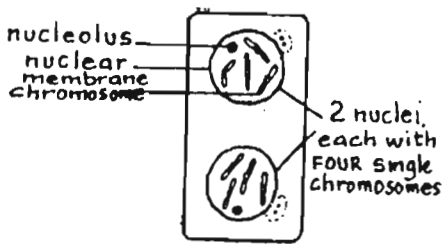


Fig. 20.6 Early Telophase

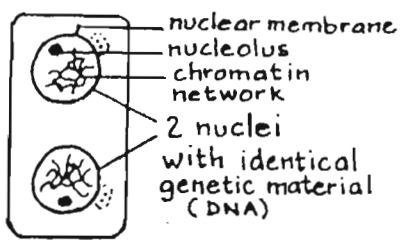
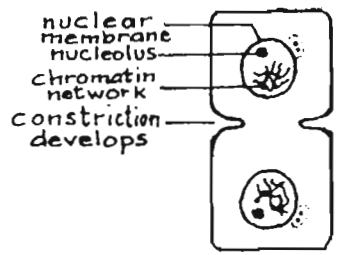


Fig 20.7 Late Telophase

2.2 Division of the cytoplasm

- In animal cells a constriction develops between the two nuclei. Deepening of the constriction divides the cell into two.



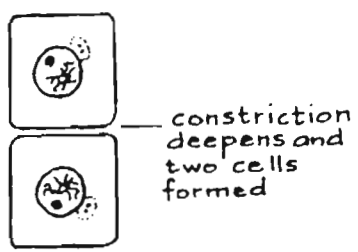
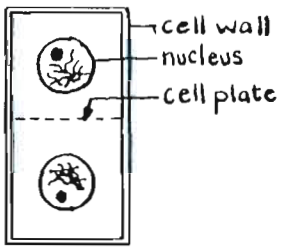


Fig. 20.8 Division of the cytoplasm in animal cells

- In plant cells, a cell plate is formed between the two nuclei.
- Eventually the cell plate becomes a new cell wall dividing the cell into two.



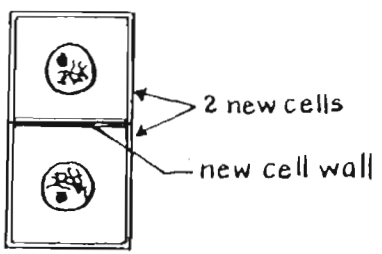


Fig. 20.9 Division of the cytoplasm in plant cells

- In either case, a single cell has given rise to two new cells each with identical DNA. The DNA of each cell is also identical in amount and type to that of the parent cell which no longer exists.

3. THE IMPORTANCE OF MITOSIS

- It allows for growth of the individual from a single-celled zygote to a complex, multicellular organism.
- It allows for the replacement of worn out and damaged tissues.
- It makes possible vegetative reproduction and asexual reproduction (e.g. by binary fission in *Amoeba*, and by spores in fungi, mosses, ferns).

21 MEIOSIS

1. THE NEED FOR MEIOSIS

- Each cell of an individual plant or animal species has a specific amount of DNA in a **characteristic number of chromosomes**. For example, man has 46 chromosomes in each somatic cell. Since there are really two sets of 23 different kinds of chromosomes, we say that the cells have a **diploid** (2n) number of chromosomes, and in man the 2n number is 46.
- In sexual reproduction a male gamete fuses with a female gamete to form a zygote.
- If the male and female gametes have the same number of chromosomes (hence the same amount of DNA) as the adults from which they arise, the chromosome number of the zygote will double.
- If the zygote grows, producing more cells by mitosis, then all the cells of the offspring will have double the chromosome number as the original parents.
- To get back the number of chromosomes characteristic of each species, the number of chromosomes must be halved.
- This halving of the chromosome number occurs by a process referred to as **meiosis**.
- In vertebrates, meiosis takes place when gametes are formed (i.e. before fertilisation). These gametes therefore have half the chromososme number or one set of chromososomes (the **haploid number** or **n**) compared to the adult.
- The fusion of the gametes results in the diploid chromosome number being restored in the zygote which undergoes mitosis to produce a multicellular adult.
- In some plants, such as *Rhizopus* and *Spirogyra*, the adults are haploid giving rise to haploid gametes which on fertilisation result in a diploid zygote. Meiosis occurs in the zygote or zygospore (i.e. after fertilisation) to halve the chromosome number so that the new offspring also have the haploid number of chromosomes.

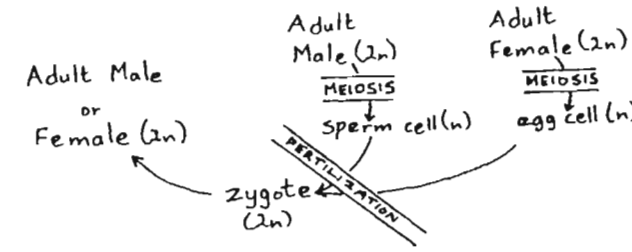


Fig. 21.1 Restoration of the chromosome number by meiosis in vertebrates

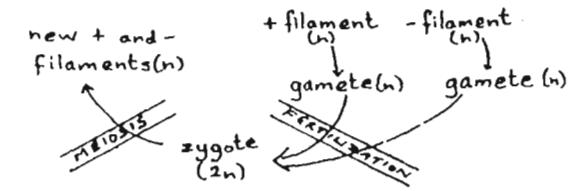


Fig. 21.2 Restoration of the chromosome number by meiosis in some plants

- Meiosis is therefore essential to ensure that each species maintains its characteristic chromosomes number from generation to generation.

2. THE PROCESS OF MEIOSIS

Meiosis usually occurs during the formation of gametes, or in lower plants, immediately after fertilisation. Meiosis is the division of one cell into four cells each of which only has half the chromosome number as the parent cell. Furthermore, each of the four cells is genetically different from each other. In meiosis, the nucleus undergoes two divisions.

2.1 The First Division

(a) Interphase I

- In preparation for the nuclear division, **DNA replicates** so that the genetic material is doubled (NB. Some writers indicate that this occurs in Prophase I).

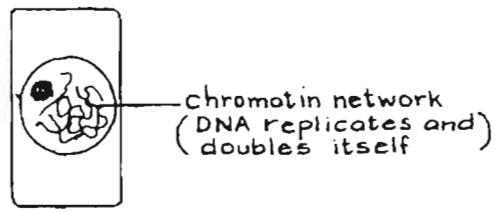


Fig.21.3 Interphase I

(b) Prophase I

- The chromatin network unwinds to form **chromosomes**.
- At first, each chromosome appears to be single.
- Later, it can be seen that each chromosomes is made up of two identical chromatids (because of DNA replication in Interphase I) held together by a centromere.
- The chromosomes come together in **homologous pairs** i.e. two identical chromosomes, one of maternal origin and one of paternal origin, called **homologues**, come together.
- A pair of homologous chromosomes has four chromatids (2 chromatids from each chromosome) and such a structure is called a **bivalent**.

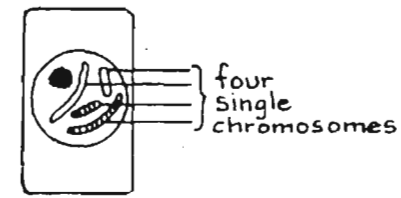


Fig. 21.4 Early Prophase I

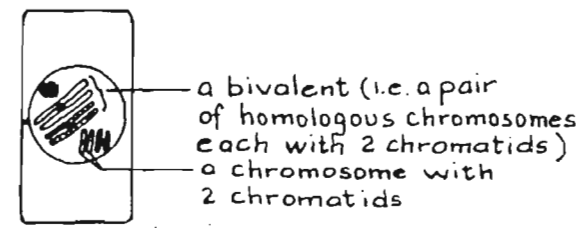


Fig. 21.5 Later prophase showing homologous chromosomes and bivalents

- Exchange of genetic material takes place between chromatids of homologous chromosomes. This process is referred to as **crossing- over** and the point of crossing-over is called a **chiasma** (see details in 3 later)
- After crossing-over each chromosome has some genetic material of its homologous partner.

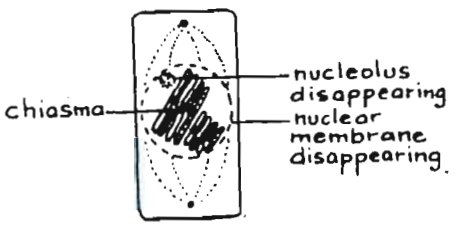


Fig. 21.6 Prophase I showing crossing over

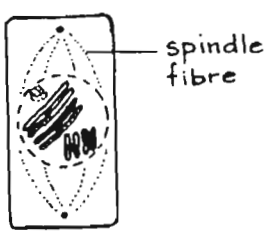


Fig. 21.7 Prophase I after crossing-over

- In the meantime, the nucleolus and nuclear membrane begin to disappear and a spindle begins to form.

(c) Metaphase I

- The chromosomes become arranged along the equator in **homologous pairs**.
- The chromosomes are attached to the spindle.

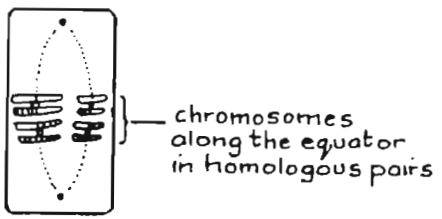


Fig. 21.8 Metaphase I

(d) Anaphase I

- The spindle shortens.
- One member of a pair of homologous chromosomes is pulled to one pole and the other member is pulled to the other pole.
- In other words, **whole chromosomes** (each with two chromatids) move towards opposite poles.

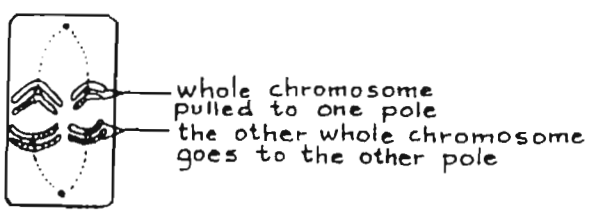


Fig. 21.9 Anaphase I

(e) Telophase I

- Two groups of chromosomes appear - one at each pole.
- Each group has half the number of chromosomes as the original parent cell.
- Each group is surrounded by a nuclear membrane within which a nucleolus reappears.
- Thus we have two nuclei within which there are **half the number of chromosomes** as the original.
- The nuclei are also **genetically different** from each other because of crossing-over.

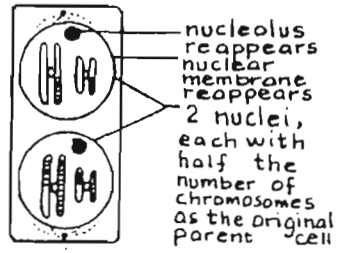


Fig. 21.10 *Telophase I*

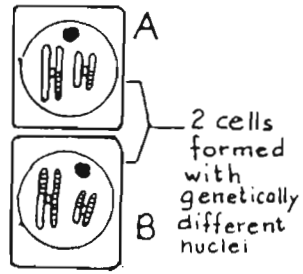
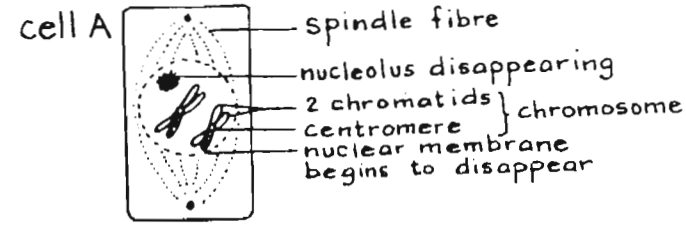


Fig 21.11 Formation of two cells

- The cytoplasm divides by constriction (in animal cells) or by formation of a cell plate (in plant cells)
- so that two cells (A and B) with half the number of chromosomes as the parent cell are formed.
- Each of the two cells is genetically different from the other.
- Each of the two cells formed undergoes the second division which is similar to mitosis. We will follow what happens to one cell only (Cell A). The other cell undergoes an identical process.

2.2 The Second Division (similar to mitosis)

(a) Prophase II



Fi. 21.12 Prophase II

- Each chromosome is made up of two chromatids held together by a centromere.
- The nucleolus and nuclear membrane disappear.
- A spindle forms from the poles to the equator of the cell.

(b) Metaphase II

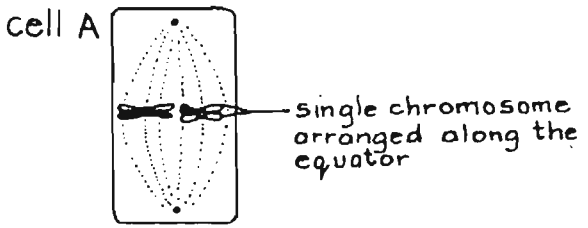


Fig. 21.13 Metaphase II

- The chromosomes become arranged along the equator **singly**.
- Each chromososme becomes attached to a spindle.
- The nucleolus and nuclear membrane completely disappear.

(c) Anaphase II

- The centromeres split.
- The two chromatids making up each chromosome are pulled towards opposite poles by shortening of the spindles fibres.
- Each chromatid is really a single-stranded chromosome since DNA replication took place in interphase I (or Prophase I, according to some authors).

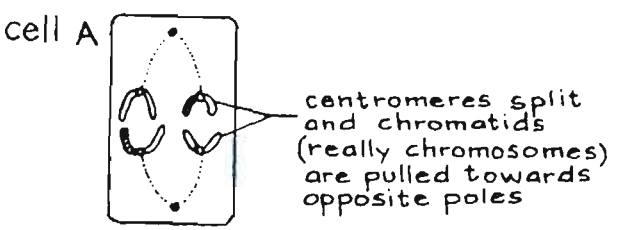


Fig. 21.14 Anaphase II

(d) Telophase II

- Two groups of chromosomes occur - one at each end of the cell.
- Each group is surrounded by a nuclear membrane within which a nucleolus reappears.
- Thus we have two nuclei with the same number of chromosomes as when the second division started but half the number of chromosomes we originally started with in the first division.
- The nuclei are also genetically different because of crossing- over.

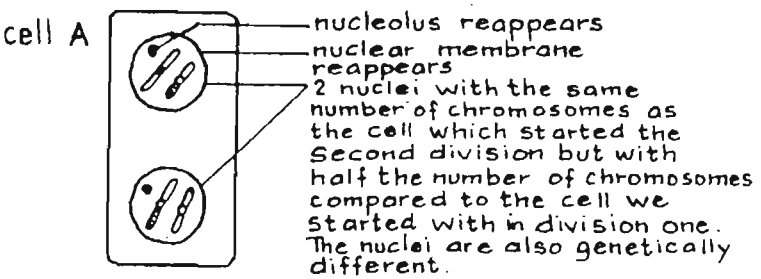


Fig. 21.15 Telophase II

- The cytoplasm divides by constriction (in animal cells) or by formation of a cell plate (in plants)
- so that two cells with half the number of chromosomes as the parent cell are formed.
- Each of the two cells is genetically different from each other.

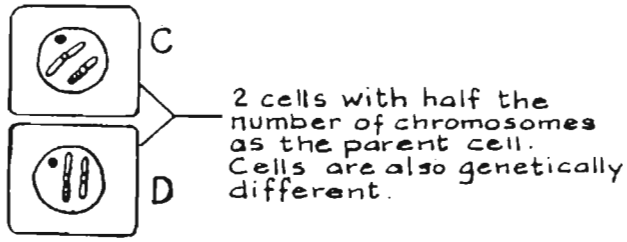


Fig 21.16 Division of the cytoplasm to form two new cells

NB. Since the other cell formed by the first division (cell B) also undergoes the second division in the manner described, four cells are formed in all during the entire process of meiosis from one parent cell. The four cells have half the number of chromosomes as the original parent cell. The four cells are also genetically different from each other.

3. THE PROCESS OF CROSSING-OVER IN DETAIL

- It takes place in the first prophase of meiosis (Prophase I).
- **Homologous chromosomes** (i.e. identical chromosomes, one of maternal origin and one of paternal origin) come to lie close together.
- Each chromosome is made up of two chromatids held together by a centromere
- so that the pair of homologous chromosomes has four chromatids.
- Such a structure is called a **bivalent**.

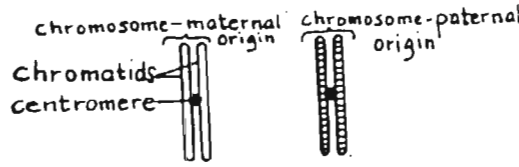


Fig. 21.17 A homologous pair of chromosomes before crossing-over

Fig. 21.18 Chromatids intertwining

- One chromatid of each chromosome crosses over or intertwines over one chromatid of its homologue.
- The points of crossing-over are called **chiasmata** (sing.**chiasma**).
- The chromosomes separate in such a way that each has one original chromatid and one chromatid with genetic material from its homologue.

Fig. 21.19 A pair of homologous chromosomes after crossing-over

- Crossing-over results in shuffling of genetic material so that each chromosome has genetic material from both parents.
- The cells (usually gametes) produced are therefore different from each other.
- This therefore results in variation of offspring.

4. VARIATION OF OFFSPRING

- Offspring produced by sexual reproduction are different from each other and their parents because of two main reasons viz. the gametes are produced by meiosis and are therefore different from each other, and because fertilisation is a chance process.
- The gametes produced by meiosis are different because :
  - crossing-over during the first prophase results in shuffling of genetic material so that each chromosome has genetic material from both parents.
  - The random arrangement of chromosomes along the equator during first metaphase allows chromosomes of maternal and paternal origin to move towards opposite poles in many possible ways.

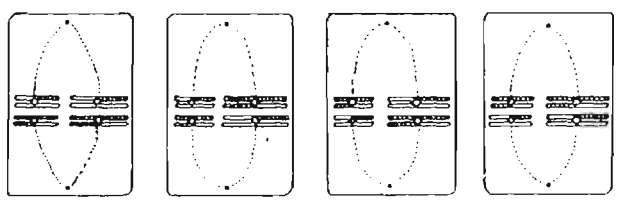


Fig. 21.20 4 possible arrangements of 2 pairs of homologous chromosomes along the equator.

- Chance fertilisation results in variation of offspring because :
  - Usually more than one sperm and one egg are produced, all of which are genetically different for reasons mentioned above. Since fertilisation is a chance process, it may occur between any sperm and any egg. Thus, if there were 4 sperm cells and 4 egg cells there are 16 possible zygotes as shown in the table below :

		EGGS			
		1	2	3	4
SPERMS	A	A_1	A_2	A_3	A_4
	B	B_1	B_2	B_3	B_4
	C	C_1	C_2	C_3	C_4
	D	D_1	D_2	D_3	D_4

- *Therefore, the possibility of two zygotes, resulting from two fertilisations, being identical is small (1 in 16).*
- Since in practice organisms produce much more than 4 eggs and 4 sperms, the chances of identical offspring is very remote.

5. THE IMPORTANCE OF MEIOSIS

- Meiosis prevents doubling of the chromosome number from generation to generation by halving the number either before or after fertilisation.
- In lower plants a diploid sporophyte generation alternates with a haploid gametophyte generation. Meiosis is responsible for halving the chromosome number and thus bringing about this alternation of generations.
- Meiosis results in the offspring produced by sexual reproduction being genetically different from each other and from their parents.

6. DIFFERENCES BETWEEN MITOSIS AND MEIOSIS

Mitosis	Meiosis
Occurs in all somatic cells.	Occurs in sex organs during gamete formation or in zygote.
One nuclear division.	Two nuclear divisions.
Two cells formed have the same number of chromosomes as the parent.	Four cells formed have half the number of chromosomes as the parent.
Two cells formed are genetically identical to each other and to parent	Four cells formed are genetically different from each and from parent.
During prophase the chromosomes are not in pairs	During first prophase the chromosomes come together in homologous pairs.
No crossing-over	Crossing-over takes place during first prophase.
During metaphase centromere splits and chromatids are pulled towards opposite poles	During first metaphase, whole chromosomes are pulled towards opposite poles. The centromere does not split.

22 GENETICS

1. INTRODUCTION

Heredity refers to the transmission of characteristics from parents to their offspring. **Genetics** refers to the study of heredity and the variations that occur in the transmission of hereditary characteristics. In other words, in genetics we study the similarities and differences between related individuals.

2. GENES IN SOMATIC CELLS

- The somatic cells of higher plants and animals contain two **sets** of chromosomes (not two chromosomes!) i.e. they are **diploid**.
- One of these sets is of maternal origin and the other is of paternal origin.

Fig. 22.1 A cell with two sets of 4 different types of chromosomes (i.e. 4 pairs of homologous chromosomes or 8 chromosomes. 2n = 8)

- Thus in man we have two sets of 23 different types of chromosomes (i.e. the diploid or 2n number is 46) where one set (i.e. 23 chromosomes) comes from our male parent and the other set from our female parent.
- A pair of identical chromosomes where one is of maternal origin and the other of paternal origin is referred to as a **homologous pair** of chromosomes.
- The chromosomes are made up of genetic material called **DNA**.
- The DNA is in turn made up of short parts called **genes** which are the actual units responsible for the transmission of hereditary characteristics.
- We can therefore say that the chromosomes are made up of genes.
- Genes control such characteristics as eye colour, blood type, hair colour etc.
- Each characteristic is controlled by two genes.
- One of these genes is on one member of the homologous pair of chromosomes.
- The other gene is on a corresponding position in the other member of the homologous pair of chromosomes.

Fig. 22.2 A pair of homologous chromosomes showing position of genes

- Both genes may control the characteristics in the same way e.g. both genes may be for tallness or both the genes may be for shortness. We then say that this individual is **homozygous** for this characteristic.
- Sometimes the two genes may attempt to control a characteristic in contrasting ways e.g. one gene may be for tallness and the other for shortness. Such genes are called **alleles** and the individual is said to be **heterozygous** or hybrid for this characteristic.

3. GENES IN GAMETES

- The gametes of higher plants and animals are formed by **meiosis**.
- Therefore they contain only a single set of chromosomes i.e. they are **haploid**.
- Thus, there will be 23 single chromosomes in each sperm cell and egg cell of human beings.

- Since the chromosomes are no longer paired, the genes are no longer paired.
- Each characteristic will therefore have only one gene for it.

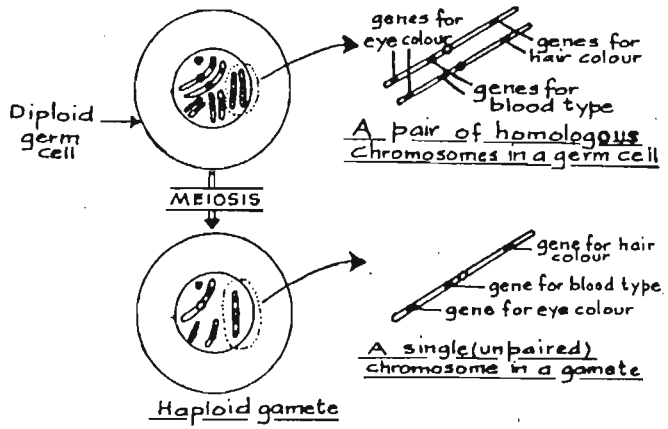


Fig. 22.3 Production of Gametes with unpaired genes

- During sexual reproduction a haploid egg cell is fertilised by a haploid sperm cell so that the zygote becomes diploid once again.
- Since the sperm cell came from the male parent and the egg cell from the female parent, one set of chromsomes in the zygote has come from the male parent and the other from the female parent.
- This then means that, of each pair of homologous chromosomes on the zygote, one member (one chromosome) is of maternal origin and the other is of paternal origin.
- This in turn means that, of the two genes controlling any characteristic, one comes from the male parent and the other from the female parent.

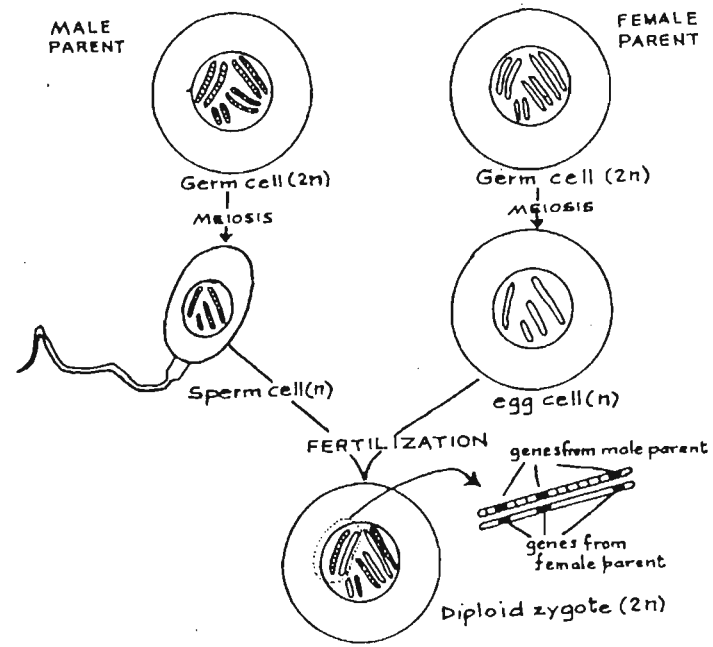


Fig. 22.4 *How gametes bring genes from both parents together during fertilisation*

Fig. 22.4 How gametes bring genes from both parents together during fertilisation

- Since the zygote divides by **mitosis** to produce **identical cells** which go up to make the multicellular adult, it follows that every cell in the individual is genetically identical to the zygote. This means that every cell in our bodies (and in the bodies of higher plants and animals) except the sex cells, contains one gene from each parent for every characteristic we possess.

4. MONOHYBRID CROSSES

A monohybrid cross involves breeding where only a single pair of contrasting characteristics is considered.

4.1 Mendel's Experiments

- Gregor Mendel, an Austrian monk, carried out breeding experiments with garden peas from 1857 to 1864.
- When Mendel crossed a pure breeding tall plant with a pure breeding short plant, all the offspring (called the first filial generation or F1) were tall.

Parents	Tall	x	Short
Offspring (F1)	All Tall		

When Mendel crossed the F1 offspring, he found that the second generation (F2) produced tall and short plants in the ratio 3:1.

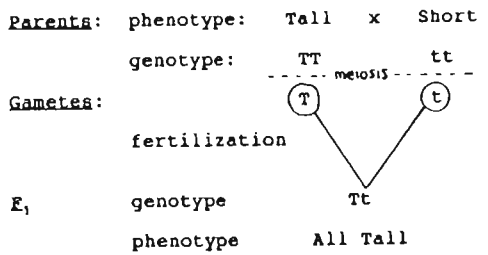
F1 (acting as parents)	Tall	x	Tall
Offspring (F2)	3 Tall : 1 Short		

- Mendel's work with other pair's of contrasting characteristics such as round and wrinkled seeds, yellow and green seeds, green and yellow pods, also produced similar results.
- Mendel called the characteristic that showed up in the F1 the **dominant characteristic** and the characteristic that was hidden, the **recessive characteristic**.
- As result of his work Mendel came to the following conclusions :
  - When two individuals with pure breeding contrasting characteristics are crossed, the individuals of the F1 generation all display the dominant characterisitic. This is known as the **Law of Dominance**.
  - For each characteristic, a plant possess two "factors" (now known as genes) which separate or segregate so that each gamete contains only one of these factors. This is known as Mendel's first law, the **Law of Segregation**. (Refer to page 107, 3. Genes in Gametes, for an explanation of how this happens).

4.2 Explanation of Mendel's work in terms of genes

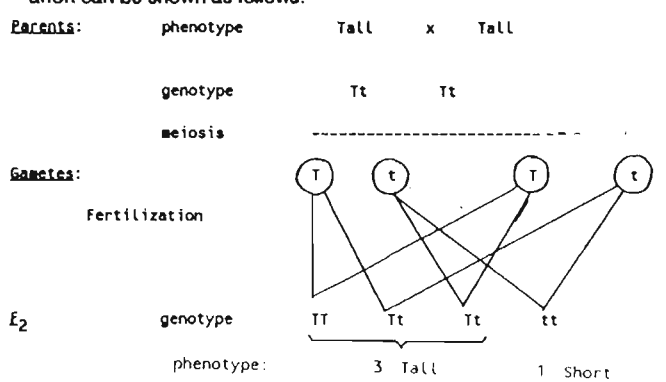
- Each characteristic is controlled by two genes.
- The pure breeding tall plant had two genes for tallness and these can be shown as T and T. (Capital "T" is used because this is the dominant gene).
- The pure breeding short plant had two genes for shortness and these can be shown as t and t. (Small "t" is used because this is the recessive gene).
- As a result of meiosis taking place during gamete formation, the gametes from the tall plant has only a T gene and the gamete from the short plant has only a t gene.
- During fertilisation the gamete with the T gene from one parent fuses with the gamete with the t gene from the other, resulting in a zygote (which develops into an offspring) with a Tt gene combination.
- The offspring is tall since the T gene dominates or masks the t gene i.e. tallness is dominant and shortness recessive.
- The genetic constitution of the individual (which cannot be seen externally) is called its **genotype**.

- The externally visible characteristic is called its **phenotype**.
- Diagrammatically, Mendel's monohybrid cross leading to the F1 can be shown as follows:



(NB : Since we do not show the actual **number** of gametes, but only the **ratio** of each of the different types, it is not necessary to write T, T and t, t - T and t will do.)

- The F1 offspring are all hybrid or heterozygous tall with the gene combination Tt, as opposed to pure breeding tall (TT).
- When the F1 are crossed with each other, two types of gamete will be formed from each parent viz. T and t.
- These two types of gametes from each parent can result in four possible combinations during fertilisation viz. TT, Tt, Tt and tt.
- One of the two types of offspring will be pure breeding tall (TT), two will be hybrid tall (Tt) and one will be pure breeding short.
- Diagrammatically Mendel's monohybrid cross leading to the F2 generarion can be shown as follows:



NB. The combination of gametes during fertilisation may also be shown by means of a Punnet square thus :

		MALE GAMETES	
		T	t
FEMALE GAMETES	T	TT	Tt
	t	Tt	tt

- It should be noted that :
  - phenotypically (i.e. from external visible characteristics) the pure breeding tall plants cannot be distinguished from the hybrid tall plants.
  - while the dominant characteristic shows up in the homozygous (pure breeding) or heterozygous (hybrid) state, the recessive condition only shows up when both genes are recessive i.e. in the homozygous state.
  - this does not imply that if in the F2 generation there are 4 plants, 3 will be tall and 1 will be short. It merely indicates that if a large number of plants are produced, the ratio of tallness to shortness will be approximately 3:1 (Mendel obtained 787 tall to 277 short).

4.3 More Examples of Monohybrid Crosses

Example 1

A heterozygous red-flowering plant is crossed with a white- flowering plant.

(i) Which is the dominant flower colour? Why?

(ii) What is the genotype of the red flowering plant? Why?

(iii) What is the genotype of the white flowering plant? Why?

(iv) Diagrammatically represent the cross showing the phenotypes and genotypes of the parents and their offspring. Also show the ratio of the different phenotypes found amongst the offspring.

Solution

(i) red. Dominant colour always shows up in heterozygous combination.

(ii) Rr. The plant is heterozygous for flower colour, therefore it must have one dominant and one recessive gene.

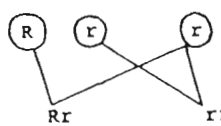
(iii) rr. White flower colour is recessive and the recessive condition only shows up when both genes are recessive.

(iv)

Parents:

phenotype:	red	x	white
genotype	Rr		rr

Gametes:



F_1 genotype	Rr		rr
phenotype	red		white
phenotypic ratio	1	:	1

Example 2

Amongst guinea pigs black fur colour is dominant over white. A black male guinea pig is crossed with a white female guinea pig. Black and white offspring were produced.

(i) There are two **possible** genotypes for the black male guinea pig. List them and explain why both are **possible.**

(ii) What is the genotype of the female guinea pig? Why?

(iii) Show diagrammatically the results of the two possible crosses between the black male and white female.

(iv) Which of the two possible genotypes is correct? Why?

Solution

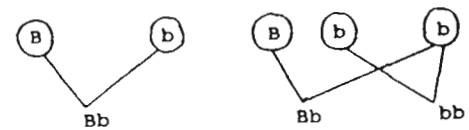
(i) BB and Bb. The dominant condition shows up when in homozygous or heterozygous combination.

(ii) bb. White fur colour is recessive and the recessive condition only shows up in homozygous combination.

(iii)

Parents	Cross X			Cross Y		
phenotype	Black	x	white	Black	x	white
genotype	BB		bb	Bb		bb

Gametes



F_1 genotype	Bb	Bb	bb
phenotype	All Black	Black	white

(iv) Cross Y is correct because only if the male guinea pig is heterozygous (hybrid) can it produce both black and **white** offspring.

NB. When an organism showing the dominant condition is crossed with one showing the recessive condition to determine whether the dominant condition is homozygous (pure breeding) or heterozygous (hybrid) it is called a **test cross.**

Work out the following problem for yourself:

In mice, long ears (E) are dominant over short ears (e). A short- eared female mouse (mouse A), with long-eared parents (mice B and C), produces a long-eared offspring (mouse D) when crossed with another mouse (mouse G). The long-eared offspring (mouse D) is crossed with another long-eared mouse (mouse H). This last cross produces long-eared offspring.

What are the genotypes of all the individuals involved? Give reasons for your answer in each case.

5. DIHYBRID CROSSES (Not for Standard Grade)

A dihybrid crosses involves breeding where two pairs of contrasting characteristics are considered.

5.1 Mendel's Experiments

- Mendel carried out more complicated experiments than those described in 4.1.
- He crossed pure breeding plants with round and yellow seeds with pure breeding plants with wrinkled and green seeds and found that all the F1 offspring were round and yellow.

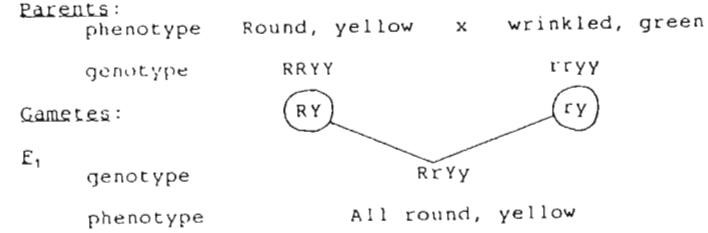
Parents: round, yellow X wrinkled, green

Offspring : All round, yellow

- When Mendel crossed the F1 offspring, he found the F2 generation produced the following seed types in the phenotypic ratio 9:3:3:1
  - 9 round, yellow seeds
  - 3 wrinkled, yellow seeds new
  - 3 round, green seeds combinations
  - 1 wrinkled, green
- It should be noted that in addition to the phenotypes of the grand-parents (round, yellow and wrinkled, green) two new phenotypic conditions appeared in the F2.
- From this work Mendel developed his Second Law - the **Law of Independent Assortment** which states that :
  - » the various "factors" controlling the different characteristics (seed shape, seed colour, plant height, flower colour) are separate entities, not influencing each other in any way, and sorting themselves out independently during gamete formation.

5.2 Explanation in terms of genes

- Each characteristic is controlled by two genes.
- The pure breeding plant with round and yellow seeds had two genes for roundness (R and R) and two genes for yellowness (Y and Y).
- The pure breeding plant with wrinkled and green seeds had two genes for the wrinkled condition (r and r) and two genes for for greeness (y and y).
- As a result of meiosis during gamete formation, the gametes from the round and and yellow-seeded parent only has one R gene and one Y gene.
- Similarly the gametes from the wrinkled and green-seeded parent only has one r gene and one y gene.
- During fertilisation the gamete with RY from one parent combines with the ry gamete from the other parent resulting in a zygote (which develops into an offspring) with RrYy.
- The offspring is round and yellow since the R dominates or masks the r gene and the Y gene dominates or masks the y gene i.e. roundness and yellowness are dominant while wrinkledness and greeness are recessive.
- Diagrammatically this dihybrid cross leading to the F1 can be shown as follows :



- The F1 offspring are all hybrid or heterozygous round, yellow with the gene combination RrYy as opposed to pure breeding round, yellow (RRYY).
- When these F1 are crossed with each other, four types of gametes will be possible from each parent viz. RY, Ry, rY and ry.
- These four types of gametes from each parent can result in 16 possible combinations during fertilisation as follows:
  - 9 round,yellow
  - 3 round, green
  - 3 wrinkled yellow
  - 1 wrinkled green

Diagrammatically Mendel's dihybrid cross leading to the F2 generation can be shown as follows:

Parents:

phenotype Round, yellow x Round, yellow

genotype RrYy RrYy

Gametes: RY Ry rY ry RY Ry rY ry

F_2

Male Gametes

Female gametes	RY	Ry	rY	ry
RY	RRYY round yellow	RRYy round yellow	RrYY round yellow	RrYy round yellow
Ry	RRYy round yellow	RRyy round green	RrYy round yellow	Rryy round green
rY	RrYY round yellow	RrYy round yellow	rrYY wrinkled yellow	rrYy wrinkled yellow
ry	RrYy round yellow	Rryy round green	rrYy wrinkled yellow	rryy wrinkled green

NB. Phenotypic ratio : 9 round, yellow : 3 round, green : 3 wrinkled, yellow : 1 wrinkled green.

5.3 Dihybrid cross to work out yourself

In a certain species of plants, tallness is dominant over shortness and red flowers are dominant over white flowers. A plant which is pure breeding for tallness and red flowers is crossed with a short, white flowering plant and the F1 plants are interbred. Represent these crosses diagrammatically showing all the genotypes and phenotypic ratios of the F1 and F2.

6. COMPLETE AND INCOMPLETE DOMINANCE

- According to the Law of Dominance, when two individuals with pure breeding contrasting characteristics are crossed, the individuals of the F1 generation all display the dominant characteristic.
- While this law applied to the seven contrasting characteristics Mendel studied and to many other characteristics as shown in the examples above, it does not **always** apply.
- In some cases, the two pure breeding parents produce an offspring showing an **intermediate condition**.
- For example, when a pure breeding, red flowering four o' clock plant is crossed with a pure breeding white flowering four o' clock plant, all the F1 plants have **pink** flowers.

Parents

phenotype Red x White

genotype RR WW

Gametes R W

F_1 genotype RW

phenotype All Pink

NB. Since neither red or white is completely dominant, we use two separate letters, both in capitals, to represent the genes.

Examples for you to work out on your own (Not for Standard Grade)

(a) What would be the genotypes and the phenotypes of the F2 offspring if the F1 offspring produced above were interbred? Show diagrammatically.

(b) In snap-dragons, the broad-leaf condition (B) is incompletely dominant over the narrow-leaves (N). A cross between the two pure breeding types produces plants with intermediate leaves. Show diagrammatically the results of a cross between a narrow-leafed plant and an intermediate leafed plant.

7. SEGREGATION

- Mendel's Law of Segregation states that, for each characteristic, a plant possesses two "factors" (now known as genes) which separate or segregate so that each gamete contains only one of these factors.
- Hereditary characteristics are controlled by genes on chromosomes.
- For each characteristic there are two genes which occur on corresponding positions on homologous chromosomes.
- During gamete formation meiosis takes place so that gametes only contain one set of chromosomes i.e. they are haploid.
- The homologous chromosomes thus become separated each going into a different gamete.
- The two gametes controlling a characteristic thus also become separated
- so that each gamete contains only one gene for a particular characteristic.

8. INDEPENDENT ASSORTMENT

- Mendel's Law of Independent Assortment states that the various "factors" controlling the different characteristics (plant height, seed colour etc.) are separate entities, not influencing each other in any way, and sorting themselves out independently during gamete formation.
- Genes situated on different chromosomes are able to sort themselves out independently of each other because of the random arrangement of chromosomes along the equator of the cell during the first metaphase of meiosis.

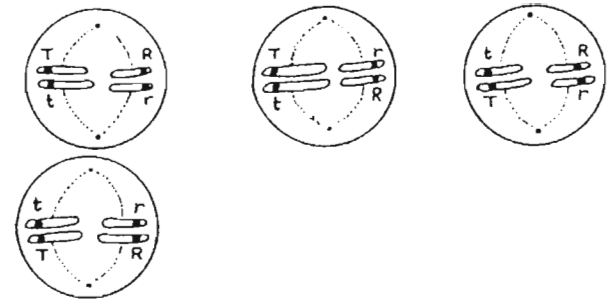


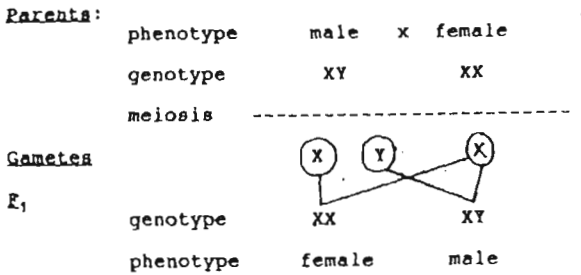
Fig. 22.5 Random arrangement of chromosomes along equator during first metaphase of meiosis showing independent assortment of genes.

- From the diagrams it can be seen that :
  - The T gene can occupy two possible positions.
  - The t gene can occupy two possible positions.
  - The R gene can occupy two possible positions.
  - The r gene can occupy two possible positions.
  - The positions occupied by the genes for height (T, t) are not influenced by the positions occupied by the genes for flower colour (R, r).
- Because the position occupied by these genes are not influenced by each other, they can end up in different cells (gametes) independently of each other i.e. they sort themselves out independently.
- However, if the genes are on the same chromosome, there will be a tendency for them to stay together i.e. they have a tendency to be **linked**. Even genes which are on the same chromosome may sort themselves out independently if they become separated as a result of crossing-over.

9. SEX DETERMINATION

- Every somatic cell of the human body has 23 pairs of chromosomes.
- Of these, 22 pairs are called **autosomes** and the remaining pair is called the **sex chromosome**.
- The sex chromosomes are of two types viz. X and Y.
- Females have two X chromosomes (+ 22 pairs autosomes).

- Males have an X and a Y chromosome (+ 22 pairs autosomes).
- The egg cells of females will contain only one X chromosome (+ 22 single autosomes) because they have been produced by meiosis.
- The sperm cells of males on the other hand may have either an X chromosome (+ 22 single autosomes) or a Y chromosome (+ 22 single autosomes) because they have been produced by meiosis.
- If an X sperm cell fertilises an ovum (which must have an X chromosome) the zygote has an XX combination which is a female.
- If a Y sperm cell fertilises an ovum (X), the zygote has an XY combination which is a male.
- Since X and Y sperm cells are produced in equal numbers, there is a 50:50 chance of the offspring being male or female.



10. PROTEINS AND DETERMINATION OF CHARACTERISTICS (GENE ACTION) (Not for Standard Grade)

- We have learnt that the presence of a particular combination of genes leads to a particular characteristic e.g. a Tt gene combination in a plant will give rise to a tall plant, whereas a tt combination will lead to a short plant.
- These gene combinations not only control externally visible characteristics but also the metabolism of the cells and thus the physiology of the entire organism.
- The way in which the genes act is as follows:
  - Each gene, which is a small portion of DNA, has a particular sequence of nitrogenous bases on it.
  - This sequence of bases determines which protein is formed.
  - Since the protein is the basic component of the cell, the nature of the proteins in it determine its character and behaviour.
  - Some of the proteins formed are really enzymes which control all the activities of the cell.
  - So genes bring about their action by determining which proteins and enzymes are going to be formed in the cells, which in turn determine the structure and activity of the cells and the organism as a whole.

11. GENE MUTATION (refer Chapter 19, sub-section 6, page 90). (Not for Standard Grade)

12. NATURAL SELECTION (Not for Standard Grade)

- Darwin's ideas on natural selection were published in his book "*The Origin of the Species*" in 1859.
- The principles of natural selection can be explained as follows :
  - Most organisms produce a **large number of offspring**.
  - These offspring are not identical - they show a great deal of **variation** because of:
    - crossing-over in first prophase and random arrangement of chromosomes (in first metaphase) during gamete production by meiosis.
    - chance fertilisation between sperm cells and egg cells.
  - These large number of different offspring compete with each other for the limited food and living space.
  - In this struggle for survival, only those who are best suited to the environmental conditions survive, while those that are less suited die. This is known as "survival of the fittest".
  - In other words, those that are best adapted to the environment have been **selected** by **nature** to **survive**.

- Since characteristics are genetically transmitted from parent to offspring, the next generation will show a greater percentage of individuals with the favourable characteristics.
- If this change continues from generation to generation, eventually the offspring produced will be genetically so different that they will be unable to interbreed with the original type of individuals which may remain in another habitat i.e. a new **species** has **evolved**.

- An example of natural selection is the phenomenon of **industrial melanism** in the peppered moth which took place in Manchester as follows:
  - Normally the light-coloured peppered moth is difficult to see against the light coloured lichens on tree trunks.
  - Gene mutations sometimes resulted in a dark-coloured moth which was immediately spotted and eaten by predators.
  - As a result of industrialisation in Manchester, the tree trunks became blackened with soot.
  - The light-coloured peppered moths now became conspicuous and easy prey
  - whereas the dark moths were better suited to the environment since they were camouflaged against the dark background.
  - In subsequent generations, the number of dark-coloured moths greatly increased while the light-coloured moths almost dis- appeared.
  - However, in less industrialised areas the light-coloured moths predominate.

13. SOME PRACTICAL APPLICATIONS OF GENETICS

13.1 Increased Productivity

- By controlling the breeding of plants and animals, farmers are able to produce new offspring which yield greater quantity and better quality food for man.
- This may be done by **selective breeding** or by **hybridisation**.

(a) Selective Breeding

- By carefully selecting animals and plants showing desirable characteristics and allowing only these to breed, new and improved varieties or strains may be obtained.
- The increased production of milk by Friesian cows has been brought about in this way.
- The increased productivity cannot go beyond the genetic ability of the parental types.

(b) Hybridisation

- Sometimes two genetically different lines may be crossed to produce a hybrid with high-yield, low resistance to disease, increased fertility etc.
- The productivity, resistance etc. of the hybrid goes beyond the genetic ability of either parental type.
- This is referred to as **hybrid vigour** or **heterosis**.

13.2 Inheritance and Prediction of Blood Groups

- There are four blood groups in man viz. group A, group B, group AB and group O. These are the **phenotypes**.
- There are three alleles controlling these four blood groups viz. genes A, B and O.
- An individual can only have two of these three genes.
- The O gene is recessive to the A and B genes.
- The genes A and B are incompletely dominant over each other.
- The table below illustrates the possible gene combinations (genotypes) and the blood groups (phenotypes).

GENE COMBINATION (Genotype)	BLOOD GROUP (Phenotype)
AB	AB
AA, AO	A
BB, BO	B
OO	O

- This knowledge can be used to predict the blood groups of the offspring if the blood groups of the parents are known.
- The table below illustrates how the various possible blood groups of offspring can be determined if the blood groups of the parents are known. (NB. The table need not be memorised - it is for explanation purposes only!)

Parental Blood Groups	Parental Genotypes	Possible Genotypes of Children	Possible Blood Groups of Children
AB x AB	AB x AB	AA, AB, BB	A, AB, B
AB x A	AB x AA or AO	AA, AB, AO, BO	A, AB, B
AB x B	AB x BB or BO	AB, BB, AO, BO	AB, B, A
AB x O	AB x OO	AO, BO	A, B
A x A	AA or AO x AA or AO	AA, AO, OO	A, O
A x B	AA or AO x BB or BO	AB, AO, BO, OO	AB, A, B, O
B x B	BB or BO x BB or BO	BB, BO, OO	B, O
A x O	AA or AO x OO	AO,OO	A, O
B x O	BB or BO x OO	BO, OO	B, O
O x O	OO x OO	OO	O

- From the table it can be seen that knowledge of the blood groups of parents and children may be used to solve problems disputed parentage.
- For example, it can be seen that :
- If the mother has A blood group and the child O blood group, a man of blood group AB **definitely cannot** be the father but a man with blood group A, B or O **may** be the father.
- If the mother has B blood group and the child O blood group, a man of blood group AB **definitely cannot** be the father but a man with blood group A, B or O **may** be the father.
- If the mother has A blood group, and the child AB blood group, then the father **may** be a man with blood groups B or AB but **certainly not** a man with blood groups O or A.

13.3 The Rhesus (Rh) Factor

- The Rh factor is a factor occuring in red blood corpuscles, independent of the A, B, AB and O blood groups.
- About 85% of humans have this factor (i.e. they are Rh positive) while the other 15% do not have this factor (Rh negative).
- If a person with Rh negative blood receives Rh positive blood in a transfusion, he develops antibodies against this blood.
- At the first transfusion, these antibodies have no effect but should a second transfusion of Rh positive blood occur, the antibodies reject the new blood leading to complications or even death.
- Since the Rh negative condition is recessive, it will only show up when both genes are recessive.
- Thus it is possible for a Rh negative mother to produce a Rh positive child, if the father is Rh positive.
- The mother produces antibodies against the Rh positive foetus.
- Should a later pregnancy produce another Rh positive child, the antibodies may reject the foetus causing serious damage or even death of the unborn child.
- However, our knowledge of genetics enables us to predict the possibility of the child being Rh positive or negative.
- If the prediction indicates that an Rh negative mother is going to produce an Rh positive child in her second or subsequent pregnancies, a complete replacement of the child's blood by Rh positive blood (without the antibodies) may be necessary immediately after birth.

23 HUMAN REPRODUCTION

1. THE MALE REPRODUCTIVE SYSTEM

- The male reproductive system of humans consists of :
  - a pair of testes situated in a scrotum.
  - the epididymis, vas deferens, ejaculatory duct and urethra.
  - the seminal vesicles, prostate gland and Cowper's glands.
  - the penis.

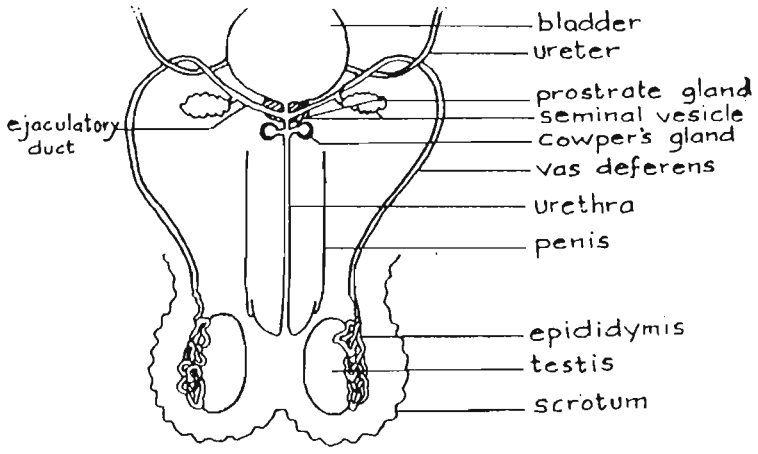


Fig. 23.1 The Male Reproductive System

- The **testes** are the male gonads. They occur in a bag-like scrotum.
  - Within each testis are found seminiferous tubules and interstitial cells.
  - The seminiferous tubules are lined by germinal epithelium cells which produce:
    - the spermatozoa by spermatogenesis.
    - cells of Sertoli which supply food to the developing spermatozoa.
  - The interstitial cells produce male hormones called **androgens** which produce the secondary sexual characteristics in males.

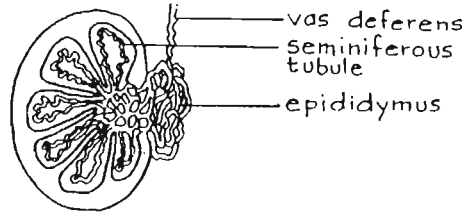


Fig. 23.2 L/S testis

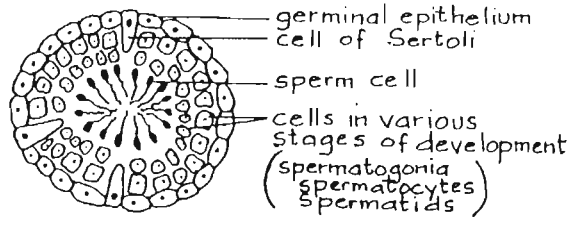


Fig. 23.3 T/S seminiferous tubules

- The tubes responsible for carrying the spermatozoa and related products to the outside include the epididymis, vas deferens, ejaculatory ducts and the urethra.
  - The **epididymis** is a coiled tube lying outside each testis but within the scrotum. It leads from the seminiferous tubules, stores sperms temporarily and later passes these sperms into the vas deferens.

- The **vas deferens** or sperm duct carries the spermatozoa from the epididymis through the abdomen into the ejaculatory duct.
- The two **ejaculatory ducts** join the urethra just after it leaves the bladder. Contraction of the muscular walls of the ejaculatory duct forces its contents (called semen) through the urethra.
- The **urethra** is a tube which runs through the penis and opens at the tip of it. It is a common tube for the passage of urine and semen.

- The tubes transporting the spermatozoa are joined by seminal vesicles, the prostate gland and Cowper's glands.
  - The **seminal vesicles** are gland-like structures joining each vas deferens before it becomes the ejaculatory duct. It secretes a fluid which contains enzymes and nutrients which promote movement of the spermatozoa. The mixture of this fluid and the spermatozoa is called **semen**.
  - The **prostate gland** occurs at the neck of the bladder where the two ejaculatory ducts join the urethra. The prostate gland secretes a fluid which stimulates the movement of the spermatozoa and is responsible for the alkalinity of the semen.
  - A pair of **Cowper's glands** open into the urethra at the base of the penis. They secrete a mucous substance.
- The **penis** is the external reproductive organ of the male. It is made up of spongy tissue which becomes filled with blood causing the penis to become erect before it is inserted into the female organ. The penis is responsible for transferring spermatozoa from the male to the female.

2. THE FEMALE REPRODUCTIVE SYSTEM

- The female reproductive system consists of :
  - a pair of ovaries.
  - a fallopian tube or oviduct leading from each ovary.
  - the uterus or womb.
  - the vagina or birth canal.
  - the vulva or external opening.
- The **ovaries** are the female gonads. They occur in the lower part of the abdominal cavity and are held in place by ligaments. Each ovary is made up of a covering of germinal epithelium with a large number of follicles within it.
  - The **germinal epithelium** produces the **follicles**.
  - **Oogenesis** takes place within the follicles to produce the **oocytes** which become the **ova**.

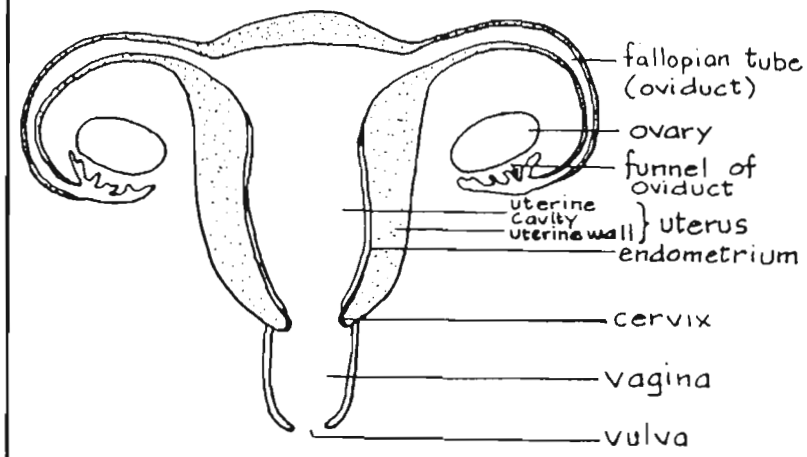


Fig. 23.4 The Female Reproductive System

- The **fallopian tubes** convey ova from the ovaries to the uterus. The upper part of the fallopian tubes are expanded into ciliated funnels which partially enclose the ovaries.
- The two fallopian tubes open into the **uterus**
  - which is a pear-shaped, hollow organ with muscular walls.
  - The lining of the uterus, the **endometrium**, is richly supplied with blood vessels.
  - The neck of the uterus, the **cervix**, extends into the vagina.
  - The uterus serves for attachment of the embryo should fertilisation take place.

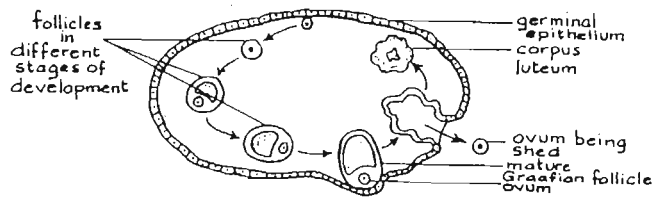


Fig. 23.5 Section through the ovary

- The **vagina** leads from the uterus to the outside by means of the external opening, the **vulva**. During copulation the penis is placed into the vagina where it releases its spermatozoa.

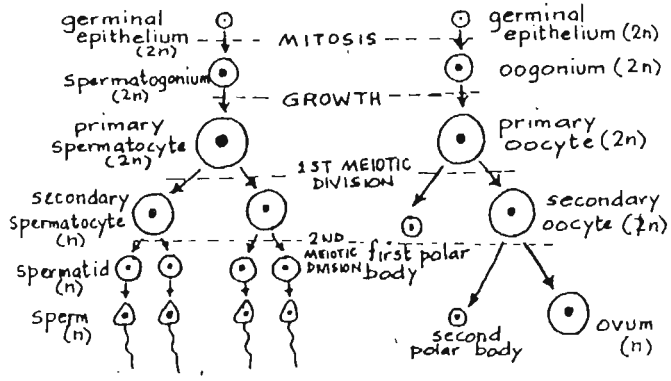
3. GAMETOGENESIS (Not for Standard Grade)

- **Spermatogenesis** refers to the process by which spermatozoa are produced from the germinal epithelium of the testis. **Oogenesis** refers to the process by which ova are produced from the germinal epithelium of the ovaries. **Gametogenesis** is a general term which includes spermatogenesis and oogenesis i.e. it refers to the process by which gametes are produced from the germinal epithelium of the gonads.

3.1 Spermatogenesis

- At puberty the diploid germinal epithelial cells lining the seminiferous tubules divide by **mitosis** several times to produce many diploid **spermatogonia**.
- Each spermatogonium grows to form a diploid **primary spermatocyte**.
- Each primary spermatocyte undergoes **meiosis**.
- The cells formed after the first division are haploid **secondary spermatocytes**
- which form haploid **spermatids** after the second division.
- Each spermatid matures into a haploid **spermatozoan** or **sperm cell**.
- Each spermatozoan is made up of a head, a middle-piece and a tail.

- The head is made up of mainly the **nucleus** which contains the 23 chromosomes with DNA.
- The head also has an **acrosome** at its tip which produces enzymes which dissolve the surface of the egg at the time of fertilisation.
- The long tail enables the spermatozoan to swim in the semen.



Spermatogenesis *Oogenesis*

Fig. 23.6 Gametogenesis

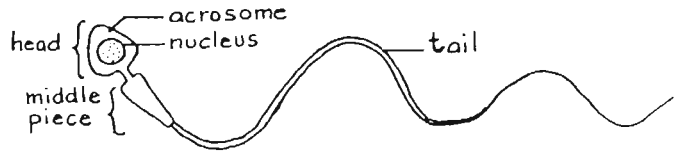


Fig. 23.7 A spermatozoan

3.2 Oogenesis

- While still in the uterus of its mother, the germinal epithelial cells of the ovary of the female embryo divides by **mitosis** several times to produce many diploid **oogonia**.
- At puberty, each oogonium grows to form a diploid **primary oocyte**.
- Each primary oocyte undergoes **meiosis**.
- The first meiotic division produces a haploid **secondary oocyte** and a very much smaller **polar body**.
- The secondary oocyte undergoes the second meiotic division to produce a haploid **ovum** and a **second polar body**.

4. OVULATION AND MENSTRUATION (Not for Standard Grade)

- The oogonia develop into oocytes within fluid-filled **follicles**.
- A large follicle with a mature ovum is called a **Graafian Follicle**.
- The follicles secrete **oestrogen** which prepares the endometrium lining of the uterus for implantation of the fertilised egg.
- At intervals of approximately four weeks, a single Graafian Follicle ruptures to release an ovum. This is called **ovulation**.
- The ovum is collected by the funnels of the fallopian tube
- and pass down the fallopian tube.
- The ruptured follicle becomes transformed into a **corpus luteum**
- which secretes the hormone **progesterone** which maintains pregnancy.
- If fertilisation does not result the corpus luteum degenerates.
- No progestrone is secreted and the endometrium lining is sloughed off as the menstrual period, accompanied by bleeding.

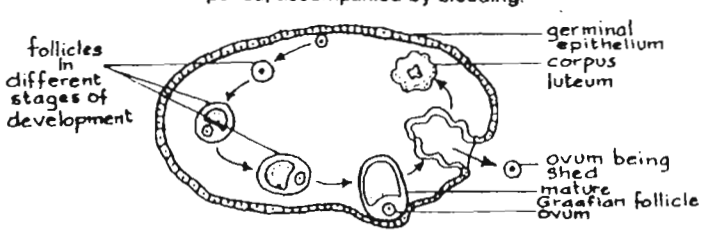


Fig. 23.8 Section Through Ovary

5. FERTILISATION

- The spermatozoa are placed in the vagina during copulation.
- The spermatozoa swim up the uterus and into the fallopian tube.
- If an ovum is present in the fallopian tube at this time, one spermatozoan may penetrate and fertilise the egg, resulting in a diploid zygote.
- The zygote immediately forms a fertilisation membrane around itself to prevent other spermatozoa from entering.
- Since the spermatozoan has 23 single chromosomes and the ovum has 23 single chromosomes, the zygote has 23 pairs of chromosomes (i.e. it is diploid).
- Since the sperm cell came from the male parent and the ovum from the female parent, the zygote contains genetic material from both parents.

6. EMBRYONIC DEVELOPMENT AND IMPLANTATION

- As the zygote passes down the fallopian tube into the uterus it divides by **mitosis** to form a ball of cells called the **morula**.
- By the time it reaches the uterus, the cells are so arranged that a hollow develops inside the ball of cells and it is now called a **blastocyst**.
- The blastocyst becomes embedded into the endometrium wall of the uterus. This is referred to as **implantation**.
- The blastocyst continues to develop and after about three months it becomes transformed into a **foetus**.

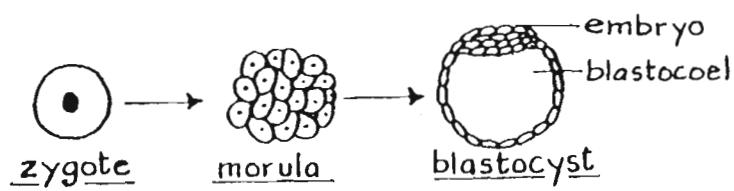


Fig. 23.9 Development of the morula and blastocyst

7. GESTATION

- This is the period during which the embryo develops within the uterus of the mother. It is also referred to as the state of **pregnancy**.
- Soon after pregnancy the embryo develops four extra-embryonic membranes viz.:
  - the **chorion** on the outside, which forms the chorionic villi.
  - an **amnion**, with its cavity, the amniotic cavity, filled with amniotic fluid.
  - the **yolk sac**, which arises from the gut of the embryo, but serves little purpose in humans.
  - the **allantois**, also arising form the embryo's gut, which eventually *fuses with the chorion.*

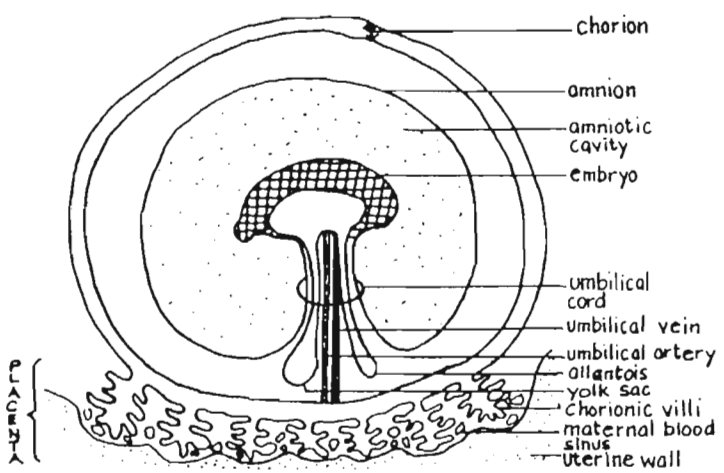


Fig. 23.10 The foetus with its extra-embryonic membranes

- *The chorionic villi together with the allantois of the embryo and the* uterine tissue in which the villi are embedded makes up the **placenta** which has the following functions :
  - it serves for attachment of the embryo to the mother.
  - it allows for diffusion of dissolved food from the mother to the foetus.
  - it allows for diffusion of oxygen from the mother to the foetus, and for the diffusion of carbon dioxide from the foetus to the mother.
  - it allows for diffusion of nitrogenous excretory wastes from the foetus to the mother.
  - after about the twelfth week of pregnancy it secretes **progesterone** which maintains pregnancy.

NB.

1. The blood of the foetus and that of the mother are very close to each other since the chorionic villi are bathed by the blood from the maternal sinuses. However, there is **no direct contact** because they are separated by the walls of the chorionic villi.

2. The embryo's respiratory, excretory and digestive systems are non-functional. Therefore the placenta has to take over the functions of these systems.

- The **amniotic fluid** has the following functions :
  - it acts as shock absorber, protecting the foetus against mechanical injury.
  - it prevents dehydration of the embryo.
  - it keeps the foetus within a small temperature range.
  - it allows relatively free foetal movement for growth and development.
- The **umbilical cord** attaches the foetus to the placenta. It contains connective tissue, the umbilical artery, umbilical vein, yolk sac and allantois. The umbilical artery carries deoxygenated blood with nitrogenous wastes from the embryo to the placenta. The umbilical vein carries oxygenated blood with dissolved food from the placenta to the foetus.

8. POST-NATAL CARE

- About 280 days after conception (fertilisation), birth occurs.
- Muscular contraction of the uterus causes the baby to be pushed out through the vagina.

- The new born baby is completely helpless and relies on its mother for :
  - its food supply.
  - protection against danger.
  - protection against disease.
  - its mental health and stimulation.
- Post-natal care continues until the child becomes completely independent. The age at which independence occurs may vary from individual to individual but it usually ranges from the late teens to the early twenties.