

**A CONTEXT-BASED PROBLEM SOLVING APPROACH IN
GRADE 8 NATURAL SCIENCES TEACHING AND LEARNING**

by

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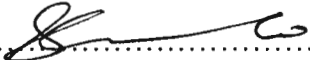
As the candidate's supervisor I agree to the submission of this thesis.

JANUARY 2009

DECLARATION


I hereby declare that the research involved in my thesis entitled, A context-based problem solving approach in grade 8 Natural Sciences teaching and learning, is entirely my own work, that it has not been submitted for any degree or examination in any other university, and the sources I have used or quoted have been indicated and acknowledged by complete references.

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ABSTRACT

The demands of the new curriculum are such that problem solving is foregrounded as one of the core skills in the learning of the Natural Sciences. However teachers in general have difficulties in conceptualizing how this core skill should be incorporated into their everyday teaching of the Natural Sciences. Furthermore there seems to be some confusion in the literature on how the concept of problem solving should or ought to be understood. This is a qualitative case study to explore a grade 8 Natural Sciences educator who involves the learner's context when developing the curriculum, during teaching and learning and assessment. The educator allows the learners to use their context to negotiate during teaching and learning. The learners discuss the context-based activities in their groups and solve problems in their context, produce the portfolio boards by using the resources from their context and present their portfolio board to the class. The educator assesses the learners' activities in context and the portfolio boards. The educator and classroom activities are explored by using semi-structured interview as the main source of the data, unstructured interviews semi-structured observation schedule and classroom observation. The educator's understanding is explored by using a multifaceted methodology which targets the following key aspects namely, curriculum development, teaching and learning and assessment. In the activity theory the context is the unit of analysis. Activity theory is used as the lens and the conceptual framework in this study to understand how the educator develops the curriculum, teach learners Matter and Materials in their context and assess their context-based activities and the portfolio boards. The findings show that according to this educator he sees himself as the curriculum implementer rather than developer. The curriculum changes are at theoretical level rather than classroom level. Contextual teaching involves construction of knowledge from learners pre-knowledge and interests. Teaching within an Outcomes Based Education is transformative and educator as a mediator of learning. Problem solving needs more time but maximise non-routine thinking. Assessment is for learning, it is continuous and it contributes towards assessment for grading.

DEDICATION

This research study is dedicated to my family, my late, caring and loving mothers Ethel MaChiya Mdubeki and Elizabeth MaShozi Khumalo, my loving, tolerant and incredible supportive husband Mbusiswa Blessing, my father Gatrack Mdubeki and my dearest children Zolani Samkele, Ndumiso Ntuthuko and Nozibusiso Mbalenhle for your patience, understanding and believing in me.

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LIST OF ABBREVIATIONS

OBE:	Outcomes Based Education.
NCS:	National Curriculum Statement.
RNCS:	National Curriculum Statement.
LO:	Learning outcome.
AS:	Assessment standard.
DoE:	Department of Education.
LLC:	Language, Learning, and Communication.
MLMMS:	Mathematical Literacy, Mathematics and mathematical sciences.
CO:	Critical Outcome.
DO:	Developmental Outcome
GET:	General Education and Training.
FET:	Further Education and Training.
UK:	United Kingdom.
USA:	United States of America.

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CHAPTER 1

THE CONTEXT OF EDUCATION IN SOUTH AFRICA

1.1. INTRODUCTION

After the 1994 democratic elections, the South African Department of Education (DoE) engaged in a process of extensive curriculum reform, a process that ended with the adoption of the learner-centred Outcomes Based Education (OBE) approach, introduced in 1995. This educational innovation was combined with what became known as Curriculum 2005, a project that led to the introduction of the National Curriculum Statement (NCS), which was implemented in all grades in 2005. This NCS was challenged and subsequently revised. After this revision it became the Revised National Curriculum Statement (RNCS) and was introduced and implemented in the Foundation Phase and Intermediate Phase in 2004, the Senior Phase in 2005, and in Further Education and Training in 2006. Given the fact that my study focuses on science education, the discussion will be based mainly on the impact on science education of all these changes. In the previous science curriculum, for example, the focus was on transmission of scientific knowledge, routine problem solving, and demonstrative practical activity. This is the main reason that Curriculum 2005 was introduced, in order to redress these limitations. All of the innovations that accompanied these initiatives, however, were found to be wanting.

This is the reason that in 2000 the Minister of Education appointed a committee to review the structure and design of Curriculum 2005. Part of the reason for such reviews was that

expected levels of performance were all removed from the curriculum (Revised National Curriculum Statement Grades R-9, 2002).

While Learning Outcomes (LOs) described the knowledge, skills and values that learners should achieve in the curriculum, assessment standards (ASs) described the level at which learners should demonstrate their achievement of the learning outcomes in the curriculum. Assessment Standards (ASs) are now grade specific, showing what is expected of learners in each grade and how conceptual progression will occur in each learning area. The integration of knowledge, skills and values occurs within and across learning areas, and is balanced with conceptual progression from grade to grade within a learning area. Learning outcomes and assessment standards for grade R are now also specified in the curriculum (Revised National Curriculum Statement Grades R-9, 2002).

The focus of South African science education, the main aspect in this study, is on the development of science process skills in daily life, in the community and in the work place with regard to scientific knowledge and understanding and science and society (Revised National Curriculum Statement Grades R-9, 2002). The assessment is continuous and is based on Outcomes Based Education (OBE) principles, upon which ideas are drawn to assist learners to reach their full potential and learners' performance that is measured against the Learning Outcomes and their Assessment Standards. In this context, education is expected to help learners to become scientific problem solvers in the context of their society (Revised National Curriculum Statement Grades R-9, 2002). It is in this context that OBE is viewed as forming the basis for the South African curriculum because of its focus on promoting a learner-centred and activity-based approach to education. This is because it is designed to assist learners acquire knowledge, skills, values and attitudes as a result of learning. It also sets Learning Outcomes (LO) that assist learners to reach their maximum potential. The learning outcomes and assessment standards put the emphasis on participatory, learner-centred and activity-based education.

The RNCS, furthermore, requires that educators design curricula that are interesting and relevant to everyday experiences of the learners, according to the central guidelines, set of outcomes and assessment standards. There are three design features accompanying this, namely, critical and developmental outcomes (CO and DO), learning outcomes (LO) and assessment standards (AS) (DoE, 2002). The learning outcomes are developed from the critical and developmental outcomes. In RNCS, each learning outcome (LO) consists of the assessment standards (AS). In Natural Sciences, Grade R to 9, in LO1 (Scientific Investigations), there are three assessment standards, in LO2 (Constructing Science Knowledge), there are four assessment standards and in LO3 (Science, Society and the Environment), there are three assessment standards (Revised National Curriculum Statement Grades R-9, 2002).

LO1 enables the learner to act confidently curious about natural phenomenon, to investigate relationships and to solve problems in scientific, technological and environmental contexts. The ASs for LO1 are achieved if the learner can plan and conduct the investigation, collect and evaluate data and communicate his/her findings. LO2 enables the learner to interpret and apply scientific, technological and environmental knowledge. The ASs for LO2 are achieved if the learner can recall and categorize meaningful information to reduce complexity, look for patterns, interpret information and apply knowledge to problems that are not taught explicitly (Revised National Curriculum Statement Grades R-9, 2002). LO3, furthermore, enables the learner to demonstrate an understanding of the interrelationship between science and technology, society and the environment. The ASs for LO3 are achieved if the learner can understand science and technology in the context of history and indigenous knowledge, the impact of science and technology on the environment and on people's lives and recognize the bias in science and technology on people's lives. These LOs are used to assess the progress of the learner's ability to plan and carry out investigations involving knowledge and to apply

that knowledge in the classroom and in society (Revised National Curriculum Statement Grades R-9, 2002).

More specifically, the focus of South African science education is on the development of science process skills in daily life, in the community and in the workplace, on scientific knowledge and understanding and science and society (RNCS R-9, Natural Sciences, 2002). The process skills are applicable to all LOs and are the most important aspect for teaching and learning of science. “Process skills refer to the learner’s cognitive activity of creating meaning and structures from new information and experiences” (RNCS Grades R-9, Natural Sciences, 2002, p. 13). Observing and comparing, measuring, recording information, sorting and classifying, interpreting information, predicting, hypothesizing, raising questions about the situation, planning science investigations, conducting investigations and communicating science information are important in designing OBE activities. The framework of process skills allows educators to assess learners and design questions that promote the thinking required by LOs and to engage learners with the world (RNCS Grades R-9, Natural Sciences 2002).

As OBE implies, the assessment in Natural Sciences is continuous and thus assists learners to reach their full potential. Their performance is measured against the Learning Outcomes and their Assessment Standard. The education is expected to help learners to become scientific problem solvers in the context of their society (Revised National Curriculum Statement Grades R-9, 2002). Planning for teaching, learning and assessment at school is now done in three stages. The different phases are foundation, intermediate, senior and FET. Each phase will produce a learning programme based on RNCS and NCS documents. The first stage of planning, for a particular learning area, is done by all educators. The second stage of planning is done by grade educators and produces the work schedule based on the learning programme. The third planning is done by individual educators and produces a lesson plan based on the work schedule.

Planning in the previous curriculum was done by one subject educator who produced schemes of work based on the syllabus which in turn produced daily preparation schemes. The focus of the South African science education in the previous curriculum was based on transmission of scientific knowledge, routine problem solving, and demonstrative practical activity. It was content based, relied largely on textbooks and notes prepared by the educator. Learners were passive and worked individually. Assessment was not continuous and certainly not designed to enhance learning. Educators were teaching and then assessing learners' work. Contrary to this, in the new RNCS and NCS, assessment is continuous, promoting learning and covers all the OBE assessment principles that ensure that assessment is:

- Ongoing;
- Supporting the growth and development of learners;
- Providing feedback from learning and teaching;
- Allowing for integrated assessment;
- Using strategies that cater for a variety of learner needs and;
- Allowing for summative assessment. (Revised National Curriculum Statement Grades R-9, 2002).

The above principles indicate clearly that in the RNCS, assessment should assist learners to judge their own performance, put goals for performance and encourage further learning. The educators of RNCS are expected to fulfil their roles as summarized by the Norms and Standards for Educators. These roles include educators as mediators of learning, interpreters and designers of learning, programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors and learning area or phase specialists (Norms and Standards, 1998). The educator in this study is to mediate learning and all other roles as mentioned in the norms and standards.

1.2. RATIONALE FOR THE STUDY

I am a Grade10-12 Physical Sciences educator at Kwafica High School in the Port Shepstone district, in the uMzumbe circuit. Kwafica High School is a rural school, located 50km from Port Shepstone and 120km from Durban. I have been teaching Physical Sciences in this school for the last 16 years. Our small school laboratory only caters for chemistry, but not physics demonstrations. Currently, my Physical Sciences teaching relies heavily on textbooks. It is occupied mainly with problem tasks that come from the textbooks and previous examination papers. These tasks are used as part of continuous assessment to prepare learners for final examinations. The same problem tasks given to the learners, such as examples, classwork, homework, informal tests, tutorials, assignments, practical work and formal tests for each term and final examination cover the work of three terms. These problem tasks or exercises I give to my learners are, however, as Hobden (1999) rightly argues, routine and have a low conceptual demand.

My preoccupation with the issue of problem solving within the Physical Sciences curriculum arises from the demands of the new curriculum, which emphasizes problem solving as a core curriculum skill. As borne out in numerous workshops I have attended thus far, most Natural Sciences and Physical Sciences educators, including myself, have difficulties with implementing the RNCS vision, especially the aspect of involving learners in ‘real-world’ problem-solving experiences. As Dufresne, *et al.* (2005) significantly highlight that science learning and teaching is a spiral of confusion and failure because classroom practices do not meet learners needs and take into account their already existing knowledge and skills. It is against this brief background that the rationale for the study is to document an example of ‘best practice’ in the Natural Sciences teaching. The study maps out the practice of a Grade 8 educator who has tried to

teach problem solving in context. It is hoped that his experiences will provide insights into the dynamics involved in the teaching and learning of Natural Sciences, in context.

1.3. RESEARCH PURPOSE

The purpose of the study is to explore a Grade 8 Natural Sciences educator's understanding of the curriculum needs in involving learners in 'real-world', problem-solving experiences. The purpose of the study is to explore the world of a Grade 8 Natural Sciences educator who involves the context of the learners. This allows the learners to negotiate and discuss the subject during teaching and learning, to produce a portfolio board and present their portfolio board to the class. I also wish to explore the context-based, problem-solving approach during curriculum development, teaching and learning and assessment of Grade 8 Natural Sciences. These purposes will be addressed through the following research question.

1.4. RESEARCH QUESTION

What does it mean to teach Grade 8 Natural Sciences problem solving in context, in terms of:

- curriculum development;
- teaching and learning and;
- assessment?

1.5. THE CONTEXT OF THE STUDY

1.5.1. THE SCHOOL

The school is a public school, situated in a semi-urban area in one of the locations around Durban. It is an ex-House of Representatives school and this is why the majority of the learners in this school are Indian, Coloured, and black Africans. The teaching staff represents the three racial groups mentioned above. English is used as the medium of instruction and learners choose from Isizulu and Afrikaans as their second additional language. The school caters for both General Education and Training (GET) and Further Education and Training (FET) phases and begins from Grade 8 to 12. There are 220 Grade 8 learners, 225 Grade 9 learners, 240 Grade 10 learners, 197 Grade 11 learners and 217 Grade 12 learners (see appendix B3).

1.5.2. THE EDUCATOR

The research participant was selected because of his experience in teaching and learning that involves the environment of the learners. The educator has conducted a study on project-based learning in which he argues that learning context is failing the learners because there are less opportunities created for learners to negotiate their identities within the context of learning science. The educator has been teaching in this school for the past twenty-three years. He is a Biology teacher, but is also teaching Natural Sciences as one of his learning areas in the RNCS. This particular educator responds to all his learners' answers and accepts all answers. There is no wrong answer for him, but he often asks learners to explain why they respond the way they do whenever they answer his questions in class. Other learners are asked by the educator to assist other learners that may be

struggling in class. The educator interacts with the learners throughout the lesson and facilitates learning.

1.5.3. THE LEARNERS

Out of 220 Grade 8 learners, only 43 Grade 8B learners were research participants in this study. These participants were observed during the Natural Sciences lessons only. The classroom is arranged in such a way that allows learners to be divided and sit in groups so that it is easy for them to discuss their ideas during teaching and learning. The learners participate actively, control and direct their own learning and are always in their groups of 6 to 8 during teaching and learning. They actively participate during class with group discussions and use isiZulu and English during these discussions. Learners answer questions freely and do not waste time by standing up. During teaching and learning, learners get involved in activities from their workbook and are assessed by the educator and the other learners. These learners identify and solve problems. The educator also gives them real-world problems to solve in their workbooks.

1.5.4. OUTLINE OF THE STUDY

This study consists of six chapters, starting with an introduction and the context of the study. The second chapter focuses on the literature review, elaborates on problem solving and the context-based approach. Chapter Three focuses on a theoretical framework, and elaborates on activity theory. Chapter Four focuses on the research methodology and elaborates on theorizing the methodology and research design. Chapter Five focuses on the presentation of data. Chapter Six focuses on a discussion of the findings.

1.6. CONCLUSION

This chapter presented the context of education in South Africa and changes in the education system, the researcher's background and rationale, research purpose, research question, the context of the study and the outline of the study. In the following chapter, I present the literature reviewed in this study.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter explores the array of literature that has emerged out of the field that forms the basis of this study. Such an exploration encompasses research conducted both within local and international contexts that focus on a context-based approach and problem solving in the teaching and learning of science. It will emerge in this chapter, furthermore, that the theoretical framework draws on activity theory of learning. I begin this chapter with an exploration of the following teaching and learning imperatives: first, the challenges of problem solving as one of the core skills of teaching and learning of the Natural Sciences and Physical Sciences in the new curriculum; second, the importance of context in problem solving; and third, the work that has been done on problem-solving and context-based approach. The chapter engages critically with, firstly, the importance of learner's everyday experience and contexts for teaching and learning of sciences; secondly, the role played by contextualized activities in promoting problem solving; thirdly, the challenges of a context-based approach for both educators and learners; fourthly, the importance of problem solving as part of the process of conceptual development in science; and finally, the development of thinking, application of knowledge, and making learning interesting and realistic.

2.1.1 CHALLENGES IN TEACHING PROBLEM SOLVING

The challenges that accompany the process of problem solving, one of the core skills in the teaching and learning of Natural Sciences and Physical Sciences in the new curriculum manifest at three different levels: teacher practice level, theoretical level and organizational level. These, inevitably, bring about a noticeable impact in the successful facilitation of the processes of learning, knowledge construction and advanced understanding. In the South African National Curriculum Statement (NCS), problem solving is regarded as one of the core skills in the learning of the Natural Sciences and Physical Sciences. Teachers in general, however, often experience difficulties in conceptualizing ways in which core curricular skills can be incorporated into 'traditional' teaching of the Natural Sciences and Physical Sciences, and literature does not offer much help in this regard (Hobden, 2002).

The new National Curriculum Statement, however, highlights the importance of clarifying the meanings of the terms 'problem' and 'problem solving'. Such clarification is necessitated by the fact that there is tangible confusion within the mathematics and science community with regard to the meanings of these seemingly similar terms. Hobden (2002) points out that confusion lies in the very use of the term 'problem' within, for example, the science and mathematics community, the curriculum documents, and our own teaching practices. To avoid the confusion inherent in the use of the terms 'problem' and 'problem solving' within the science and mathematics community, Hobden (2002) suggests that authors should provide the meanings of the terms used for their research context, should clarify all the terms used and to use the meaning of critical thinking in the curriculum to disclose the meaning and intensions of problem solving.

This rather absurd confusion in the use of the terms ‘problem’ and ‘problem solving’ within the mathematics and science community, furthermore, implies a move away from the common definition of problem solving as defined in Hobden’s (2002, p. 3) words:

what we do when we do not know what to do to a multi faceted cognitive activity in which we engage when we are confronted with a task in which routine action or normal thinking does not allow one to go from the given existing situation to the desired goal situation, but rather there is a recourse to some form of critical thinking.

Hobden (2002) further provides educators and researchers with the criteria in terms of which they are assisted in the process of tracing the original meaning of problem solving and to provide the framework for development of instructional problems, which promote critical thinking within the context of science. These criteria are, first, the goal, second, the context, and third, critical thinking. This implies that a person is involved in problem solving if the solver overcomes the barrier through critical thinking and finds the solution of a non-routine task. It is this intentional thinking, hopefully within a context , that Hobden (2002) tries to allude to when arguing for the redefinition of the meaning of problem solving.

Similar to Hobden (2002), Watts (1994) emphasizes that if the problem solver does not experience a barrier when solving a problem, then that is not a ‘problem’, and an easy problem cannot be regarded as a ‘problem’. The particular problem, furthermore, can have different barriers to the solution. Watts (1994) highlights three barriers experienced by problem solvers as they try to find solutions for a particular problem; namely: psychological hurdles, such as “the need for perseverance and concentration; a positive mood and attitude towards completion and success; motivation and a sense of competition; co-operative and social skills and coping with anxiety and insecurity” (Watts, 1994, p. 13). The second barrier is the challenge to knowledge and understanding, such as “the capacity to recognize and conceptualize the problem; appropriate or

unrelated frameworks of prior knowledge; accurate or flawed perception of the context of the problem; too little (or sometimes too much) information surrounding the problem; the level of complexity or abstraction of the problem; an appreciation of the models , analogies, metaphors, and their respective limits within the problem; the level of symbolic representation involved and the level of creativity required” (Watts, 1994, p. 13). The third barrier is the need for skills such as “methodological approaches to experimentation; graphical skills; numeric and calculative; manipulative; information processing and linguistic/semantic” (Watts, 1994, p. 13).

In this regard, Watts (1994) argues that if problem solving is the core skill required within the National Curriculum, then the way in which learning, knowledge and understanding are organised need to be critically analysed. This critical look at the organization of learning, knowledge and understanding implies that problem solving involves actionable knowledge; the interaction between thinking and actionable knowledge allows problem solving to be practical. According to Watts (1994), it is this practical use of knowledge that provides relevance that goes beyond abstraction or concrete tinkering. This means that problem solving not only focuses on the transfer of knowledge, but also extends into the affective domain because it motivates, provides enjoyment, and stimulates interests and creativity. It is in this respect that the decision-making process is put into the hands of the problem solver (Watts, 1994). As Watts (1994) rightly argues, when both cognitive and affective domains are infused into problem-solving activities, self-confidence and personal satisfaction are enhanced.

2.1.2 THE IMPORTANCE OF CONTEXT IN PROBLEM SOLVING

The 2001 draft Chemistry and Physics syllabuses in Australia define context as “the group of related situations, phenomena, technological applications and social issues”

(Beasley & Butler, 2006, p.2). This definition is important to science educators because it shows ways in which context is defined in Chemistry and Physics. According to Beasley and Butler (2006), the term context could cover a wide range of examples, such as drugs, medicine, the air we breathe, fertilizers and pesticides, choosing the right material, forensic chemistry, the health of our rivers, the manufacture and analysis of beer, wine and spirits, the sugarcane industry, marine chemistry and metals and mining. These examples were adopted by Queensland educators and used as the starting point for designing the units of Chemistry and Physics work at school.

According to Beasley and Butler (2006), a context-based approach requires educators to accept the notion of a context as the starting point for their learners' learning of science. When educators design the curriculum, they are required to use different approaches in the process of selecting the content, teaching strategy and assessment instruments in order to make science more meaningful and enjoyable to learners. Designing the curriculum like this places physics or chemistry in the social context of the learners, cultivates scientific inquiry and decision-making skills. This enables learners to use chemistry or physics to understand socio-technological problems and demonstrate the inter-relationship between the sciences (Beasley & Butler, 2006).

Finkelstein's (2000) paper on the 'context', in the context of Physics and learning, was written as a response to the development of contextual learning. In his paper, Finkelstein (2000) argues for a contextual constructivism model of learners learning, where context is central to learners learning. According to Finkelstein (2000), context shapes learning, learners, and other educational participants where educational activities occur by promoting construction of content understanding and conceptual change. Learners create an understanding of the content in context and the context mediates learners understanding of content. For Finkelstein (2000), context is the local environment, which is expected to support the development of conceptual understanding and the ability to

transfer such understanding to new and relevant situations. Finkelstein (2000) highlights three levels of context: the context of a particular problem, the situation in which the problem takes place and the broader setting that creates the circumstances for the situation. Finkelstein (2000) calls these levels the task formation, situation and idioculture. According to Finkelstein (2000), the presentation of task is an example of task formation, and when learners work together, this is an example of situation and such situations are a part of a larger context, which is an example of the idioculture.

Gaoseb, Kasanda and Luben (2002) conducted a study on the use of everyday context by Mathematics and Science educators in 14 Mathematics and 29 Science lessons in Namibian secondary schools. The aim of Gaoseb *et al.* (2002), was to examine and compare the use of everyday contexts by Mathematics and Science educators. In their study, the participants were the teachers of the final year of the Mathematics and Science Teachers Extension Project (MASTEP) in-service training programme.

The study addressed three research questions: to what extent do mathematics and a science educator use learner's everyday experiences? What type of everyday context do these researchers use and what are the intended pedagogical purposes for teaching these subjects? How does the use of an everyday context differ from mathematics and science teaching? The findings of the study show that science educators use out-of-school experiences more than mathematics educators do in junior secondary than at senior secondary schools. The educators initiate context more than learners in science, but not in mathematics. The out-of-school context depends on the topic being taught. However, more common experience context, such as household appliances, are being referred to in science than in mathematics. Context, referring to everyday objects and words, are used frequently in mathematics lessons. The learner's environment determines the common and uncommon everyday experiences, and context is used as a secondary strategy. Furthermore, it was observed that context is introduced when the non-contextual strategy

is failing, and is used for classroom control, motivating lesson introduction and practicing a skill. Interestingly, everyday context is used for asking questions more in science than in mathematics.

According to Watts (1994), problem solving is identified as the core skill within the National Curriculum, irrespective of content and context. Problem solving thus motivates and provides enjoyment, stimulates interest, creativity and learning (Watts, 1994). This is because problem solving occurs in the form of knowledge in almost every field of life and human enquiry. There is evidence in the science education research, for example, that context is important for problem-solving abilities across subjects, and it ranges from industrial applications, environmental studies information technology and alternative technology (Watts, 1994).

Harrison (1994) highlights the following key advantages of introducing industrial context into the science and technology curriculum:

- An industrial context provides a huge range of real and relevant context for learning about science and technology and increases motivation;
- It provides opportunities for the introduction of cross curriculum aspects and mutual support structures and strategies for placements, visits, visitors, curriculum development, training courses, and careers work;
- It promotes partnership between education and business and;
- Learners gain understanding and appreciate the role of science and technology in their lives and that science principles are not separated from social, economic and environmental aspects.

These advantages indicate clearly that context is important in problem solving and that problem solving within industry assists learners to value their own problem- solving capabilities (Harrison, 1994). It is therefore the duty of the curriculum developers to

create problem-solving experiences for learners. According to (Harrison, 1994) this does not consume more time of the curriculum, but focuses on knowledge and understanding of the specific topic. This is the reason the context covers a wide range of situations found in the learners' environment, and this encourages the situation where the curriculum designers are expected to consider the social context of the learners when designing the curriculum and the educators to select the relevant context as the starting point of the lesson. The relevant learners' context supports development of conceptual understanding, shapes learning, mediates learners' understanding, motivates learners and is important for problem solving. All this implies the importance of context during teaching and learning.

2.1.3. THE WORK DONE ON PROBLEM SOLVING AND CONTEXT-BASED APPROACH

I now wish to turn to the work done on a context-based approach and problem solving in different countries. Such countries include Botswana, China, Namibia, South Africa, Swaziland, the United Kingdom and the United States. The theme for this section is problem solving and the context-based approach.

2.1.3.1. PROBLEM SOLVING

Chacko (2004) conducted a study on solutions of real-world and standard problems by primary and secondary schools learners in Zimbabwe. The findings of the study indicate that learners solve real-world problems as if they were solving standard problems. This is irrespective of educational level. They expect the solution to have one answer. Learners do not bring outside world knowledge in solving classroom problems and

perform better in standard solutions than in real-world problems, both at primary and secondary schools. This is despite the fact that teaching needs to include the application of concepts in real-life contexts and educators encourage learners to create and solve real-life problems, identify and correct the mistakes. Educators should incorporate continuous assessment in teaching that will allow educators to use project work and open ended questions to promote thinking and exploration. It is such conditions that enable learners to develop meaningful learning and take ownership of their learning (Chacko, 2004). Braun, Gaiger and Rogan (2006), on the other hand, conducted a study in 16 urban high schools with 189 learners. Their purpose was to investigate the effects of a structured problem solving on performance and conceptual understanding. The findings of the study conclude that problem-solving strategies develop problem- solving skills and conceptual development. Problem-solving skills link a particular concrete situation with appropriate physics principles.

Kaino (2003), furthermore, conducted a study on Mathematical problem-solving teaching in Botswanan Junior Secondary schools. The aim of the study was to analyze some mathematics teachers' views on problem-solving teaching and learners' performance in mathematical problem solving at Junior Secondary school level in Botswana. The study required some views from mathematics educators on problem- solving content and learner attitude towards problem-solving activities, learner problem-solving assessment, the importance of problem solving and learners' attitude towards problem-solving activities. The study concluded that educators experience difficulties with preparing lessons designed to develop learners' problem-solving skills because these skills are difficult. One of the findings indicates that problem- solving content is limited and these teachers need other sources of information. This is a setback because problem solving is important for the development of mathematical thinking, application of knowledge and making learning more interesting and realistic. It was easy to assess learners' problem-solving activities. Almost all learners in both schools were unable to make general formulations of the solution.

Hobden's (1998) work on the role of routine problem tasks in science teaching, is a response to the curriculum of most developing countries arguing that it is controlled by the syllabus and accompanied by a regimented examination system. As a result, science educators prepare a set of routine problem tasks to be done by learners from the beginning of the year until learners write the examination. This results in uncritical teaching strategies. Hobden (1998) discusses the reasons why educators use routine problems during teaching and learning, looking at the beliefs that underpin the use of routine problems and the influences of the existing system of education. He further discusses the context in which the problems are used by looking at the classroom tasks, didactical contract or the place of problem tasks in the classroom and learners' expectations of problems. It is interesting to note that he also highlights the effectiveness of using routine problems as an assessment tool by looking at the base of knowledge construction, development of problem-solving skills and learners' attitude to science. His work suggests ways that can be adopted to transform traditional practice by looking at the strategies that transform traditional tasks and the use of relevant problem contexts.

Hobden (1998) concludes that there is evidence that the use of routine problem tasks is ineffective in achieving our objectives of teaching and learning, developing conceptual understanding, problem-solving skills and a positive attitude towards science. According to Hobden (1998), educators need to commit themselves to transformation. He also highlights the following components of transformation: the need to change instructional practice to focus on the meaning of school science not to accept traditional practice; the creation of different experiences and new learning environments that create positive attitudes to science; to challenge the methods used during the teaching and learning of science by changing from quantitative methods to qualitative understanding; the redefinition of the meaning of achievement and to change from assessment, using tests full of routine tasks, to assessment that is designed to promote valuable thinking.

The study conducted by Kriek and Grayson (2003) on the influence of problem-solving strategies and cooperative learning on teacher's ability to solve the physics problems, has its own influences in the subject of my study. This study is in fact responding to the fact that problem solving is regarded as important for any physics course. If learners are experiencing difficulties in solving physics problems, what about the educators? The aim of the study was thus to find out if problem-solving strategies, learnt through cooperative learning approaches, would have an effect on teachers' and learners' ability to solve physics problems. The educators were given pre and post tests on work-energy problems and introduced to cooperative learning as compared to group work. The findings of the study indicate that a problem-solving strategy, through a cooperative learning approach, improves teachers' ability to solve physics problems. These findings further imply that, during teaching and learning, educators should encourage learners to apply the concepts in real-life situations by solving real-life problems. Solving problems in context assists learners to develop problem-solving skills and conceptual development. The next section discusses the literature on context-based approaches to teaching and learning.

2.1.3.2. A CONTEXT-BASED APPROACH TO SCIENCE TEACHING AND LEARNING

Whitelegg and Parry (1999, p.68) define context-based learning as "the social and cultural environment in which students, teachers and institutions are situated". According to Whitelegg and Parry (1999), in order for meaningful classroom discussion to take place, learners need real-life resources, the use of context by both educators and learners, and the educators to select relevant context. Under these circumstances, the context increases social awareness. This learning in context requires that educators and learners relate learning to a real-world application. Research in context-based learning indicates that relevant context increases learner's interest, self-esteem and prestige.

Whitelegg and Parry (1999), for instance, further presented a paper on real-life context for learning physics, meanings, issues and practice. This paper is responding to the introduction of context to the physics curriculum. The aim of the paper is to examine the issue of learning physics content through real-life contexts and the meaning of context-based learning in the UK and Australia. They are focusing on the context of energy.

Dlamini, Dlamini and Helly (2003), furthermore, conducted a study that focused on teaching science, using contextualized versus non-contextualized activities, with primary and secondary school learners. They were responding to concerns by the Swaziland education system about the relevance of the science school curriculum. The relevant curricula are developed and known as contextualized curriculum. This curriculum is seen as relevant to the learners because learners become aware of and form links between the science in their lives and the science they do in the classroom. Learners' problem-solving skills improve through this contextualized curriculum. The aim of this study was to investigate ways in which learners view the contextualization of activities in Swaziland primary and secondary schools. The study addressed two research questions: How do students view contextualization and what differences exist between the views of primary and secondary school learners? The findings of the study conclude that learners prefer non-contextualized activities at both primary and secondary schools. This study indicates further that learners prefer non-contextualized activities more than contextual activities. Non-contextualized activities that have one right answer do not promote problem solving and critical thinking, but contextual activities promote problem solving (Dlamini, Dlamini and Helly (2003).

Malcolm and Stears (2003) conducted a study on the usage of everyday knowledge in the science classroom as part of the process of evaluating the Western Cape Primary Science Project. The aim of the study was to determine ways in which educators and learners from the townships and informal settlements in the Cape Flats area of Cape Town

introduce the use of everyday knowledge into the science classroom and how they shift between formal science and everyday knowledge during teaching and learning. The study was guided by the following research questions: “What experience, interest and knowledge do learners in the Cape flats have that might be used as a basis for science learning, and to which school science might contribute? How do educators and learners use learners’ everyday knowledge in science classrooms? How do educators and learners make transitions between the domains of everyday knowledge and formal science knowledge? How does lesson content influence the level of engagement between learners and between learners and educators? The findings of the study indicate that although learners have different experiences, they have the same interest on everyday knowledge. Educators do attempt to plan activities that link to learner’s everyday experiences and both learners and educators make the transition between informal everyday knowledge and formal school science easily. The use of everyday knowledge increases the level of learner’s engagement with the science classroom.

In terms of Bennett and Lubben (2006), context-based approaches to the teaching of sciences started in the early 1980s and context was used as the starting point for the development of scientific understanding in the twentieth century up until now. The scientific ideas are introduced on a “need to know” basis in a context-based approach to assist in explaining and understanding the context used. The context-based approach is called the Salter’s approach because the development of chemistry teaching materials by Salter’s Institute for Industrial Chemistry, which included context-based learning, was successful. The Salter’s story also started during the past two decades and is still ongoing, being used by a group of science educators who met at York to discuss ways of making science attractive to learners at school. The educators at that meeting decided to develop five context-based chemistry units for junior-secondary schools and it was named Salter’s courses. Now, after twenty years, the Salter’s course covers Biology, Chemistry and Physics for high schools in England and Wales. Other countries, like Belgium, China (Hong Kong), New Zealand, Russia, Scotland, Slovenia, Spain, Swaziland and the USA have adapted many courses.

The study was conducted on educator experience on teaching Salter's Advance Chemistry as compared to more conventional courses. The data was collected by questionnaires from 222 educators. The findings from the educators' responses may be summarised as follows:

- Educators reported that they are motivated to teach Salter's Advance Chemistry course;
- They find teaching this course demanding. Educators did not have any concern about learner's scientific understanding of concepts;
- Educators experiences were influenced by the in-service support provided to the course and this support build their confidence and the success of the course and;
- Learners were interested in chemistry and they were willing to learn chemistry at University level. Learners engaged independently in the study and took responsibility for their own learning.

Yam (2000) also gives an overview of the idea of a contextual approach, or Salter's approach to teaching and learning in the UK and US, responding to the changes in the science curriculum by governments in these countries. Learners are motivated to study science, if science is learned in context. In the UK, context-based learning is defined as "putting real-world contentious or controversial issues, often social issues, to discuss" (Yam, 2000, p. 3). In the US, contextual teaching and learning is defined as "a conception of teaching and learning that helps teachers relate subject matter content to real-world situations and motivates students to make connections between knowledge and its applications to their lives as family members , citizens, students and workers" (Yam, 2000, p. 4). A context-based approach thus encourages learners to make connections between learning and the real world. Contextual teaching and learning strategies, furthermore, put the emphasis on problem solving, recognizing the importance of context

for teaching and learning, applying authentic assessment, allowing learners to be responsible for their own learning and direct learning, encouraging learners to learn from each other during group discussions and attaching teaching in learners learning in different life contexts (Shiu-sing & Yam 2000). Yam (2000) defines context as something outside of the classroom environment, like something from the family, society and the workplace. Authentic assessment allows learners to assess themselves to monitor, regulate and direct their own learning (Yam, 2000).

Shiu-sing (2000) shares some of the reflections and experiences gained during the course production, some ideas on the development of physics education, and to introduce essential ideas of contextual teaching and learning of physics in Hong-Kong. Shiu-sing (2000) participated in the secondary school physics curriculum reform and worked in the production of physics contextual teaching and learning trial materials for the Science Education Section of the Education Manpower Bureau. Most of the ideas of Shiu-sing are similar to Yam's ideas.

Few studies are conducted on learners' understanding of scientific ideas, but most of the studies on Salter's Advanced Chemistry focus on learners' understanding of chemical ideas. The findings from the learners indicated that their choices for doing chemistry were different. The learners doing a conventional course chose to do chemistry for the career more than from interest, and the learners' interest in chemistry dropped throughout the course. The learners from Salter's Advanced Chemistry course chose to do chemistry from interest more than for the career, but their interest increased as they continued with the course and they studied chemistry- related courses at the university. The research indicates that a context-based approach is more effective than a conventional approach and it produces better results in learners' understanding. Educators play an important role in planning, designing and curriculum development because they overlap between the aspirations of developers and what is happening in the classroom. The educators are

aware of the context of interest to their students and they are important in selecting context as the starting point of learning (Bennett, & Lubben, 2006). When designing a context-based approach, we should consider context as the content, as the learning stimulation and as the frame for situated development and application of knowledge and competencies (Gilbert, 2006).

Belt, Leisvik, Hyde and Overton, (2005) presented a paper on using a context-based approach to undergraduate chemistry teaching. The aim of the paper is to describe the rationale for the context-based approach that is used for teaching of undergraduate physical chemistry in the UK, using the context of the next generation of energy in Los Verde in the south-west region of the USA, called the Capital City case study. They were responding to employers, educators, funding bodies, QAA Subject Benchmarking and Programme Specific template that emphasize that the university courses must develop transferable skills and subject specifics. The findings of the Capital City case study suggest that learners welcomed learning chemistry within the applied context. Learners mentioned that learning in context develops subject knowledge and increases confidence in approaching problem solving in the future. This paper indicates that a context-based approach develops subject knowledge and problem solving.

Beasley and Butler (2006) presented a paper on the implementation of context-based science within the freedoms offered by Queensland schooling. The aim of the paper is to analyze the challenges facing educators and learners in Queensland schools on implementation of context-based science and reports on their experiences and expectations after six months of a two-year trial period. The findings regarding the challenges facing educators and learners to act differently are substantial and need time for sustained professional development opportunity.

Rayner (2005) presented a paper on reflections on context-based science teaching. The aim is to report on an ongoing project to contextualize a first-year physics course for physiotherapy learners, and experience in implementing changes and outcomes for both learners and educators. Rayner (2005) finds that implementing contextual physics is time consuming, challenging and successful for physiotherapy learners. The context-based approach demands the educators to choose carefully the context that interest learners to apply ideas to everyday life and to generalize. Young (2000), a lecturer, gives the personal views and thoughts not informed by theory or research on the contextual approach to the teaching of physics. Young (2000), responding to a request made by Dr Tong Shiu-sing and Dr Wong Wing-hung, to say a few words on the contextual approach to the teaching of physics, suggests that context is the point of entry of the learning process, a tool, not a goal, specific, subjective and distinctive, while science is general. Actual experience must be used in the contextual approach. For the contextual approach to be successful educators must lead in designing and planning the content and examples and teaching should not be planned by central authorities. This implies that in a context-based approach, context is used as the starting point of the lesson by the educators and the context is important for learners to understand the content.

Jafta (2006) conducted a participatory study on project-based learning as mediated in a teaching unit of electricity for Grade 8 learners. The aim of the study is to explore how a group of Grade 8 learners, at a specific school, negotiate their identity in a science classroom in order to gain access to meaningful learning in science through project work. The educator chose the topic of electricity in response to a call by the local community ward councillor regarding problems with electricity consumption and supply. Data was collected by using the following instruments, the questionnaires, probe, video recorded instruction sessions, semi-structured interviews, clinical interview and reflective diaries. Jafta (2006) argues that learning context is failing the learners because there are less opportunities created for learners to negotiate their identities within the context of learning science. Jafta (2006) mentioned: "it is believed that learners can shape their own identities when given an opportunity to participate in a social learning situation centered

on a community rich framework” (p. 11). In a learning situation, educators act as a mediator; Jafta (2006) defined a mediator as “a more knowledgeable adult or peer who acts as an external agent in assisting the learner mediates his or her own learning” (p. 20). The role of the educator as the mediator of learning is “to understand and look out for ways in which the learner approaches problem solving in order to promote learning” (Jafta, 2006, p. 28).

During the process of mediation, learners engage in learning, give meaning through individual learning and co-operative learning and the educator assists the learner as the mediator (Jafta, 2006). The mediated learning experience used by Jafta (2006) was proposed and developed by Feuerstein (2001) for learner’s learning. In this mediated learning, learners interact with the more knowledgeable adult or peer to strengthen their understanding and experience in a two-way rich communicative setting. Jafta (2006) highlighted five characteristics of mediated learning experience, namely intentionality, reciprocity, meaning being made explicit, transcendence being made transparent and development of affective attributes. In intentionality, the educator acts in “a way that the learner approaches problem begins by understanding and assisting him or her to understand how to process the information” (Jafta, 2006, p.28). In reciprocity, the learner and the educator are on the same level of understanding. In meaning being made explicit, the educators role is “to interpret for the learners the significance of what he or she has accomplished in the mediational situation, and helps the learner to reflect on the solution, how it was obtained, and in making generalizations which flow from the solution and process of learning” (Jafta, 2006 p.29). In transcendence being made transparent, the educator assists the learners to link the new experience to their own experience. The development of affective attributes “deals with the feelings, emotions and attitudes which have an impact on learning” (Jafta, 2006 p.31). These characteristics are important to the manner in which the two-way rich communicating takes place during teaching and learning (Jafta, 2006).

Mediation involves participation and there is no learning without participation. Participation is important for negotiating meaning in the social setting of the learners (Jafta, 2006). In the project-based learning used by Jafta (2006), learners are provided with the opportunity to work with other learners, educators and parents as participants and are given the opportunity to learn how knowledge is negotiated. The participants chose the topic 'electricity in our homes and school' that would empower them and the local community. Jafta (2006) concludes that "project-based learning optimizes mediation" (Jafta, 2006, p.146), and that project-based learning and mediated learning experience require practitioners to shift from a traditional mode to a participatory mode of teaching and learning. Meaningful learning is based on co-construction of meaning, learners' needs and interests, promoting learners participation and giving power to the learners. This implies that for effective teaching and learning to occur learners are expected to participate and negotiate meaning in their context during teaching and learning. Educators are mediators of learning that promote the learners' participation and problem solving during teaching and learning.

2.2. CONCLUSION

This chapter indicates clearly the way in which literature centralizes context in the teaching and learning of science. The following themes emerge from the review of this literature. These include the fact that learners' everyday experiences / contexts for teaching and learning of sciences are important, that the contextualized activities in promoting problem solving play an important role in the teaching of science, that there are identifiable challenges of the context-based approach for both educators and learners, and that problem solving is important for the conceptual development, the development of thinking, application of knowledge and making learning interesting and realistic. The following chapter will present the theoretical framework of this study.

CHAPTER 3

THEORETICAL FRAMEWORK

3.1. INTRODUCTION

This study, as already mentioned, seeks to understand the teaching of Natural Sciences using a context-based, problem-solving approach. According to Harrison (1994), it is the responsibility of the curriculum developers to create problem-solving experiences that focus on knowledge and understanding of the specific topic for learners. Harrison (1994) further argues that it is the duty of the curriculum developers to consider the social context of the learners when designing the curriculum. The responsibility of the educator is seen by Harrison (1994) to be one of selecting the relevant context as the starting point of the lesson. This is the reason this study explores how an educator involves learners' contexts during teaching and learning of science. The focus was born out of the literature selected in this study, which discussed the centrality of context in the teaching and learning of science. Learners' everyday experiences or contexts were argued to be critical in mediating meaningful learning in science.

The literature reviewed pointed out that the term 'context' is looked at differently by different scholars when arguing for teaching and learning of science using the learners' context. Beasley and Butler (2006) define the term 'context' as a group of community related issues. By community related issues they refer to contexts such as drugs, medicine, the air we breathe, fertilizers and pesticides, choosing the right material, forensic chemistry, the health of our rivers, the manufacture and analysis of beer, wine

and spirits, the sugar cane industry, marine chemistry, and metals and mining. Finkelstein (2000) looks at context as the local environment that supports the development of both conceptual understanding and the ability to transfer such understanding to new and relevant situations. Yam (2000) looks at context as family, society and workplace. Jafta (2006) looks at the notion of context as the cause of failure and argues that it allows learners to negotiate their identities within the context of learning science.

Finkelstein (2000) argues that the use of the local environment mediates and gives structure to learning, learners, and other educational participants where educational activities occur. He further states that the use of the local environment promotes the construction of content understanding and conceptual change (Finkelstein, 2000). An everyday context is used for classroom control, introducing and practicing a skill for motivation, for asking questions in science more than in mathematics, and when a non-contextual strategy is failing. (Gaoseb, Kasanda & Luben, 2002). Solving problems in context assists learners to develop problem-solving skills and conceptual development (Kriek & Grayson, 2003).

The different understanding of the term 'context' by educators assists them to look at the context in different ways and use the learner's context in the learning of science. Some educators consider and use the learner's context in the learning of science because they recognize that context is important in the teaching and learning of science. In this study, the educator is using the learners' environment during the teaching of Matter and Materials in Grade 8. This means that learning in context requires educators and learners to relate learning to the real world, and this relationship leads to an increase in learners' interest, self-esteem and prestige (Whitelegg & Parry, 1999). The use of context is of great interest for this study as it focuses on learning in science, because the activity theory proposes a particular notion of context that is that "activity itself is the context" (Nardi, 1996, p. 76). Actions are always located in a context and it is impossible to

understand actions without the context (Kuutti, 1996). An activity is the “minimal meaningful context for understanding individual actions” ((Kuutti, 1996, p. 28). It is along this line of thinking that different understandings of the term ‘context’ and the use of context in teaching and learning have started an interesting debate. Against this background, the following questions come to the fore:

- How does context mediate learning?
- How does context promote content understanding, conceptual change and problem-solving skills?

3.2. OBJECTIVES OF THIS CHAPTER

This chapter seeks to explore the debate around the mediation of learning, using the learners’ context. The activity theory is used as the theoretical framework for this study that will seek to answer the following question: *How does the context mediate and shape learning in science?* In other words, I explore how the activity theory could help us in understanding the role that context plays in the learning of science. The objective of the study is to explore a Grade 8 Natural Sciences educator’s understanding of the curriculum needs in involving the learners in ‘real-world’ problem-solving experiences.

3.3. ACTIVITY THEORY

The cultural-historical theory of activity first started in the 1920s and 1930s in the cultural-historical school of psychology in Russia by a group of revolutionary Russian psychologists. Vygotsky was concerned about the 1920s psychology that was dominated by psychoanalysis and behaviourism. Vygotsky and his colleagues, Luria and Leont’ev,

proposed a new theoretical framework to overcome their concerns. The new theoretical framework was meant to go beyond psychoanalysis and behaviourism. Their framework was called artifact-mediated and object-oriented action. Artifact-mediated and object-oriented action means that human activities cannot interact directly with the environment, but are always mediated by cultural means, tools and signs (Vygotsky, 1978). This leads to the idea of cultural mediation of action, articulated as the triad of subject, object and mediated artifact. This is the first generation of activity theory, which focused on individual actions (Engeström, 2001).

This individual focus inspired Leont'ev to formulate the second generation of the activity theory, which distinguished between individual actions and collective actions (Engeström, 2001). Leont'ev formulated a three level model of activity that clarified the difference between activity, action and operations (Leont'ev, 1981). The uppermost level is determined by object-related motive, the middle level is determined by conscious goal and conditions and tools of the action at hand determine the bottom level (Leont'ev, 1981).

The first and second generation of activity theory was characterised by a discourse of vertical development towards higher psychological functions only, but the issue of cultural diversity was ignored. Cole (1993) addressed the issue of cultural diversity by clarifying the insensitivity towards cultural diversity. When the activity theory expanded internationally, the question of diversity and traditions between different perspectives was challenged (Engeström, 2001). These concerns led to the development of the third generation of activity theory, which includes the two interacting activity systems (Engeström, 2001). The third generation of activity theory must deal with these concerns by the international community.

The third generation of activity theory had to develop conceptual tools to understand dialogue, multiple perspectives and networks of interacting activity systems (Engeström, 2001). The developments of the third generation of activity theory led to a new approach called expansive learning, and this included two interacting activity systems. In expansive learning, the object is the whole activity system in which learners are involved. The new cultural patterns are produced by the expansive learning activity, as shown in Figure 1.

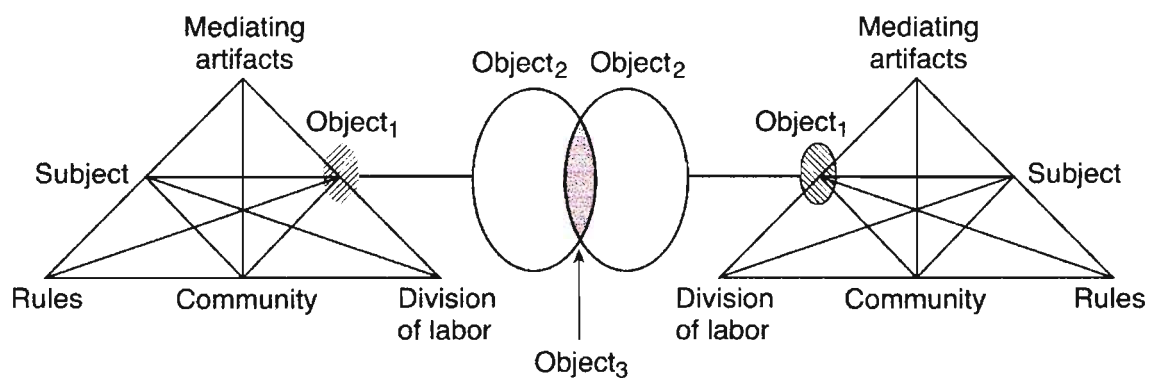


Figure1: Two interactive activity systems as the minimal model for the third generation of activity theory (Engeström, 2001, p. 136).

Engeström (2001) highlighted five principles of the third generation of activity theory:

- “ A collective, artifact-mediated and object-oriented activity system;
- The multi-voicedness of activity systems;
- Historicity;
- The central role of contradictions as a source of change and development and;
- The possibility of expansive transformations in activity systems” (Engeström, 2001, pp. 136-137).

In a collective activity system as the unit of analysis, for activity theory, activity systems are contexts and contexts are containers or situational created experiential spaces

(Engeström, 1993). According to Engeström (2001), the activity system is the unit of analysis or a collective artifact-mediated and object-oriented activity system, and activity systems generate actions and operations. Actions are always located in a context and it is impossible to understand actions without the context (Kuutti, 1996). A meaningful context for individual actions must be incorporated in the basic unit of analysis, and is the activity (Kuutti 1996; Nardi, 1996).

Activity theory proposes a particular notion of context that is that “activity itself is the context” (Nardi, 1996, p. 76). What is taking place in the activity system is composed of object, actions and operations in the context. This implies that the internal and the external aspects of context are not separated but are infused together. An activity is the “minimal meaningful context for understanding individual actions” (Kuutti, 1996, p. 28). An individual can participate in many activities at the same time. In activity theory, participating in different activities creates consciousness and shapes personality (Kuutti 1996).

In the multi-voicedness of activity, the activity must be analysed at different levels because the community is made up of different points of views, traditions and interests (Engeström, 2001). An activity system always has the historical modes (Engeström, 1996). Historicity of activity systems takes shape and the changes in thinking occur in the social plane over a lengthy period of time (Engeström, 2001). This is called the historic mode (Engeström, 1996). The historical types are humanized activities, craft activity, rationalized activity and collectively and expansively mastered activity. These activities are characterized by a degree of complexity and of centralization. Humanized activity has increasing complexity and decreasing centralization. Craft activity has low complexity and growing centralization. Rationalized activity has increasing complexity and high centralization. Collectively and expansively mastered activity has high complexity and low centralization.

Activity systems are characterised by inner contradictions as the driving forces of change and development. Contradictions also generate disturbances, conflicts and innovative attempts of change of the activity (Engeström, 2001). Engeström (1987) highlighted primary, secondary and tertiary contradictions. Primary contradictions are contradictions between exchange and use values at each corner. Contradictions between corners are tertiary contradictions. The cultural, more advanced form of the central activities are tertiary contradictions. There are more advanced forms of central activities known as object activities, instrument-producing activities, subject-producing activities and rule producing activities. These activities are categorized as expansive learning through education, the total curriculum, learner historicity, multi-voicedness and policy (Engeström, 1987).

Expansive cycles are regarded as the possible form of transformation in activity system. The zone of proximal development of the activity may be used to understand the full cycle expansive transformation (Engeström, 2001). Engeström (1999, 2001) describes an ideal-typical sequence of learning action and corresponding contradictions in the expansive learning cycle as:

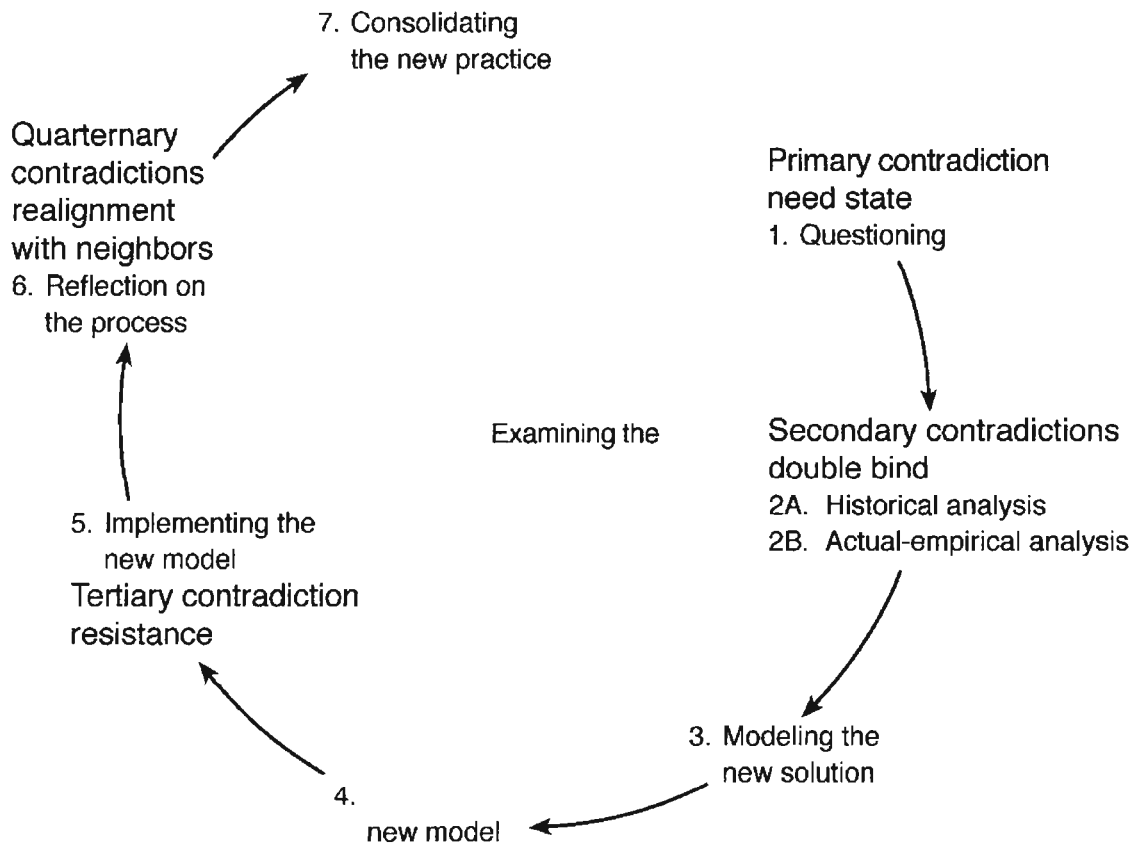


Figure 2. Strategic learning actions and corresponding contradictions in the cycle of expansive learning (Engeström, 2001, p. 152).

- Questioning (Primary contradiction need state);
- Analysis of the situation (Secondary contradiction double bind);
- Modelling the new solution;
- Examining the new model;
- Implementing the model (Tertiary contradiction resistance);
- Reflecting and evaluating the process (Quaternary contradictions realignment with neighbours) and;
- Consolidating the new practice.

This cycle of expansive learning is important for learning organisations that struggle to employ new practices. According to Engeström (1987, 1999, 2001), expansive learning is used for the creation of a learning environment and learning resources. Expansive learning is generated by a double blind caused by contradictory demands on the

participants forced by the context (Engeström, 2001). In order to examine activity theory and its notion of expansive learning, the following questions are used:

1. Who are the subjects of learning and how are they defined and located?
 2. Why do they learn and what makes them make an effort?
 3. What do they learn and what are the key contents and outcomes of learning?
 4. How do they learn and what are the key actions or processes of learning?
- (Engeström, 2001, p. 133).

According to Engeström (2001), the principles and the questions above are used to draw the matrix. The matrix served as the framework to summarise answers provided by the expansive learning.

Table 1: Matrix for the analysis of expansive learning.

	Activity system analysis	Multi-unit of voicedness	Historicity	Contradictions	Expansive cycles
Who are the subjects of learning?					
Why do they learn?					
What do they learn?					
How do they learn?					

The above matrix was used in the study that was conducted in Finland's children's hospital. In this study, the above matrix will be used at the selected school on a particular educator who is using a hands-on approach and project-based learning. One matrix will be drawn for curriculum development, the teaching and learning and the assessment. This matrix will be used to guide the first level analysis. Activity theory principles will be used to guide the discussion of the second level of analysis. In this study, activity theory is used as a lens for describing the development of the curriculum by the educator, the structure of teaching and learning in context and the assessment of the learners when solving problems in context.

Engeström's (1996) human activity model refers to the subject as the individual or subgroup involved in an activity. He refers to object as the "raw material" or "problem space" that gives a specific direction to the activity. Object is transformed into outcomes with the assistance of mediating tools and signs. Community is formed by multiple individuals or subgroups who share the same general object. Division of labour refers to horizontal and horizontal division of tasks among the members of the community. Rules refer to the explicit and implicit regulations, norms and conventions that limit actions and interactions within the activity system.

In this study, the tools are the tools used by the educator and the whole class during the activity of teaching and learning; for example language use in curriculum development, during teaching and learning and assessment. The tools are also the tools used by the learners to produce their portfolio boards. The subjects are Grade 8B learners and the educator. The learners learn through active engagement in the activities in their context. The object is the content understanding and the conceptual understanding of scientific concept by the learners. The outcome is the presentation by the learners of their poster or portfolio boards to show their understanding of science. The rules are the class rules, the rules they follow during group discussions; rules such as one person is allowed to talk at

a time while the others listen, to allow time for all learners to talk, to listen to each other and reach consensus, to explain your idea to others and not to laugh at each other. The communities are the institutional context (Engeström, 1999b), the educator, learners in the classroom and parents at home. Division of effort or labour is the educator determining the pace and the sequence of activities. Learners are divided into groups by the educator. Learners work in groups where they share knowledge and skills and present the portfolio boards.

3.4. CONCLUSION

This study sought to understand how the educator mediates context-based learning. Activity theory was used as a lens and the conceptual framework for describing the development of the curriculum by the educator, the structure of teaching and learning in context, and the assessment of the learners when solving problems in context. The matrix would be designed to analyze the data at the second level. The following chapter focuses on the research methodology adopted in this study.

CHAPTER 4

METHODOLOGY

4.1. INTRODUCTION

The purpose of this chapter is to present the case study as the research methodology, the research design adopted in the study, as well as discuss issues of sampling, validity and ethical consideration. The research design presents the description of what was done, data collection plan and data analysis. This is a descriptive case study that aims to explore a Grade 8 Natural Sciences educator understands of the curriculum needs in involving learners in “real-world” problem-solving experiences. Cohen, Manion, & Morrison (2000) argue that a case study is not a methodology, but an approach to research that is predicated on in-depth case analysis. In this regard, it alludes to a phenomenon of some sort occurring in a bounded context (Miles and Huberman, 1994). Case study is an intensive holistic description and analysis of a single instance, phenomena or social unit. It is a end product (Merriam, 1998, Wolcot, 1992).

4.2. WHAT IS A CASE STUDY?

Case studies mainly focus on individuals and local situations or unique instances. They are single cases such as individual group roles, organizations, episodes, events, cultural groups, communities and any unit of social life organization (Cohen, *et al.*, 2000). The purpose of the case study is to refine theory, suggest complexities for further investigations and to establish the limits of a generalization (Stake, 1994). Furthermore, it is used to emphasize the understanding of the unity and wholeness of the particular case, delve deeper and in-depth exploration, examine subtleties and intricacies, explore processes and outcomes, investigate the context and setting of a situation and build a holistic understanding through the development of rapport and trust (Cohen *et al.*, 2000).

Case studies are also used for exploration in order to gain more information about the structure or the process (Sarantakos, 1998).

Case study research involves the studying of individual cases in their natural environment (Sarantakos, 1998). It is the study of instance in action (Adelman *et al.*, 1980). For Nisbet and Watts (1984), a case study is a specific instance that is frequently designed to illustrate a more general principle. It is a method used to study elements of the social aspect through a comprehensive description and analysis of a single situation. For some, it is an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between the phenomenon and context are not clearly evident and in which multiple sources of evidence are used (Yin, 1994 as cited by Sarantakos, 1998). The case study method was seen to be appropriate for this study because the study aims to explore one particular educator who involves learners' context when developing the curriculum, teaching and assessing their work. This study aims to describe, analyse and interpret the uniqueness of the individual situation through accessible accounts (Cohen *et al.*, 2000).

4.3. RESEARCH DESIGN

4.3.1. DESCRIPTION OF WHAT WAS DONE

In order to collect data relevant to this study, a semi-structured observation schedule, classroom observation, unstructured and semi-structured interviews were used. The semi-structured observation schedule was also used to observe the human setting of the school and interactional setting in the classroom. The classroom observation was done during the teaching and learning of Matter and Materials and assessment of learners' activities and presentation of portfolio boards by the learners. The interviews explored the individual educator's understanding and experiences of using the learner's context when developing the curriculum during teaching and learning and assessment of learner's activities and presentation of the portfolio boards.

Semi-structured interviews

The semi-structured interviews became the main research instrument for data collection, being conducted on day four before the lesson presentation. The semi-structured interview consisted of the following six research questions:

1. For how long have you been teaching Natural Sciences to Grade 8? What has the experience been like?
2. With the new curriculum in South Africa, do you think that it has brought about changes in the ways that teachers teach Natural Sciences? If yes, how so?
3. The philosophy underpinning the new curriculum points to educators having to teach in a different way (i.e. moving the focus away from being teacher-centred to being learner-centred; moving from context to content rather than from content to context in the teaching of Natural Sciences).
 - a. Do you think there is a need for educators to use different teaching approaches to meet the challenge of the new curriculum? (Probe further with the following questions :)
 - i. Which approaches do you prefer and use in your teaching of Natural Sciences?
 - ii. How do you apply these approaches during teaching and learning?
4. The new curriculum puts emphasis on problem solving as a core skill. What are your thoughts on this? (Probe further with the following questions :)
 - a. What is your experience of teaching problem solving in your context?
 - b. How do you involve the learners in problem solving during your lessons?
5. What kind of problem tasks have you used in your teaching of Natural Sciences?
6. Have you ever used real-world problems when teaching Natural Sciences? If so, how did you do it? (Probe further with the following questions:)

- a. Explore the philosophy that guided the instruction and application of real-world problems in science classrooms.
- b. What are the implications (for teaching, learning, assessment, resources etc.) of teaching Natural Sciences using real-world problems?

While questions one and two elicited data around issues relating to curriculum development, questions three, four, five and six yielded data that focussed on the teaching, learning and assessment of learners.

Unstructured interviews

The unstructured interviews consisted of post lesson interviews, which targeted curriculum development, teaching and learning and assessment. Post lesson interview questions were conducted after the lesson presentation on days 2, 4, 5 and 7, as shown below in Table 2. Portfolio presentations were done on day seven as shown below. No unstructured interviews were conducted after day one and day three because the educator was having another class coming in immediately after the lesson presentations.

Table 2: Post lesson unstructured interview questions.

DAYS GUIDING QUESTIONS

- Day 1** • No interviews were conducted.
- Day 2** • Did you achieve your outcomes for today?
 • What will you do tomorrow?
- Day 3** • No interviews were conducted.
- Day 4** • Did you achieve your outcomes for today's lesson?
 • What do you plan to do tomorrow?
 • When are the learners going to start with their posters?
- Day 5** What can you say about today's lesson? Did you achieve your outcome today?
- Day 7** • Did you achieve your outcome today?
 • However, do you feel students understood the concept of "Matter and Materials?"
 • How are you going to proceed from this point?
 • Why did you choose soil as the point or as something that you are going to use to teach matter and materials?
 • How are you going to assess them?
 • Do you collect the assessment sheets, which are with them?
 • Does this assessment contribute to their marks?
 • What do the learners use to make these colours on their portfolio boards?

Semi-structured observation schedule

The semi-structured observation schedule enabled the researcher to gather data on human, interactional and programme setting, resources and their organization, pedagogic styles, curricula and their organization during classroom observation. The physical setting involved the physical environment and its organization and the human setting involved the organization of people, the characteristics and make up of the groups or individuals being observed. The interactional setting involved formal, informal, planned, unplanned, verbal and non-verbal interactions that take place during observation (Cohen, *et al.*, 2000) (see appendix B2).

Member checking

The following member checking interview questions were asked for strengthening the credibility, validity and trustworthiness of the data:

1. What are the learners expected to do?
2. How does the structure of planning relate to NCS?
3. How the starting point is related to the activities that the learners had to engage with?

The data constitution plan is provided in the next section.

4.3.2. DATA CONSTITUTION PLAN

The plan below was used to constitute the data.

Table 3: Data constitution plan.

Date	Activity	Instrument
07-08-2006	Activity 1 Teaching, learning and assessment	Observation schedule Video recording
08-08-2006	Activity 2 Teaching, learning and assessment	Tape recording Observation schedule Classroom observation

		Video recording
		Interview schedule
10-08-2006	Activity 3	Tape recording
		Observation schedule
	Teaching, learning and assessment	Classroom observation
		Video recording
14-08-2006	Activity 4	Tape recording
		Observation schedule
	Teaching, learning and assessment	Classroom observation
		Video recording
		Interview schedule
15-08-2006	Activity 5	Tape recording
		Observation schedule
	Presentation of projects	Classroom observation
		Video recording
		Interview schedule
04-09-2006	Activity 7	Tape recording
		Observation schedule
	Discussions and finalizing the portfolio boards	Classroom observation
		Video recording
		Interview schedule
05-09-2006	Activity 8	Tape recording
		Observation schedule
	Presentation of portfolio boards and assessment	Classroom observation
		Video recording

Interview schedule

Tape recording

4.4. DATA ANALYSIS

The analysis of data to interrogate already gathered data was done at two levels. The first level of data analysis consisted of three stages, namely:

- Stage 1: Grouping of educator's responses according to the three components of the research question, i.e. curriculum development, teaching and learning as well as assessment.
- Stage 2: Generation of categories.
- Stage 3: Summation of categories- derivation of themes.

The second level of analysis consisted of one stage, that is the use of the theoretical framework to interrogate the themes that were derived in the first level of analysis.

4.4.1. THE FIRST LEVEL OF ANALYSIS

The analysis of the data in the first level was done in the following three stages:

Stage 1

The first stage involved grouping of the educator's responses from semi-structured, unstructured interviews and classroom observation, using three components of the research question, namely:

- i. Curriculum development.
- ii. Teaching and learning.
- iii. Assessment.

These components were used to interrogate the raw data of the semi-structured, unstructured interview and classroom observation. The inductive coding was used to code the educator’s responses of the semi-structured and unstructured interviews because the codes emerged from the data (see appendix B5, B6 and B7).

Stage 2

The second stage involved the generation of the categories from the grouped educator’s responses from semi-structured, unstructured interviews and classroom observation, using three components of the research question in the first stage (see appendices B8, B9 and B10).

Curriculum development component

The focus in this component was on 3 categories that explored curricula issues (see appendix B8).

Table 4: Categories for the curriculum development component

Components of Focus	Analysis
Research Question	
Curriculum development	
1. Curriculum changes	Curriculum changes are perceived by the educator to be at a theoretical level and not linked to day-to-day experiences of teachers on the ground.
2. Curriculum implementation	The new curriculum reduced the teachers to being curriculum implementers rather than developers.

- 3. Curriculum documents
The new curriculum provides educators with documents like the NCS and the RNCS, which are used by educators to develop the learners' workbooks and lesson plans (see appendix B8, C1 and C2).

Teaching and learning component

The focus in this component was on 6 categories which explored the learner-centred nature of teaching and its challenges to teaching and learning (see appendix B9).

Table 5: Categories for the teaching and learning component

Components of Focus	Analysis
Research Question	
Teaching and learning	<ul style="list-style-type: none"> 1. Teaching experience. The educators teaching experience of the new curriculum is transformative. The educator considers the learners' experience when teaching the new curriculum by using a hands-on approach and project-based learning. 2. Learners' pre-knowledge and interest. The educator takes the learners' pre-knowledge and interest into consideration during teaching and learning by asking them what interests them about a particular topic. 3. Learners' context. The learners learn from their environment and raise and solve real-world problems . 4. Knowledge construction and problem solving. Learners construct their own meaning of science, solve problems and as a result they learn more. 5. Educator as a mentor. The educator assists learners to discover things and solve problems in their context. 6. Time factor. Learners need more time to work together in group discussions, think, internalise and to construct their knowledge.

Assessment component

The focus in this component was on 2 categories which explored how the educator perceived the role of assessment in his teaching (see appendix B10).

Table 6: Categories for the assessment component

Components of Focus	Research Question	Analysis
Assessment	Assessment for learning.	Continuous assessment is part of learning and contributes to the learners' performance and grading.
	Assessment for monitoring.	The educator is using the assessment to monitor the learners' progress and this monitoring of learners performance is developmental.

Third stage

The third stage involved the derivation of the themes from the categories that were elicited in stage 2. With regard to the curriculum development component of the research question, the following themes came to the fore:

- Theme 1: Curriculum changes are at a theoretical level rather than classroom level.
- Theme 2: Educators are seen as curriculum implementers rather than developers.
- Theme 3: The transformative nature of the new Natural Sciences curriculum.
- Theme 4: The contextual nature of the Natural Sciences curriculum.

With regard to the teaching and learning component of the research question, the following themes came to the fore:

- Theme 1: Teaching within an OBE framework is transformative and the educator acts as a mediator.
- Theme 2: Contextual teaching involves construction of knowledge from learners pre-knowledge and interests.
- Theme 3: Problem solving needs more time but maximises non-routine thinking.

With regard to assessment component of the research question the following theme came to the fore:

- Theme 1: Assessment is for learning; it is continuous and it contributes towards assessment for grading (Summative assessment).

4.4.2. THE SECOND LEVEL OF ANALYSIS

Activity theory was used to interrogate the themes that were derived in the first level of analysis. The categories emerged in the first level of data analysis, the activity theory principles and questions were used to draw the matrix in the second level of data analysis. According to Engeström (2001), any learning theory must answer the following questions:

1. Who are the subjects of learning, how are they defined and located?
2. Why do they learn, what makes them make an effort?
3. What do they learn, what are the key contents and outcomes of learning and
4. How do they learn, what are the key actions or processes of learning? (Engeström, 2001, p. 133).

The questions above raised by Engeström concentrate on learning only. These questions were amended for the purpose of this study so that they involve all three components of the research question. The suggested amendments are based on the fact that in classroom practise one cannot separate curriculum development, teaching and learning and assessment. Below, I am elaborating on the amended questions based on Engeström, which focuses on learning.

For curriculum development the questions were:

- Who are the subjects of developing the curriculum?
- Who are the subjects that implement the curriculum?
- What is the nature of the new Natural Sciences curriculum?
- Why do they develop the curriculum?
- How do they develop the curriculum?

For teaching and learning the questions were:

- Who are the subjects of teaching and learning?
- Why do the learners learn?
- How do the learners learn?
- What do the learners learn?
- What is the role of the educator during teaching and learning?
- What is the role of the learners during teaching and learning?

For assessment the questions were:

- Who are the subjects of assessment? or, who conducts the assessment?
- How does the educator assess learners?

- What is the assessment done for?
- Why does the educator do the assessment?

These questions were used to draw the matrix tables in the second level of analysis of this study (see Tables 7, 8 and 9 below). In order to develop the matrix, we needed the following five Engeström principles of activity theory. According to Engeström (2001) there are five principles of activity theory:

1. A collective, artifact-mediated and object-oriented activity system,
2. The multi-voicedness of activity systems,
3. Historicity,
4. The central role of contradictions as a source of change and development and
5. The possibility of expansive transformations in activity systems (Engeström, 2001, pp. 136-137).

These principles of activity theory will be used together with the amended questions to draw a matrix for each component of the above-mentioned components of the research question, that is: curriculum development, teaching and learning and assessment. The questions and principles are taken from Engeström (2001). The data on the matrix came from semi-structured and unstructured interviews and classroom observation. The matrix is composed of questions on the left hand side and the headings for the columns are the principles of the activity theory. Each of the matrixes will be used to guide the discussion in Chapter Six.

Matrix for curriculum development

Table 7: Curriculum development matrix

	A collective, artifact-mediated and object-oriented activity system	Multi-voicedness	Historicity	Contradictions	Expansive cycles
Who are the subjects of curriculum development?	Departmental officials of outside the school level at a higher level. Educators at school level.	People from different backgrounds, traditions and interests formed the committee that reviewed the curriculum. They came with different voices.	The curriculum was developed and revised over a long period of time to develop documents.	The committee members developed the curriculum (primary contradiction). As they discuss in their groups they experienced contradictions (secondary contradictions). After the release of the NCS curriculum other contradictions arise (tertiary contradictions). All these contradictions resulted in the change of NCS to RNCS. In this RNCS there are still contradictions.	The committee considered the importance of expansive learning cycles. Educators developed the curriculum that involved the expansive cycles.
Who are the subjects that implement the curriculum?	Departmental officials that do not implement the curriculum. Educators implement the curriculum.	Educators' background, tradition and interests are different from the curriculum developers. The educators' voice is important during implementation of the curriculum.	Educators also need time to develop the school level curriculum. The before they can implement the curriculum.	Educators experienced contradictions such as the one above when they implemented the curriculum.	Educator implemented the by using expansive learning cycles.
What do they learn?	They learn to interact with each other in the activity system of people in the curriculum and to develop the OBE curriculum. To bring about changes in the curriculum.	They learn to listen to the voices of other people in the activity system.	Enough time to be allocated for curriculum development.	Contradictions about the curriculum bring about changes.	To develop the curriculum that allows educators to implement expansive learning and its cycles.
Why do they develop the curriculum?	Departmental officials to change the voice from the class. traditional to OBE. Educators learn to implement the new curriculum by	To allow learner their views in educational problems of the past (before 1994).	To correct the contradictions.	To address the contradictions.	To allow transformation to take place.

interpreting and making sense of the policies.

How do they develop the curriculum? Departmental officials produced NCS RNCS documents. The curriculum was developed by policy changing traditional curriculum which is educator - centred to OBE curriculum, which is learner-centred. They changed the curriculum by the contradictions of the past to the developed the RNCS. They considered when they developed the RNCS. By developing OBE that supports expansive learning.

Educators use NCS and RNCS documents to plan subject framework, work schedules, lesson plans and learners activity in the learners context. Educators integrate content with learners' prior knowledge and interest. They develop the curriculum that allows learners to participate fully.

Table 8: Teaching and learning matrix.

	A collective, Multi-voicedness artifact-mediated and object-oriented activity system	Historicity	Contradictions	Expansive cycles
Who are the subjects of teaching and learning?	<p>Educator provides with context-based activities.</p> <p>Learners engage in context-based activities and solve context-based problems in small groups.</p> <p>Learners discuss Matter and</p>	<p>Educator and learners come from different backgrounds, traditions and interests. In the classroom there are voices of the learners that contribute during activities, problem solving and group discussions.</p>	<p>Educator needs time to explain the activities to the learners.</p> <p>Learners need enough time to work together, make sense of what they do, think, probe and negotiate the construction of</p>	<p>Learners experience primary contradictions as individuals are involved in to bring transformation during teaching and learning.</p> <p>secondary contradictions. When the whole class is involved in discussions the learners experience tertiary contradictions.</p> <p>Educator begins teaching and learning by asking learners what they want to learn and what they are interested in?</p>

	Educator mediates of science concepts. learning.	to respond to questions asked by the educator or other learners.	during teaching and learning.
What is the role of learners during teaching and learning?	<p>Learners engage in context-based activities by asking questions related to their environment and solve problems in the activities. Learners pull their knowledge together in a poster or portfolio board and present it to their peers</p>	<p>Learners voice their personal views during group and class discussions. Their views are different based on their different backgrounds, traditions and they need time to understand each other when they work together in their groups. Learners need time to make sense of what they have learned, to negotiate and construct their own knowledge.</p>	<p>Learners resolve their contradictions during group expansive cycles in learning Matter and Materials in their context.</p>

Table 9: Assessment matrix

	A collective, artefact-mediated and object-oriented activity system	Multi-voicedness	Historicity	Contradictions	Expansive cycles
Who are the subjects of assessment?	<p>Educator assesses learner's activities.</p> <p>Learners also assess their activities.</p>	<p>Educator and learners voices are important in the assessment of activities.</p>	<p>Assessment is not a once-off exercise. Assessment is continuous and developmental.</p>	<p>Educator assesses learners' contradictions in the activity systems as the driving force of change and development of the learners in science learning.</p>	<p>Educator assesses expansive cycles of expansive learning.</p>
How does the educator assess learners?	<p>Assessment is done by marking learners activities and by using rubrics to assess presentation of portfolio boards</p>	<p>Educator listens to learners voices when assessing their activities</p>	<p>Assessment is done over a period of time.</p>	<p>Educator assesses the learners contradictions as part of the learning programme and these assessments contribute to the learners' performance.</p>	<p>Educator asks learners questions during activities, allows learners to do a model in the form of portfolio boards and assesses them. Allows learners to reflect on what they have learned in the presentation of the portfolio boards.</p>

What is the assessment one for?	Assessment is done for learning, monitoring learning and for summative assessment.	To assess learners from different backgrounds, traditions and interests.	To contribute to summative assessment at the end of the year.	Assessment is done for change and development.	Assessment is done for learning science in Matter and Materials.
Why does the educator do the assessment?	To assess learners' activities as to whether learners show understanding of science concepts in Matter and Materials in their context. To monitor learners progress in science learning. To monitor learners performance in activities.	To assess each learners' contribution during the presentation of the portfolio board and all the activities done by the learners in their workbooks.	To compile the assessment of all the work done by the learners in all activities. Time is needed to compile the assessment of the learners.	Assessment is done for learning during contradictions that arise in group and class discussions.	Assessment is done as the form of transformation in the activity system.

As discussed earlier the matrixes above will guide the discussion in Chapter Six.

4.5. SAMPLING

Qualitative studies usually employ non-probability sampling, such as purposive sampling (Sarantakos, 1993). Purposive sampling is popular in qualitative research and election is based on purpose (Patton, 1990). In this study, the researcher adopted purposive sampling because, in this form of sampling, a researcher selects the sample on the basis of his or her judgment that will satisfy his or her needs (Cohen, *et al.*, 2000). The sample selected includes only those people of interest and excludes those that are not of interest to the researcher. This seemed to be the most relevant sampling method for this study because it allowed the researcher to select unique cases that were especially informative for the research questions. In this study, the researcher needed an educator that is interested and experienced in involving learners' context during teaching and learning.

4.6. VALIDITY AND RELIABILITY

According to Denzin (1978), methodological triangulation involves using more than one method of collecting data. According to Barrett, Mayan, Morse, Olson and Spiers (2002) validity and reliability means strategies to evaluate trustworthy in the study. In an effort to ensure validity and reliability I ensured that there is triangulation and that the instruments covered the items that they were supposed to cover. In this study, the following data sources were used to ensure validity: semi-structured and unstructured interviews; video recording and classroom observation. As mentioned earlier, the main source of data gathering was semi-structured interviews to ensure validity and reliability of the data from this particular educator who is supporting context-based teaching. The post interview questions, which formed part of the unstructured interviews, were asked before and after the lessons for validation and reliability.

I transcribed all the tape-recorded data and kept it in a safe place for confidentiality until the time for data analysis arrived. According to Barrett et al (2002) the strategies used to achieve trustworthiness are negative cases, peer debriefing, prolong engagement and persistent observation, audit trails and member checks. In this study I observed the educator for seven days during the teaching and learning of a unit on Matter and Materials. I analysed semi-structured and unstructured interviews, a video recording of lessons observed during teaching and learning for seven days and classroom observation to ensure validity and reliability. I also conducted member checking where the educator was interviewed to verify data, after the first level of analysis, to ensure validity and reliability. I also discussed the analysis with the first level of analysis with the educator and with the supervisor.

4.7. ETHICAL CONSIDERATION

Before undertaking the study, I requested permission to do so from the provincial Department of Education offices located in Pietermaritzburg, and permission was granted. I also requested permission from the principal of the school in writing and permission was granted. Permission was requested from the educator to observe him during teaching and learning and also to conduct interviews pre and post teaching and learning. In the letters requesting permission, I promised to ensure the anonymity and confidentiality of the school, the educator and the learners who participated in the study. All interviews were recorded on a tape recorder by the researcher. All lessons during teaching and learning were video recorded by the researcher's assistant and tape recorded by the researcher. Note-taking was also done during observation of teaching and learning by the researcher. All interviews and classroom observations were completed in seven days. All the video and tape recorder cassettes are locked up in a safe place at my home for confidentiality.

4.8 CONCLUSION

In this qualitative case study I used three instruments of data constitution, namely, semi-structured interviews, unstructured interviews and classroom observation. The analysis is done in two levels. The principles of the activity theory are used to draw the matrix according to the three components of the research questions, namely, curriculum development, teaching and learning and assessment. The matrixes will be used to guide the discussion of data in Chapter Six. The following chapter will present the data of this study.

CHAPTER 5

PRESENTATION OF DATA

5.1. INTRODUCTION

In this chapter, I present data and this presentation will be according to the themes that emerged from the data gathered by semi-structured interviews, unstructured interviews, a semi-structured observation schedule and classroom observations. Data were collected in order to answer the following research question:

What does it mean to teach Grade 8 Natural Sciences problem solving in context, in terms of:

- curriculum development ;
- teaching and learning and;
- assessment?

5.2. PRESENTATION OF DATA

With regard to the research question, the first component that focuses on curriculum development, the following four themes came to the fore during the semi-structured interviews with the educator:

5.2.1. SEMI-STRUCTURED INTERVIEWS

5.2.1.1. CURRICULUM DEVELOPMENT

Curriculum changes are at theoretical level rather than classroom level

I: With the new curriculum in South Africa, do you think that it has brought about changes in the ways that the teachers teach the Natural Sciences? If, yes, how so? (Appendix B1, Day 4, L34)*

E#: Yes, it has brought about changes, but these changes are all at theory level. They are in somebody's mind that is not in the classroom. (Appendix B, Day 4, L37)

* I stands for the researcher or interviewer.

E stands for the educator.

The educator views changes in the curriculum development as being changes at theoretical level rather than at classroom level, which means that the curriculum changes are not practical. These changes, furthermore, are not informed by classroom practices. Educators' and learners' classroom practices are different from the changes brought by the new curriculum.

Educators are seen as curriculum implementers rather than developers

I: With the new curriculum in South Africa, do you think that it has brought about changes in the ways that the teachers teach the Natural Sciences? If, yes, how so? (Appendix B1, Day 4, L34)

E: ... And teachers have a little input in the curriculum changes. They are merely on the receiving end of policies that are shaped at a higher level, and in practice they must now make sense of those theories and then interpret them in the way that learners can be engaged in their own learning. I think there is still a long way to go in South Africa for teachers to be grabbed in with the idea of allowing learners into interacting with their own learning and taking responsibility. (Appendix B1, Day 4, L38)

The curriculum is developed and designed at a higher level by people not directly involved with the learners in the classroom. These people plan and give the curriculum to the educators. The educators interpret and implement the new curriculum in the classroom. The educators are not involved during the development of the new curriculum, and the educators develop their learning programmes, work schedule and lesson plan by using the new curriculum documents, where the learning outcomes and assessment standard are provided. The educator facilitates learning by promoting the participation of the learners during classroom activities. The educator allows learners to interact with one another and with the educator. The learners take responsibility for all teaching and learning activities.

The transformative nature of the new Natural Sciences Curriculum

I: For how long have you been teaching the Natural Sciences in Grade 8? (Appendix B1, Day 4, L6)

E: Since 1997, since OBE was introduced. (Appendix B1, Day 4, L8)

I: How has the experience been like? (Appendix B1, Day 4, L10)

E: The experience that is transformative for me. Eh, the apartheid education did not give us skills as scholars to help learners to understand school science. Eh, and even the training that the teachers received in those apartheid days it was transmission mode. It was not learner action based where learners take responsibility for their own learning. So it was completely rote learning. Children simple just regurgitate what the teacher said to them. They sit quietly. They are passive in the class. (Appendix B1, Day 4, L12)

Teaching within the OBE framework is viewed by the educator as the process of change from the old curriculum to the new curriculum. Educators are still in the process of learning how to teach the new curriculum because the methods of teaching are not the same as those used in the new curriculum. In the new curriculum, learners are more active and responsible for their own learning, as compared to the old curriculum. Educators are expected to develop the skills, values and attitudes of the learners during teaching and learning, and this is currently a problem because they themselves were not exposed to this type of education. They are the product of the old curriculum where the learning of content was viewed as the most important part of the curriculum.

The contextual nature of Natural Sciences

E: ... But in Natural Sciences and at that time it was called General Science and it was a mix of all other subjects. But now, Natural Sciences is more focused and it integrates in other learning areas since the introduction of OBE and Natural Sciences. And I found that the learners participate more and are very interested in science. Their interest is shown by their questions that they ask, questions related to their daily lives in what happens at home, that they experience at home. Working around the house in matter and materials eh, playing with mud on rainy days. I can understand that when learners ask questions like that because I also grew up I played around with mud. I made mud toys and all sorts of materials you can lay hands on, because of the inquisitive nature of children. They want to find out. They ask questions all the time. When immediately the child ask question, that is the moment the child get responsibility and interest in their learning. They want to know more from the more knowledgeable adult or peer. Natural Sciences allow the space now to do this through using projects even the more action and only learning. (Appendix B1, Day 4, L19)

Teaching and learning Natural Sciences in context involves learners that are active and more interested in learning science within their environment. During their discussion, they integrate Natural Sciences with other learning areas like Agricultural Science, Life Sciences, Geography, Communication and Mathematics. The learners ask context-based questions which involve their daily life experiences. They prepare, produce and present their portfolio boards with what they have at home and in their environment. Their discussion allows learners to learn more from other learners and adults. Group work is promoted and they listen to each other and ask questions when necessary.

5.2.1.2. TEACHING AND LEARNING

With regard to the second component of the research question, which focuses on teaching and learning, the following five themes came to the fore during the semi-structured interview with the educator:

The transformative nature of the new Natural Sciences curriculum

I: For how long have you been teaching the Natural Sciences in Grade 8? (Appendix B1, Day 4, L6)

E: ... since 1997, since OBE was introduced. (Appendix B1, Day 4, L8)

I: How has the experience been like? (Appendix B1, Day 4, L9)

E: The experience that is transformative for me. Eh, the apartheid education did not give us skills as scholars to help learners to understand school science. Eh, and even the training that the teachers received in those apartheid days it was transmission mode. (Appendix B1, Day 4, L12)

The educator's experience of teaching Natural Sciences has been transformative since the introduction of Outcomes Based Education (OBE). There is a difference between the present OBE system and the past apartheid education system. The apartheid education system failed to provide educators with the necessary skills to help learners to learn and understand Natural Sciences. It failed to train educators as facilitators and how to involve learners during teaching and learning.

The teaching and learning is learner-centred

I: For how long have you been teaching the Natural Sciences in Grade 8? (Appendix B1, Day 4, L6)

E: Since 1997, since OBE was introduced. (Appendix B1, Day 4, L8)

I: How has the experience been like? (Appendix B1, Day 4, L10)

E: ... And I found that the learners participate more and are very interested in science. Their interest is shown by their questions that they ask, questions related to their daily lives in what happens at home, that they experience at home. Working around the house in matter and materials eh, playing with mud on rainy days. I can understand that when learners ask questions like that because I also grew up I played around with mud. I made mud toys and all sorts of materials you can lay on hands on, because of the inquisitive nature of children. They want to find out. They ask questions all the time. When immediately the child ask question, that is the moment the child get responsibility and interest in their learning. They want to know more from the more knowledgeable adult or peer. Natural Sciences allow the space now to do this through using projects even the more action and only learning. (Appendix B1, Day 4, L21)

As the learners engage with various activities, they participate more in all the activities given to them and ask questions about the topic presented to them and about the things that occur in their daily lives and environment. The educator uses these questions asked by the learners and their daily life experiences to teach them. The learners show interest in science by asking more questions during teaching and learning and they take responsibility for their own learning.

The contextual nature of problem solving that is driven by learner interests

I: Which approach do you prefer and use in your teaching of the Natural Sciences? (Appendix B1, Day 4, L52)

E: My approach is eh, the hand-on approach and project-based learning is an approach for me that work very well. It incorporates the problem solving where learners must identify the problem, and the teacher can also bring some problems on the table, and so can their elders in the community bring problems to the fore, which the learners also experience, in the context, which they live. And in that way we bring those problems into the class, science classroom. The learners can then see that science is something that happens in everyday life, and is not something that is in the textbooks or that only belong to the teacher, or only belongs to the scientists wearing a white jacket in the laboratory. (Appendix B1, Day 4, L55)

The learners assist the educator by identifying their problems in a particular topic in Natural Sciences. The educator uses these problems from the learners' context and their daily life experiences to teach the learners. This helps learners to understand science as an everyday experience and not as something done by scientists in the laboratory and written in textbooks. The learners learn about what they are interested in, in that particular topic. The educator is using a hands-on and project-based learning approach that involves problem solving of the problems identified by the learners during teaching and learning.

Educators are mediators of learning

I: The new curriculum puts more emphasis on problem solving as a core skill; what are your thoughts on that? What is your experience of teaching problem solving in your context? (Appendix B1, Day 4, L78)

E: Ja, problem solving is at the heart of project-based learning. The learners must formulate their own focus questions guided of course by the mentor who assists in shaping these questions. As they are still budding scientists and interacting with nature and materials on their own, touching and feeling and asking questions and engaging. So the approach eh, that is problem solving begins with focus questions and sustained engagement from a learner side in trying to answer these questions assisted of course by the knowledgeable adult or peer. (Appendix B1, Day 4, L83)

The educator assists and guides the learners in formulating their focus questions. Learners are allowed by the educator to be engaged during teaching and learning. They ask and answer questions, touch and feel the learning resources or materials. The educator assists the learners to answer their questions, focus on what is learned and grow as young scientists.

Teaching and learning involves real-world problems

I: What kind of problems have you used in your teaching and learning of the Natural Sciences? (Appendix B1, Day 4, L100)

E: Eh, every day problems, because it is not my problem, it is a problem that learners raise. They say what the problem is around the topic. Even, if the kind of problems raised that are peripheral to the topic. I try to bring those, focus them more and in assisting them as a mentor for them in their growth as budding scientists. (Appendix B1, Day 4, L103)

The educator values the use of real-world problems in Natural Sciences because these assist the learners to link school science to their lives. The learners ask questions about real-world problems and the educator is using real-world, everyday problems raised by the learners around the topic for teaching and learning. He allows the learners to touch, feel and ask questions in solving problems. The learners investigate and solve the real-world problem themselves.

5.2.2. UNSTRUCTURED INTERVIEW

5.2.2.1. CURRICULUM DEVELOPMENT

Post lesson interviews.

During the post lesson interview with the educator, the following theme came to the fore, with regard to curriculum development:

Curriculum documents provide the core knowledge

I: How do you design the curriculum or your workbook or your workbook activities? (Appendix B2, Day 6, L182)

E: Ja, the workbook begins with the topic that is designed in the curriculum. Now they have a clear topic that needs to be taught. It is also skills based that are clearly laid out in the standards in the policy documents. (Appendix B2, Day 6, L184)

The curriculum documents are used to develop learning materials. The documents provide the educator with the learning outcomes and assessment standards to be used when planning the activities.

5.2.2.2. TEACHING AND LEARNING

During the post interview with the educator, the following six themes came to the fore, with regard to teaching and learning.

Activity outcomes are learner-centred

I: Did you achieve your outcomes for today? (Appendix B2, Day, L16)

E: The intention for today's activity is to find out from the learners what they anticipate. Because the problem solving, the project approach must begin with what the learners want to know, what they are interested in. So that they can be

the one's who also be the part of finding the answers. The teacher is not going to give them the answers. They must discover that through further inquiry assisted by the teacher. (Appendix B2, Day, L18)

The educator provides the learners with activities that determine from the learners what they want to learn about a particular topic. When the learners do the activities they come up with different answers and the educator uses their responses to assist them to learn and understand the topic.

Contextual teaching and learning maximize learning

I: But, do you think they have learnt about this matter and materials? (Appendix B2, Day 7, L258)

E: Ja, you have seen what they have put together and the way they actually struggled to get to this stage shows that it was very engaging on their part. And when the children are engaged then they learn more. (Appendix B2, Day 7, L260)

The educator gives learners the opportunity to be actively involved during contextual teaching and learning. When learners are active during class discussions, they learn more about that particular topic than when they are passive, quiet and listen to the educator, who is providing them with information. They are the ones who provide the information to the educator and other learners.

Contextual teaching and learning needs more time

I: Do you think Thursday will be ok? (Appendix B2, Day 5, L161)

E: Ja, I will say let's aim for Thursday because I need more time to involve them before they can produce the posters. (Appendix B2, Day5, L162)

I: What can you say about today's lesson? (Appendix B2, Day 5, L133)

E: ...So I need another week or two weeks for learners to internalize and make sense, play and discuss and we need more of that. But these are contrive situations is like forty minutes lecture that we are taking. That is my concern is that this is gonna put the child on the spot and not think clearly. Ja, but if we give them more time to think and probe, and the period sometimes is get cut and all that. (Appendix B2, Day 5, L149)

The educator feels that learners must be given more time during contextual teaching and learning. The learners need more time to discuss how to prepare and present their portfolio boards. The more time they have, the more they interact with each other and the more they learn from that activity. They are practically involved in the preparation and presentation of the portfolio boards.

Problem solving maximizes non-routine thinking

I: What can you say about today's lesson? (Appendix B2, Day 5, L133)

E: ... So that affects the working in problem solving because some problems are messy. The route to the right answer is a bit messy. They need to get their hands dirty with problem solving. They can't sit neatly and get everything. Like, I planned neat activities. But what was happening in their minds is that messy kind of thinking process and they need more interaction and more discussions. (Appendix B2, Day 5, L154)

The educator views problem solving as a non-routine exercise that demands learners to work hard in order to solve the problem and the answer is not reached easily and neatly.

Learners pre-knowledge assists them to understand the new knowledge

I: How do you design the curriculum or your workbook or your workbook activities? (Appendix B2, Day 6, L182)

E: ...I would first begin my activities by asking them what they already know about the topic. So the learners will engage with me and be very happy to explain these things, because it is the stuff they know around the topic.

And then I will follow up that by asking them all the things they are interested around the topic. So they can also now give me more, not just what they would like to know, and in that way I suddenly infuse the content that I am aware of which they are not aware of. And bring that, and integrate that with the curriculum and their own prior knowledge and their interest and in that way I develop curriculum around that. (Appendix B2, Day 6, L187)

The learners pre-knowledge and their interest play an important role in the learning process. The educator designs the activities in such a way that the learners' pre-knowledge is accessed. As the learners explain their pre-knowledge, they prepare themselves to learn the new knowledge easily. Learners link their everyday experiences

to the new knowledge covered in the lesson. The ability to make this link is made possible because the new knowledge introduced is from the learners' everyday lives.

Learners construct knowledge by negotiating

I: When is the presentation? (Appendix, Day, L209)

E: I am hoping that the presentation will be tomorrow, but then we have to take learners own pace into account and think it might need another two days. Because they have to negotiate the construction of their own knowledge in the poster and then ready to answer the questions from the panel on what they have done. (Appendix B2, Day 6, L211)

The educator takes the interest and the pace of the learners into consideration when taking decisions about the work to be done. The educator allows the learners to discuss among themselves what they have learned and communicate the knowledge gained with the whole class in the form of a portfolio board and presentation of what is done on the poster. By doing this, the learners construct their own knowledge.

5.2.2.3. ASSESSMENT

With regard to the third component of the research question, which focuses on assessment, the following four themes came to the fore during the semi-structured interview with the educator:

During the post interview with the educator, the following three themes came to the fore, with regard to assessment.

Assessment is continuous and it contributes towards assessment for grading (summative assessment)

I: How do you assess these problems? (Appendix B2, Day 6, L171)

E: Problems as I said to you, using problems and project in the learning of children is not a new thing, as I said earlier that, it is a sustained way of learning.

It is not a once off, and it is linked with many other aspects that learners deal with in their daily lives. So this kind of learning is ongoing, hence the assessment will also then be ongoing. Because, when you monitor assessment, which will be then developmental, where they interact and ask questions and make mistakes leading at the end to a more performance kind of summative assessment. Where they then construct their own meaning and explain that to each other in the form of presentation or a showpiece. (Appendix B2, Day 6, L173)

Assessment is part of teaching and learning, and is done during teaching and learning from the beginning up to the end of the topic, not after completing the chapter or the unit.

Assessment is for learning

I: How do you assess these problems? (Appendix B2, Day 6, L171)

E: Problems as I said to you, using problems and project in the learning of children is not a new thing, as I said earlier that, it is a sustained way of learning (Appendix B2, Day 6, L173)

When the educator assesses, the assessment informs the educator about the learners' strengths and weaknesses and also informs the educator on what and how to teach the learners about that particular topic. The learners learn during assessment.

Assessment monitoring is developmental

E: ... Because, when you monitor assessment, which will be then developmental, where they interact and ask questions and make mistakes leading at the end to a more performance kind of summative assessment. Where they then construct their own meaning and explain that to each other in the form of presentation or a showpiece. (Appendix B2, Day 6, L177)

The educator monitors the development of each learner assessment during the teaching and learning process, from the beginning up to the end of the topic. All the marks are recorded and used for the progress of the learners. All the learners' marks from the classroom assessment are important for the final mark of the learner.

5.3. CLASSROOM OBSERVATION

5.3.1 CLASSROOM OBSERVATION OF ACTIVITIES

The following classroom observation was compiled by the researcher on the activities that occurred in the classroom.

Table 10: Classroom activities

DATE	TOPIC	No. of activities	Description of activity	Aim of activity
Day 07-08-1. 2006.	1. Soil study and Earth. 2. Soil study and Matter and Materials.	3	Activity 1: Finalizing Soil study and Earth and beyond and the introduction of Soil study and Matter and Materials. Activity 2: Name and describe the habitat of the animal depicted on the picture Activity 3: Matter and Materials and the things that animals require in the soil.	To assist learners to identify the key focus questions based on Soil study and Matter and Materials and usefulness of soil to living organisms.
Day 08-08-2. 2006.	1. Matter and meso-organisms, micro-organisms and macro-organisms.	3	Activity 1: Revising the previous lesson on worms and drawing the learners' attention to the questions they have in their minds about Matter and Materials. Activity 2: Discussing meso-organisms, micro-organisms and macro-organisms. Activity 3: Discussing Matter and Materials, meso-organisms and soil.	To allow learners to discuss the Soil study Matter and Materials that occurs in, and the particle nature of matter.
Day 10-08-3 2006	1. Observing the soil sample and phases of matter found in the soil.	3	Activity 1: Revising the previous lesson, the reasons why they did not bring the soil and the	To allow learners to observe the soil sample and identify the substances found

earthworms and discussing the type of soil where earthworms live.

Activity 2: Learner groups observing the soil sample provided by the educator.

Activity3: Identification of gases, liquids and solids by the learners.

in the soil sample and their phases of matter.

Day 14-08- 1. Phases and the 4
4 2006 particles of matter, physical and chemical combination and separation of substances and the periodic table.

Activity 1: Discussion of substances that are found in the soil sample and their phases of matter

Activity 2: Discussing the particles of matter.

Activity 3: Discussing the phases and particles of matter, pure substances, physical and chemical combination and separation of substances.

Activity 4: Discussing the elements in the periodic table.

To allow learners to identify elements or compounds found in the soil.

Day 15-08- 1. The first 20 3
5 2006 elements in the periodic table, in the body of the rat, in the soil and the chemical equations of oxygen and water.

Activity 1: Discussion of the first 20 elements in the periodic table and the chemicals found at home.

Activity 2: Discussing the elements found in the body of the rat and in the soil.

Activity 3: Writing the chemical equations of oxygen and water molecules.

To allow learners to identify the different amounts of elements that make up soil, and those elements that make up the body of a rat living in or on the soil.

Day 24-08- Preparation of 1
6 2006 portfolio boards.

Activity 1: Naming of three groups and To allow learners to discussing and preparing the portfolio use the knowledge boards.

use the knowledge gained in Soil study and Matter and Materials to discuss, prepare and construct the portfolio boards using resources from

Day 09-09- Presentation and 1
7 2006 assessment of
portfolio boards.

their environment.
Activity 1: Each group presents their To allow learners to
portfolio board and the educator and present their portfolio
learners assess the presentation and the boards.
portfolio board.

The above table of activities indicates that the educator is using the learners' context during teaching and learning of Matter and Materials and assessment of learners' activities. The summary of the activities above indicates that the learners move away from passive learning. The learners always work in groups, discuss, observe, solve problems, prepare and present portfolio boards in their groups. (Appendix B4). The context-based learning illustrates activity theory.

5.3.2. SEMI-STRUCTURED OBSERVATION SCHEDULE

The semi-structured observation schedule was used to observe the classroom.

5.3.2.1. PHYSICAL SETTING.

The learners change classrooms and move from one class to another. Only educators stay in their classrooms. There are 40 learners in this Grade 8B classroom. The learners are divided into six groups ranging from 6 to 8 learners in each group. Each group shares three tables. This allows learners to interact with each other during teaching and learning.

The classroom is decorated with plants and animal charts. There are plants with white roots growing in a bottle filled with water. There are cuttings from newspapers and

magazines and charts, from a previous lesson on classifying three different types of soil, displayed against the wall. The classroom looks like a laboratory because there is a long working table fixed to the wall and there are electric plugs on the wall. In front of the learners, there is one green board and a long table fixed to the floor.

There is a significant difference between the physical settings of this classroom and my classroom. The fact that the educator is not changing classrooms, as we do in our school, allows the educator to set his classroom as he likes. The learner arrangement allows the learners to use all their time for discussion as they do not waste time re-arranging desks. All the posters in the classroom are useful for teaching and learning. Real-life resources are used during teaching and learning.

5.3.2.2. SCHOOL LANGUAGE POLICY

English is used as the language of teaching and learning and learners choose between IsiZulu and Afrikaans as their second language.

T: You said ant or grasshopper, anything smaller? Anything smaller, which one? Yes. (Appendix B4, Day 1, L181)

L 9: Intwala (lice) Sir. (Appendix B4, Day 1, L182)

T: Intwala, where do we find intwala? Put your hands up. Who has the answer? Siyitholaphi lento okuthiwa intwala, ihlalaphi? (Appendix, B4, Day 1, L 183)

L 10: In the pigs. (Appendix, B4, Day 1, L185)

T: In the pigs, yes, wena (you) (Appendix, B4, Day 1, L186)

L 11: Yes Sir, inside here. (The learner is pointing to her head). (Appendix, B4, Day 1, L187)

T: Have you seen it in the dogs? (Appendix, B4, Day 1, L188)

(All learners say: Yes Sir.) (Appendix, B4, Day 1, L189)

T: Right, so we are talking about these animals, they are not very small like bacteria are very small. We have various bacteria and we need a microscope to see them. But these ones, we are talking about are called meso- organisms. We can see them with our eyes. Intwala siyayibona angithi. (We can see lice, isn't it). (Appendix, B4, Day 1, L190)

The fact that all learners in Grade 8B, where the classroom observation was done, are black Africans and the teaching and learning language is their second language. But the educator is flexible enough as he allows learners to use any language that they are comfortable using during teaching and learning. It can be seen above that the learners can use any language because the educator can speak four languages; English, Afrikaans, Isizulu and Isixhosa.

5.3.2.3. PROGRAMME SETTING

Programme setting involves pedagogic styles, curricula and their organization.

What kind of curriculum is being followed and how does it cater for teaching and learning in context?

Grade 8 and 9 are using the Revised National Curriculum Statement (RNCS), Grade 10 is using the National Curriculum Statement and Grade 11 and 12 are using NATED 550. Grade 8 and 9 follow the outcomes based education (OBE). In the OBE curriculum, context is considered as one of the most important aspects during teaching and learning. Learners are asked to use their environment as the context during teaching and learning. (Appendix, B3, L41)

The use of the (RNCS) in Grade 8 ensures that the educators include the context when planning activities for learners. The learners also include their context during teaching and learning.

What characterizes the pedagogic style of the educator? How does the style cater for teaching and learning in context?

The educator is using a hands-on approach and project-based learning as his pedagogic styles. The educator allows the learners to identify the problem and to see that science is something that happens in everyday life. The educator brings some problems and the elders in the community bring problems to the fore, which the learners also experience in the context which they live in. The learners solve these real-life problems during teaching and learning. (Appendix B3, L50)

It is obvious that the hands-on approach and project-based learning used by the educator are the pedagogic styles that cater for context, because learners solve real-life problems brought by the educator and themselves.

How does the educator engage his or her learners in the teaching and learning situation? How are learners engaged in context-based learning?

The educator engages the learners during teaching and learning by asking questions based on their context. He used soil as the context of learning Matter and Materials. He provided the learners with a picture of earthworms as an example of meso-animals living in the soil. He asked the learners about the soil requirements of meso-animals. He asked the learners to ask questions that they have in mind about the topic, Matter and Materials. The learners answer the questions by using their context and everyday experiences. All learners are willing to talk and they are actively involved during teaching and learning. They ask and answer questions; they also read and write from their workbook. He teaches the learners according to what they would like to learn. (Appendix B3, L46)

The educator engaged the learners in context-based learning by using the learners' context when teaching Matter and Materials.

How does the educator prepare the tasks for teaching and learning in context?

The educator prepares the teaching and learning tasks by preparing a workbook for the learners with activities and questions. He used newspaper articles to show the learners meso-animals. He prepares the lesson based on learners needs, from the context to the content. The educator asked the learners to bring earthworms and soil from their home gardens to school. (Appendix B3, L50)

The teaching and learning tasks in the workbooks are prepared by using the curriculum documents and new textbooks that caters for OBE education. This means that there is a transfer from content to context, to context to content.

How are the learners being assessed? How does assessment cater for teaching and learning in context?

The learners are given activities to do and assessed by the educator. The assessment is used for learning. The activities involve learners' daily life experiences. (Appendix B3, L50)

In context-based learning, assessment is done to allow the educator to identify areas that need his attention from the learners' responses .The educator uses these responses to decide what to teach and how to include the learners' daily life experiences during teaching and learning.

5.3.2.4. INTERACTIONAL SETTING

The interactional setting involves formal, informal, planned, unplanned and verbal and non-verbal interactions that take place during observation.

What happens in the Natural Sciences classrooms in terms of interactions that are taking place?

There are interactions in the classroom. The educator assists the learners in identifying the key focus questions by using soil as the context for Matter and Materials. The educator is using resources that are familiar to the learners and available in their environment, like soil, newspapers and books. The educator gives learners a chance to provide resources for learning from their context. The learners identify the focus key-questions themselves. The educator asks many questions of the learners. All learners are willing to talk and answer the questions. The learners also ask questions and the educator

responds, as the mentor. The educator uses pictures of the objects in the learners' context, such as earthworms. The educator identifies the passive learners in the class and draws their attention to the lesson discussion by directing questions at passive learners. The learners use body language to indicate some reaction in the classroom, for example when the educator explains that earthworms are not dangerous. (Appendix B3, L61)

5.4. ACTIVITY THEORY AND THEMES

5.4.1. THE ACTIVITY THEORY PRINCIPLES AND STATEMENTS

The statements are derived from the principles of activity theory for the purpose of simplifying the activity theory principles, so that it will be easy to understand and apply them in this study.

Table 11: Table for activity theory principles and statements.

Activity theory principles.	Statement of activity theory.
A collective, artifact-mediated and object-oriented activity system.	Activity system is the unit of analysis or context is the unit of analysis.
The multi-voicedness of activity systems.	Community in the activity system is made up of different point of views, traditions and interests.
Historicity.	Activity system takes shape and changes in thinking in the social plane over a lengthy period of time.
The central role of contradictions as a source of change and development.	Contradictions in the activity system are the driving force of change and development.
The possibility of expansive transformations in activity systems.	Expansive cycles are the possible forms of transformation in the activity systems.

5.4.2. THE ACTIVITY THEORY PRINCIPLES AND THE THEMES

Table 12: Table for activity theory principles matched with the themes.

Activity theory principles.	Themes.
A collective, artifact-mediated and object-oriented activity system.	Curriculum changes are at theoretical level rather than at classroom level. Educators are seen as curriculum implementers rather than developers.
Context is the unit of analysis.	Contextual teaching and learning maximizes learning. Teaching and learning involves real-world problems. Contextual nature of Natural Sciences.
The multi-voicedness of activity systems.	Curriculum changes are at theoretical level rather than at classroom level. Learner's pre-knowledge assists them to understand the new knowledge.
	The contextual nature of problem solving is driven by learner's interest.
Historicity.	Contextual teaching and learning needs more time.
	Assessment is continuous.
The central role of contradictions as a source of change and development.	Assessment monitoring is developmental.
	Learners construct knowledge by negotiating.
The possibility of expansive transformations in activity systems.	The transformative nature of the new Natural Sciences curriculum.

5.5. CONCLUSION

In this chapter I have presented and analysed the data collected by a semi-structured observation schedule, semi-structured and unstructured interviews and classroom activities. The activity theory principles and the themes will be used to discuss the findings in Chapter Six.

CHAPTER 6

DISCUSSION OF FINDINGS

6. 1. INTRODUCTION

This chapter presents the discussion of the findings of this study. The principles of the activity theory are incorporated in this chapter to guide the discussion of the findings.

6.2. DISCUSSION OF FINDINGS

The findings of this study indicate that the curriculum changes are at theoretical level rather than classroom level and educators are seen as curriculum implementers rather than developers. This means they miss the transformative nature of the Natural Sciences curriculum and the contextual nature of Natural Sciences. Teaching within an OBE framework is supposed to be transformative, but the educator becomes a mediator. It is also clear from the findings that contextual teaching involves the construction of knowledge from learners pre-knowledge and interests. Problem solving requires more time as it maximizes non-routine thinking where continuous assessment is used for learning.

Engeström (2001) suggested five principles of the activity theory, namely:

- A collective, artifact-mediated and object-oriented activity system;
- The multi-voicedness of activity systems;

- Historicity;
- The central role of contradictions as a source of change and development and;
- The possibility of expansive transformations in activity systems.

As mentioned earlier, the discussion of findings is guided by the data in the matrix (see Tables 3, 4 and 5) activity theory principles and the themes emerge from the data of this study.

A collective, artifact-mediated and object-oriented activity system

Curriculum changes are at theoretical level rather than at classroom level

As mentioned in Chapter One, curriculum 2005 was introduced in 1997 and implemented in 1998. In 2000 the Minister of Education appointed a committee to review the structure and the design of curriculum 2005 (Revised National Curriculum Statement Grades R-9, 2002).

...it has brought about changes, but these changes are all at theoretical level. They are in somebody's mind that is not in the classroom. (Appendix B1, Day 4, L37)

The curriculum was changed at a higher level by a review committee, not by educators. Educators were not involved when the curriculum changed from traditional education to outcomes based education, or from Outcomes Based Education (OBE) to the Revised National Curriculum Statement (RNCS). The curriculum is imposed on educators for them to implement as it is.

...They are merely on the receiving end of policies that are shaped at a higher level, and in practice they must now make sense of those theories and then interpret them in the way that learners can be engaged in their own learning. (Appendix B1, Day 4, L39)

Educators interpret the curriculum that is context-based by considering the learners' context. Educators are expected to develop the curriculum in the learners' context because, according to norms and standards of educators, educators are seen as curriculum developers (DoE, 1998). When educators develop the curriculum, they are required to

accept the notion of a context as the starting point for science learning and to select the relevant content in order to make the science more meaningful and enjoyable to learners (Beasley & Butler, 2006). As the learners learn the curriculum that has been developed in their context, they participate fully in the activities. In their activities the learners and educator use the artifact or resources from their context (see Appendix C2 and B4). Curriculum development is an activity undertaken by the educator, which involves the context of the learners.

As the learners do the activities, they develop in their context and they learn to solve problems of non-routine tasks in their context with difficulties, or barriers (Hobden, 2002), and they overcome barriers through critical thinking (Hobden, 2002). They enjoy solving these problems and, as a result, they develop a better understanding of science

....It incorporates problem solving where learners must identify the problem, and the teacher can also bring some problems to the table, and so can their elders in the community bring problems to the fore, which the learners also experience, in the context in which they live. . (Appendix B1, Day 4, L56)

Problem solving motivates, provides enjoyment, stimulates interest, creativity and learning (Watts, 1994). As a result learners develop problem-solving and critical-thinking skills, both of which are core in the curriculum (Watts. 1994) and in the teaching and learning of Natural Sciences and Physical Sciences within the OBE framework (DoE, 2002).

Teaching within an OBE framework is transformative and the educator is a mediator

The educator mediates learning by allowing learners to discover things through inquiry, to coordinate what they have established, to focus on problems, to want to learn more from the knowledgeable adult or peer and to construct their own meaning and explanation to their peers. The educator mediates learning by providing learners with context-based activities (see appendix C2 and B4). The educator is using the context of

the learners as the starting point. According to Bennett & Lubben (2006), context is used as the starting point for the development of scientific understanding. In this study, the educator is using soil as the context to teach Matter and Material (see appendix C2). In activity three of Matter and Materials in the learners' book (appendix C2), the educator used the learners' context to design that activity. All learners understand soil and rats because they are found in their environment. The learners developed scientific understanding of different elements in the periodic table using the soil and the rat. The learners were doing the activity in context in their groups.

According to Engeström, (2001), Kuutti (1996), Nardi, (1996), activity theory actions are always located in a context. Activity itself is the context and the activity system generates actions and operations. All the learners are actively involved in all the activities because they are in context. Learners solve problems in context, not routine exercises only (see appendix B4) because the context shapes learning (Finkelstein, 2000). The educator mediates learning by using the local environment to support the development of conceptual understanding (Finkelstein, 2000) of Matter and Material. The educator and learners are using artifacts from their local environment during teaching and learning of Matter and Materials. Their local environment is used to support the development of conceptual understanding and to transfer understanding to new and relevant situations (Finkelstein, 2000).

The preparation and presentation of portfolio boards as artifacts function to mediate learning to develop conceptual understanding and to transfer understanding to new and relevant situations. These portfolio boards were prepared in groups but presented individually by all members of the group and assessed by both learners and the educator. The educator uses teaching strategies that involve learners' context and assessment strategies in order to make science more meaningful and to allow learners to enjoy learning science. The learners take responsibility for their own learning when a context-

based approach is used for learning and where context is central to learners learning (Finkelstein, 2000).

The multi-voicedness of activity systems: Community in the activity system is made up of different point of views, traditions and interests

Contextual teaching involves construction of knowledge from learners pre-knowledge and interests

Learners learn from their environment or context by asking questions related to their daily lives. The local environment is expected to support the conceptual understanding (Finkelstein, 2000) of science.

...And I found that the learners participate more and are very interested in science. Their interest is shown by their questions that they ask, questions related to their daily lives in what happens at home, that they experience at home. (Appendix B1, Day 4, L21)

They interact with the people in their community and in the classroom. They bring samples to the classroom from their environment, construct their own meaning and draw their own conclusions. They put their knowledge together in a poster or portfolio board during interaction and group discussions. The posters or portfolio boards are presented to their peers. They raise and solve real-world and everyday problems in their activities. Learners engage in activities by exploring their prior knowledge and recognizing their interest.

...It incorporates the problem solving where learners must identify the problem, and the teacher can also bring some problems on the table, and so can their elders in the community bring problems to the fore, which the learners also experience, in the context, which they live. And in that way we bring those problems into the class, science classroom. The learners can then see that science is something that happens in everyday life, and is not something that is in the textbooks or that only belongs to the teacher, or only belongs to the scientists wearing a white jacket in the laboratory. (Appendix B1, Day 4, L56)

Educators are expected to allow learners, according to Engeström (2001), to become the community involved in an activity. This is made up of different points of views,

traditions and interests. When the educator is involved in the activity of teaching and learning, using a context-based approach, the educator is expected to consider the learners' background, tradition, pre-knowledge and interests in their context. The educator can do this by allowing learners to talk freely about their background, tradition, prior knowledge and interests in the classroom and during problem solving in their context. When the learners experience problems as they discuss context-based activities, the educator is expected to allow learners to ask questions of him and any adult person. As the learners discuss context-based activities in science and ask questions, they take responsibility for their own learning and learn more about science and make science more meaningful and enjoyable (Beasley & Butler, 2006). As a result, the educator will also enjoy acting as the mediator of teaching and learning of science. In this study, the educator is mediating the teaching and learning of Natural Sciences.

Even departmental officials who are involved in the activity of developing the curriculum come from different contexts, backgrounds, traditions and interests. These people form the reviewing committee who changed the curriculum from traditional to OBE, NCS to RNCS, and who came with different views. The educators, as the curriculum implementers, also come with their own ideas and they teach learners with different voices. This is in line with the multi-voicedness principle of activity theory, which states that the community in the activity system is made up of different point of views, traditions and interests (Engeström, 2001).

Contradictions: The central role of contradictions as a source of change and development

According to activity theory (Engeström, 2001), contradictions between people involved in the activity are the source of change and development. As mentioned above, they indicate that curriculum changes are at theoretical level in somebody's mind and at a higher level. This is due to contradictions among all the people involved in the education system in South Africa when they were having discussions about what could be done in South Africa to address the issues of the past. As the curriculum developers were

involved in the discussions, they decided to change the curriculum and develop the new curriculum because the traditional curriculum was having the following problems:

... Eh, the apartheid education did not give us skills as scholars to help learners to understand school science. Eh, and even the training that the teachers received in those apartheid days it was transition mode. It was not learner action based where learners take responsibility for their own learning. . (Appendix B1, Day 4, L12)

The contradictions resulted in curriculum change from traditional education to OBE to RNCS. In the new curriculum, the learners' context is taken into consideration and this curriculum allows learners to use their context when they learn and solve problems. Learners are actively involved and they take responsibility for their own learning. One of our science education lectures always mentions this during our contact sessions during the course of this study.

Historicity: Activity system takes shape in the social plane and the changes in thinking take place over a lengthy period

Problem solving requires more time but maximizes non-routine thinking

When learners solve problems, they need time to work together and discuss in their groups, to play around, to think and probe, to internalize and make sense of what they have learned. During the process of problem solving, non-routine thinking is maximized.

... You need to have more time. Ja, but you cover a lot of things learning this way. Ja, you can cover quiet lot of things, the skills that come through as well, communication skills, negotiation skills and making decision and all the critical outcomes come through here. That is what good about it, although it takes time but learning it maximizes. . (Appendix B2, Day 7, L470)

... I need more time to involve them before they can produce the posters. . (Appendix B2, Day 5, L 298)

... it takes time for them to be able to work together and come up with something like this. . (Appendix B2, Day 7, L464)

... You see we planned to do it over a week but now it stretched to three week, which is close to a month. We started on the seventh and today is the fourth it come closer to a month. . (Appendix B2, Day 7, L465)

... but if we give them more time to think and probe, and the period sometimes is get cut and all that. So that affects the working in problem solving because some problems are messy. But what was happening in their minds is that messy kind of thinking process the route to the right answer is a bit messy. They need to get their hands dirty with problem solving. . (Appendix B2, Day 5, L288)

All of the above statements indicate that planning and organising context-based activities, resources and materials and problem-solving activities demand more time. Context is important for problem-solving abilities. When the relevant context for learning science is used, learners are motivated to learn science (Watts, 1994). Therefore, it makes sense to say that an activity system takes shape in the social plane and that the changes in thinking take place over a lengthy period of time (Engeström, 2001). That is the principle of historicity.

Assessment is for learning; it is continuous and it contributes towards assessment for grading

Assessment is one of the most important activities in the process of teaching and learning. Activities need to be assessed and problem solving also needs to be assessed. The educator is using assessment as a reflective tool to enhance teaching and learning, to monitor learning and the development of the learners and to reflect on educators' practices. Assessment tasks are part of the learning programme and contribute to learners' performance continuously. Educators assess learners by using different components such as written work, oral work, practical work, demonstrations and portfolio board presentation. The educator is using marks and rubrics to assess the learners work.

... So this kind of learning is ongoing, hence the assessment will also then be ongoing. . (Appendix B2, Day 6, L310)

... this assessment contribute to their performance assessment tasks that is part of their learning programme. . (Appendix B2, Day 7, L455)

... it is a sustained way of learning. It is not a once off, and it is linked with many other aspects that learners deal with in their daily lives. . (Appendix B2, Day 6, L309)

... where they interact and ask questions and make mistakes leading at the end to a more performance kind of summative assessment. . (Appendix B2, Day 6, L312)

According to Kaino's (2003) research findings, it is difficult to develop lessons and learners' problem-solving skills because problem-solving skills are difficult, but it is easy to assess problem-solving activities. That is why Hobden (1998) suggests that we need to change from assessing learners, using tests full of routine tasks, to assessment that is designed to promote valuable thinking. Assessment for learning needs time because in activity theory the activity system takes shape in the social plane and take place over a lengthy period of time (Engeström, 2001). As the learners do the activities in context, the educator monitors the development of the assessment and keeps records of all assessment marks. These marks contribute to the final marks of the learners that will allow them to proceed to the next grade with the developed science concepts in their context.

Expansive cycles: The possibility of expansive transformations in activity systems

The transformative nature of the new Natural Sciences curriculum

The educator's experience of teaching Natural Sciences is transformative since the introduction of OBE because there is a difference between General Science and Natural Sciences.

...The experience that is transformative for me. . (Appendix B1, Day 4, L12)

The educator is experiencing transformation in teaching Natural Sciences, because the Natural Sciences curriculum includes the context of the learners. In the old curriculum, context of the learners was not included and educators only concentrated on the content, which was too abstract for the learners, especially in science subjects. In Engeström (1999, 2001), expansive cycles are seen as the possible form of transformation in an activity system. In this study, the educator is experiencing transformation because,

during curriculum development activities, the educator is expected to consider the learners' context.

During teaching and learning activities, the educator is following the seven steps indicated in the Engeström's expansive cycle. The educator starts teaching by allowing learners to ask questions about what they wish to learn in a particular topic. In this study, the educator asks learners questions about Matter and Materials in the context of soil. As the learners ask questions, they experience primary contradictions which are individual contradictions (Engeström, 2001). The educator allows learners to discuss and do activities based on the soil as the starting point and their context. As the learners participate actively in the activities, the learners experience secondary contradictions which are group contradictions (Engeström, 2001). When the learners interact in classroom discussions of the activities in their context, they experience tertiary contradictions (Engeström, 2001).

As the learners discuss how to model what they have learned, discussing what to put and what not to put in the portfolio board, they experience contradictions. They examine their new model by presenting the portfolio board to the class. The educator mediates the whole process and assesses the learners as they present their portfolio boards. As the educator assesses the learners, the educator allows learners to reflect on what they have done and learned (see appendix C2, day seven). As the educator allows learners to follow the expansive cycles in their context, the learners learn more about science in their environment.

The contextual nature of Natural Sciences

In this study, the educator was teaching General Science before the introduction of the new curriculum but is now teaching the Natural Sciences curriculum that is contextual. Contextual Natural Sciences gives learners an opportunity to learn science within their environment. Learners use resources from their environment to understand Natural Sciences and to produce portfolio boards. The educator also uses resources from the environment to teach the learners. In this study, the educator used soil to teach Matter and Materials.

...So those real issues they bring from their communities within them. I then place purely in the curriculum. . (Appendix B1, Day 4, L129)

...Yes, all the problems that are raised are real-world problems. . (Appendix B1, Day 4, L114)

All this indicates that learners learn more from contextual learning and that they learn and solve problems in their context.

6.3. ARGUMENT AND DISCUSSION

In this study, the educator develops the curriculum by considering the learners context. The educator also uses the learners' context during teaching and learning and also during the assessment of the learners' activities and portfolio board presentation. To develop the curriculum, which will be using a context-based, problem-solving approach, means that the curriculum developers at a higher level must consider the context of the learners. The educators must remember that the learners in the same school and classroom come from different contexts. Schools are built in different contexts. It is the duty of the curriculum developers to consider the different contexts of learners and educators. The curriculum must accommodate the entire range of contexts to enable curriculum implementers to implement what is appropriate for their learners. The curriculum developers must consult

with the educators who are the implementers of the curriculum at the lower level. The curriculum must be developed in such a way that it will be easy for the implementers to develop their learning programmes, work schedules and lesson plans in their context and their learners' context.

The educator who is using a context-based, problem-solving approach to teach science is expected to consider the learners context all the time. The educator is expected to use learners' context when planning learning programmes, work schedules and lesson plans for science. The learners' activities must be developed in such a way that the learners do the activities in their context, not the activities in their textbooks of which most are not in the learners' context. The educator can use textbook activities but try to link them with the learners' context. The educator provides the learners with the problems in their context. The learners will then solve real-world problems in their activities. The educator assesses the learners' activities and the assessment contributes to the summative assessment of the learners. The assessment is used for learning, not for allocating marks only. The activities provide learners with the opportunity to learn science from their activities in their context.

The educator must ask the learners what they want to learn about in a particular science topic, for example Matter and Materials. As the learners ask questions, the educator will act as the mediator of learning. The educator will assist the learners in answering those questions by asking the learners to discuss and try to answer those questions in their groups. The groups will ask for assistance from the knowledgeable people, such as parents and educators, providing learners with the knowledge in their context. The educator will explain science concepts to the learners by using examples from their context. The activities and problems will be based on their context. The educator allows learners to produce portfolio boards by using resources from their context. Learners in the groups come from different backgrounds, traditions and contexts. As they hold group

discussions, they bring their interests within their contexts. As they discuss, they come to agreement on what to put in their portfolio board that will demonstrate their understanding of the science concept introduced to them and what they want to learn about the topic.

The learners present the portfolio boards to the whole class to show their understanding of the science concepts. As they present the portfolio board, they are asked questions based on their presentation by the educator and other learners from the other groups. If the learners are able to answer those questions, this illustrates how much they have learned about the topic, using their context. Learners reflect on their presentation and the educator assesses the learners on their presentation of the portfolio boards. The assessment is ongoing and the assessment contributes to the summative assessment of the learners at the end of the year.

In this study, my observation of the educator, using a context-based approach, demonstrated that real-world issues were brought into the classroom and put under the spotlight of curriculum development, teaching and learning and assessment. Learning science in the context of those learners will solve the problem of science, which is seen by learners as the most difficult subject in school. This would be possible if learners' needs, interests and contexts were taken into account in the science classroom by educators. In schools, educators impose the content on learners, and this is the opposite of the activity theory. Learners solve routine problems that are too abstract for them and, as a consequence, do not solve problems which are in their context.

9. RECOMMENDATIONS

Since this study was conducted in Grade 8 and most of the results are positive, it is likely that further research can be conducted from Grades 10-12 to establish whether positive results will be obtained. Further attention should also be given to research focussing on learners in Grade 8 learning science when a context-based, problem-solving approach is used, since this study focused on the educator.

The following questions are recommended for further studies:

- How can educators develop curricula that involve the learners' contexts for learners who come from different backgrounds?
- What is the interface between a context-based, problem-solving approach and OBE?
- What are the limitations of a context-based, problem-solving approach?
 - Do all learners learn from the context-based, problem-solving approach?
 - What are the possibilities of extending learners' scientific and technological knowledge, i.e. teaching them a topic that is not available in their own context when using the context-based, problem-solving approach?
 - Is the context-based, problem-solving approach suitable for Grade 12 classes, where there is common assessment of content knowledge?
 - Are all educators ready to teach a context-based problem-solving approach?

6.5. CONCLUSION

The involvement of the learners' context by the educator when developing the curriculum, during teaching and learning, and assessment is a crucial step for the implementation of a context-based, problem-solving approach. The learners are active participants during teaching and learning. The learners solve problems in their context and as a result they develop a better understanding of science. The context mediates learners' understanding of the science content. Context is important in problem solving and assessment of learners' activities is continuous. Assessment is used for learning and in this regard, assessment contributes to summative assessment.

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APPENDICES

APPENDIX: A1

ETHICAL CLEARANCE



**UNIVERSITY OF
KWAZULU-NATAL**

Faculty of Education Research Office
Room A126
Edgewood Campus

Office: (031) 260 3524
Fax: (031) 260 7594
Email: Buchler@ukzn.ac.za

11th December 2008

LTN Khumalo

Student number: 941348424

RE: Ethical Clearance

To whom it may concern:

This communication serves to inform that the above mentioned student has applied for an ethical clearance certificate. This has been approved, but the certificate is yet to be issued.

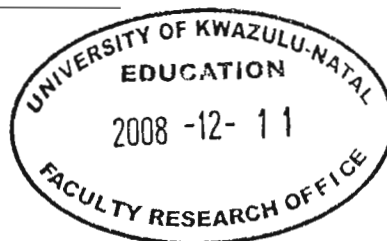
The certificate when issued will be on file in the Faculty of Education should you require a copy.

Please feel free to contact me should you have any further enquiries.

Yours truly,

Derek Buchler
Research Officer

cc. Prof Bhana
File



Faculty Research Office – Education

Postal Address: Private Bag X03, Ashwood 3605, South Africa

Telephone: +27 (0)31 260 3524

Facsimile: +27 (0)31 260 7594

Email: education@ukzn.ac.za

Website: www.education.ac.za

Founding Campuses:

■ Edgewood

■ Howard College

■ Medical School

■ Pietermaritzburg

■ Westville

APPENDIX: A2

LETTERS TO THE DEPARTMENT OF EDUCATION

P. O. Box 519

Hibberdene

4220

7 November 2005

Mr S. R. Alwar.

Research , Strategy, Policy Development and ECMIS Directorate

Private Bag x 9137

Pietermaritzburg

3200

Sir

Application to get permission to do research.

I hereby apply for the permission to do research at Stanger high school in 2006. My name is Khumalo Leonora Thandeka Nontsikelelo. I am a student at the University of KwaZulu Natal in the Science, Mathematics and Technology Education and my student number is 941348424. My supervisor is Dr B. P. Alant, her phone number is 031 2607606.

My research topic is: A context-based problem solving approach in Grade11 Physical Sciences.

I will provide the research proposal once approved and full details of my findings, copies of all articles, papers and thesis once I have completed my research.

Yours faithful

Khumalo L.T. N

P. O. Box 519

Hibberdene

4220

11 July 2006

Mr S. R. Alwar.

Research , Strategy, Policy Development and ECMIS Directorate

Private Bag x 9137

Pietermaritzburg

3200

RE:REQUEST TO GET PERMISSSION TO DO RESEARCH AT ANOTHER SCHOOL.

Dear Sir

I hereby apply for the permission to do research at News Secondary School instead of Stinger High school in 2006. The educator that was identified at Stinger High School last year is now teaching at a private school at Ballito. Due to unforeseen circumstances, it is impossible for us to continue with the research at the new school.

My name is Khumalo Leonora Thandeka Nontsikelelo. I am a student at the University of KwaZulu Natal in the Science, Mathematics and Technology Education and my student number is 941348424. My supervisor is Dr B. P. Alant, her phone number is 031 2607606.

My new research topic is: A context-based problem solving approach in Grade8 Natural Sciences. I will provide the research proposal once approved and full details of my findings, copies of all articles, papers and thesis once I have completed my research.

Yours faithful

Khumalo L.T.

APPENDIX: A3

**PERMISSION TO COLLECT DATA FROM THE DEPARTMENT OF
EDUCATION**



PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATALI
PROVINSIE KWAZULU-NATAL

DEPARTMENT OF EDUCATION
UMNYANGO WEMFUNDO
DEPARTEMENT VAN ONDERWYS

Tel: 033 341 8613

Fax: 033 341 8612

Private Bag X9137
Pietermaritzburg
3200

228 Pietermaritz Street
Pietermaritzburg, 3201

INHLOKOHHOVISI

PIETERMARITZBURG

HEAD OFFICE

Enquiries:

Imibuzo: M Francis

Navrae:

Reference:

Inkomba: 0196/06

Verwysing:

Date:

Usuku:

Datum: 14 August 2006

RE: PERMISSION TO CONDUCT RESEARCH

TO WHOM IT MAY CONCERN

This is to serve as a notice that LTN Khumalo has been granted permission to conduct research with the following terms and conditions:

- That as a researcher, he/she must present a copy of the written permission from the Department to the Head of the Institution concerned before any research may be undertaken at a departmental institution.
- Attached is the list of schools she/he has been granted permission to conduct research in. however, it must be noted that the schools are not obligated to participate in the research if it is not a KZNDoe project.
- LTN Khumalo has been granted special permission to conduct his/her research during official contact times, as it is believed that their presence would not interrupt education programmes. Should education programmes be interrupted, he/she must, therefore, conduct his/her research during nonofficial contact times.
- No school is expected to participate in the research during the fourth school term, as this is the critical period for schools to focus on their exams.

Bhim Thabula

for SUPERINTENDENT GENERAL

KwaZulu Natal Department of Education

APPENDIX: A4

LETTER OF CONSENT TO THE PRINCIPAL OF THE SCHOOL

Ms L. T. N. Khumalo

P. O. Box 519

Hibbberdene

4220

11 July 2006

The Principal

News Secondary School

P. O. Box 324

Durban

4000

RE: REQUEST TO CONDUCT RESEARCH AT YOUR SCHOOL

Dear Sir

As part of my M Ed studies in the Faculty of Education of the University of KwaZulu-Natal I am doing research on context-based problem solving approaches in Grade8 Natural Sciences. I have identified Mr N. Jeff as one of the teachers working towards achieving this goal. I, hereby, request permission to conduct research at your school.

I will do everything to guarantee the anonymity and confidentiality of your school and those that participate in the study.

Thank you for your assistance. If you have any questions you may contact my supervisor, Dr B. P. Alant, 031 2607606. I can be reached at 0828318627.

Yours faithful

Khumalo L.T.N

APPENDIX: A5

A LETTER OF CONSENT TO THE EDUCATOR

Ms L. T. N. Khumalo

P. O. Box 519

Hibbberdene

4220

11 July 2006

Mr N. Jeff

News Secondary School

P. O. BOX 324

Durban

4000

RE: REQUEST TO CONDUCT RESEARCH ON YOUR, TEACHING, LEARNING AND ASSESSMENT OF GRADE 8 NATURAL SCIENCES.

Dear Sir

As part of my M Ed studies in the Faculty of Education of the University of KwaZulu-Natal I am doing research on context-based problem solving approaches in Grade8 Natural Sciences. I have identified you as one of the teachers working towards achieving this goal. I, hereby, request permission to conduct research with you.

I would like permission to ask you a number of questions and record the interview, and to use video recorder to observe you during teaching and learning of Grade8 Natural Sciences. No real names will be used to in the write up of the interview .I will do everything to guarantee the anonymity and confidentiality of you as the participant in the study.

Thank you for your assistance. If you have any questions you may contact my supervisor, Dr B. P. Alant, 031 2607606. I can be reached at 0828318627.

Yours faithful

Khumalo L.T.N.

APPENDIX: BI

SEMI-STRUCTURED INTERVIEWS

Day: 4 14-08-2006.

Venue: Educator's classroom.

I .I: *For how long have you been teaching the Natural Sciences in Grade8?*

E: Since 1997, since OBE was introduced.

I: *How has the experienced been like?*

E: The experience that is transformative for me. Eh, the apartheid education did not give us skills as scholars to help learners to understand school science. Eh, and even the training that the teachers received in those apartheid days it was transition mode. It was not learner action based where learners take responsibility for their own learning. So it was completely rote learning. Children simple just regurgitate what the teacher said to them. They sit quietly. They are passive in the class. But in Natural Sciences and at that time it was called General Science and it was a mix of all other subjects. But now Natural Sciences are more focused and it integrates in other learning areas since the introduction of OBE and Natural Sciences. And I found that the learners participate more and are very interested in science. Their interest is shown by their questions that they ask, questions related to their daily lives in what happens at home, that they experience at home. Working around the house in matter and materials eh, playing with mud on rainy days. I can understand that when learners ask questions like that because I also grew up I played around with mud. I made mud toys and all sorts of materials you can lay on hands on, because of the inquisitive nature of children. They want to find out. They ask questions all the time. When immediately the child ask question, that is the moment the child get responsibility and interest in their learning. They want to know more from the more knowledgeable adult or peer.

Natural Sciences allow the space now to do this through using projects even the more action and only learning.

35 2. 1: *With the new curriculum in South Africa, do you think that it has brought about changes in the ways that the teachers teach the Natural Sciences? If, yes, how so?*

E: Yes, it has brought about changes, but these changes are all at theory level. There are in some body's mind that is not in the classroom. And teachers have a little input in the curriculum changes. They merely on the receiving end of policies that are shaped at a higher level, and in practice they must now make
40 sense of those theories and then interpret them in the way that learners can be engaged in their own learning. I think there is still a long way to go in South Africa for teachers to be grabbed in with the idea of allowing learners into interacting with their own learning and taking responsibility.

45 3. *The philosophy underpinning the new curriculum point out to educators having to teach in a different way (i.e. moving the focus away from being teacher centered to being learner centered, moving from the content to context rather than from the content to context in the teaching of Natural Sciences.*

50 (a). 1: *Do you think there is a need for educators to use different teaching approach to meet the challenges of the new curriculum? Which approach do you prefer and use in your teaching of the Natural Sciences?*

55 E: My approach is eh, the hand-on approach and project based learning is an approach for me that works very well. It incorporates the problem solving where learners must identify the problem, and the teacher can also bring some problems on the table, and so can their elders in the community bring problems to the fore, which the learners also experience,
60 in the context, which they live. And in that way we bring those problems into the class, science classroom. The learners can then see that science is

something that happens in everyday life, and is not something that is in the textbooks or that only belong to the teacher, or only belongs to the scientists wearing a white jacket in the laboratory.

65

(b). I: *How do you apply these approaches during teaching and learning?*

E: I design eh, learning experiences that learners can engage so it is a bit challenging to engage such, to design such experiences that allow learners to participate fully in their own learning. And sometimes one can say there are no resources but one can improvise. I use cardboard as power point presentation where learners can imagine that each board or each sheet or each poster that they prepare on certain aspects about what they wanted to learn, can be for me like a slide in the power point, there it is there. So I improvise a lot so that learners can actually engage and construct meaning and take to the peers in a group and take their learning to greater heights.

70

75

4. The new curriculum puts more emphasis on problem solving as a core skill, what are your thoughts on that?

80

(a) *What is your experience of teaching problem solving in your context?*

E: Ja, problem solving is at the heart of project-based learning. The learners must formulate their own focus questions guided of cause by the mentor who assist in shaping these questions. As they are still budding scientists and interacting with nature and materials on their own. Touching and feeling and asking questions and engaging. So the approach eh, that is problem solving begins with focus questions and sustained engagement from a learner side in trying to answer these questions assisted of cause by the knowledgeable adult or peer.

85

90

(b) *How do you involve learners in problem solving during your lessons?*

95 E: Eh, every day problems, because it is not my problem, it is a problem that learners raise. They say what the problem is around the topic. Even, if the kind of problems raised that are peripheral to the topic. I try to bring those, focus them more and in assisting them as a mentor for them in their growth as budding scientists.

100 5.1: *What kind of problem tasks have you used in your teaching and learning of the Natural Sciences?*

105 E: Eh, every day problems, because it is not my problem, it is a problem that learners raise. They say what the problem is around the topic. Even, if the kind of problems raised that are peripheral to the topic. I try to bring those, focus them more and in assisting them as a mentor for them in their growth as budding scientists.

110 6.1: *Have you ever used real world problems when teaching the Natural Sciences? If so how do you do it?*
(a) Explore the philosophy that guided the instructions and application of real world problems in science classrooms.

115 E: Yes, all the problems that are raised are real world problems. If the learner says what is soil made up of? What makes clay soil different from loam soil? Why do mango trees grow so well in my neighbour's house and in our yard the tree is so small it does not want to grow? Why I do not get many mangos of fruit like my neighbour? And yet we plant it, bought it at the same time and shop. That is already an investigation problem for them to solve. So the issues are brought to them by them to the learning situation.

120

(b)1: What are the implications (for teaching and learning, assessment, resources etc.) of teaching Natural Sciences using real world problems?

;) E: Scientists have complained for many years that there is a big prism between what happens in the real world in the learner's own real world, that they experience in the daily basis, interacting with the community, people and there are many people that they interact with, and in the classroom they only interact with one person, the teacher. So those real issues they bring from their communities within them. I then place purely in the curriculum. They are accommodated in that way. So the whole idea of using projects, its then there to help the learners to bring those experiences that they have. And that knowledge eh, whether it is traditional or western or knowledge that they have obtained from somewhere. That is, then constructed further in the group interaction with others and with of cause more knowledgeable person like teacher.

APPENDIX: B2

UNSTRUCTURED INTERVIEWS

140 Unstructured interview with the educator after the lesson

Post teaching and learning interviews with the educator

Day 1. No interviews were conducted with the educator

145

Day 2. Interview date: 08-08-2006.

Venue: Educator's classroom.

Observed lesson: Time: 9H00 –9H45.

150

1. *Did you achieve your outcomes for today?*

E: The intention for today's activity is to find out from the learners what they anticipate? Because the problem solving, the project approach must begin with what the learners want to know, what they are interested in? So that they can be the one's who also be the part of finding the answers. The teacher is not going to give them the answers. They must discover that through further inquiry assisted by the teacher.

155

160 2. *What will you do tomorrow?*

E: Tomorrow will be the follow up of what questions they have and what interest they have and go into finding the answers ehm... series of answers. They co-ordinate what they found with the teachers assistance Then they will present, ehm... will create and present a poster or a board which pulls this information they found to their questions and be able to present it to the class.

165

Day 3. No interviews were conducted with the educator

170 Day: 4 Interview date: 14-08-2006.
Grade: 8B. Venue: Educator's classroom.
Observed lesson: Time: 9H00 –9H45.

175 1. *Did you achieve your outcomes for today's lesson?*

E: Yes, today the outcome was to get the names of different elements. Ehm...to get the names of different elements and making use of their experience in naming the different substances that matter, that soil is made of. And, eh, working from the list they compiled the last time in the previous lesson of the kind of material that soil is made up of. And I divided that into solids, liquids and gases.

180
185 And then to see if the learners can actually state which ones are made of single substance, or which one are made of combination of substances. Where the single substance they will then be able to eh deduce whether that's a compound or element or a mixture. And as you have noticed that the mixture was easy to begin with, because you can take the physical examples. Because of the physical nature of separating the mixture using ordinary household substances like the day they have experienced like chemically, the salt and curry powder to eat green mangoes. And let's say nuts and raisins and other bigger substances.

190
195 Getting the idea that mixtures are made of substances that are combined physically and they can be separated as such. And looking at compounds as ordinary substances mixing with other chemically. And that it will be difficult to separate them physically. And we have the elements as a pure substance and they could mention that. And I am glad they came to conclusion on their own. Where the sheets only helped them to consolidate their own ideas that they came with to their classroom. So I am quiet

200 happy that I have achieved that, and I thought it was going to be difficult to get the stage of them identifying mixtures, compounds and elements. I think that went quiet well, eh making use of their own experiences.

2. *What do you plan to do tomorrow?*

205 E: Now, tomorrow, eh, the homework is for them to list the first twenty elements of the periodic table. And they were also introduced today in how scientists have made all possible elements on the earth and have drawn up a periodic table. And which they were able to identify some of the substances that they mentioned in their list they came up with.

210 Tomorrow I would like to move on to looking how, how these elements that appears could combine together and combine in a chemical way to form compounds and the smallest part of which is there, the molecule. And we will make use of the worksheet page fifteen for them to arrive at the combination of elements to form compounds, using ordinary
215 substances again like balloon, water, and glass, and how those things are formed and how possible these things combine and the product of such things and looking at diagrams and word sentences. And diagrams for using the symbol of compound and formula they come across in today.

220

3. *When are the learners going to start with their posters?*

225 E: Now the poster stage, which I am trying to rush too, is to move from the mixtures. Because soil where these meso-organisms can be found is leafy, moist, loamy type of soil which is more of a mixture, but one will find compounds in there which are then used to make food in the plants in photosynthesis. And then, hence the soil actually helps these organisms to live because of the food that is in that type of soil. That comes the plant and the insects so that there is a food chain to see how those matter and

230 materials has been actually transferred in the energy flow within the food
chain. And in that way, then they will see that matter and materials that is
in the soil actually is useful to support and sustain biodiversity in the soil
of these organisms that live there which is the overall unit that conserving
biodiversity.

235

4. *What was the overall lesson how was it?*

E: The overall lesson was very good. It was so interesting to see the learners
themselves dividing solids, liquids and gases themselves not being told by
240 the educator. And how the educator introduced elements, compounds and
mixtures. It was so amazing to ask the learners, especially the part of
mixtures. It was so interesting when we asked how they eat mangos at
home. They all raised their hands and they all wanted to talk and the ones
that were sitting next to me some of them mentioned sugar and knorox. I
245 was so surprised to see them looking at the mixture and how the educator
bring down to very few particles in the mixture not having too much. And
when they were asked how they separate oranges and apples. It was so
easy for them to see that you can separate those easily, but with salt and
curry powder it was a little bit difficult for them to tell whether it is
250 possible. Or, because some of them are saying the particles are so small,
they themselves are saying it not the educator. The educator is not telling
them how to separate them. But what we use to do before. We use to come
to class and tell and read from the textbooks the examples. But in this case
when these learners learn, they learn from what they have from their
255 environment. May be they all have mangoes at home and the issue of the
mothers ring. That one was so interesting, because they see these rings
everyday but they never thought of what material is made up of. The other
one even said copper, the others were asking copper and some were
surprised. I was asking them why they are surprised, because copper is
260 also good.

Day: 5 Date: 15-08-2006.

Grade: 8B. Venue: Educator's classroom

265 Observed lesson: Time: 9H00 –9H45

1. What can you say about today's lesson?

270 E: They would have understood what I told them, but going home and them doing it
on their own showed me that the interpretation of this thing was not easy as I took
it for granted that they would do it. So that, that, and that what I get it is that with
those two who had made an error in following the table, they couldn't really follow
properly. I think he got a better chance on how to move from one to twenty in this
275 table. So I had to a little bit more time here, so I found that part the learners had to
get a better understanding and interpretation of this table on their own and so that
slows us a little bit down. And then they are coming to grips with the element in
the soil and the elements in the animal body that took a little bit along for them
also to interpret that way. That these elements that are in the soil eventually do
280 end up in the animal's body, because the animals get the elements from the soil
indirectly by eating these things. So that link was necessary as well. And I took
for granted that there will be a natural move over to this. Whereas the way that the
understanding and the fact that I use that plant some roots by chance that they
could see that roots have this job of getting elements from the soil .So I need
285 another week or two weeks for learners to internalize and make sense, play and
discuss and we need more of that. But these are contrived situations is like forty
minutes lecture that we are taking. That is my concern is that this is gonna put
the child on the spot and not think clearly. Ja, but if we give them more time to
think and probe, and the period sometimes is get cut and all that. So that affects
290 the working in problem solving because some problems are messy. The route to
the right answer is a bit messy. They need to get their hands dirty with problem

solving. They can't sit neatly and get everything. Like I planned neat activities. But what was happening in their minds is that messy kind of thinking process and they need more interaction and more discussions.

295

2. *Do you think Thursday will be ok?*

E: Ja, I will say let's aim for Thursday because I need more time to involve them before they can produce the posters.

300

Day: 6 24-08-06

Grade: 8B. Venue: Educator's classroom.

Observed lesson: Time: 8H15-9H00.

305

1. *How do you assess these problems?*

E: Problems as I said to you, using problems and project in the learning of children is not a new thing, as I said earlier that, it is a sustained way of learning. It is not a once
310 off, and it is linked with many other aspects that learners deal with in their daily lives. So this kind of learning is ongoing, hence the assessment will also then be ongoing. Because, when you monitor assessment, which will be then developmental, where they interact and ask questions and make mistakes leading at the end to a more performance kind of summative assessment. Where they then construct their own
315 meaning and explain that to each other in the form of presentation or a showpiece.

2. *How do you design the curriculum or your workbook or your workbook activities?*

E: Ja, the workbook begins with the topic that is designed in the curriculum.
320 Now they have a clear topic that needs to be taught. It is also skills based that are clearly laid out in the in the standards in the policy documents. Then, when the learners bring to the fore around certain core areas in the

325 syllabus. I would first begin my activities by asking them what they
already know about the topic. So the learners will engage with me and be
very happy to explain these things, because it is the stuff they know
around the topic.

330 And then I will follow up that by asking them all the things they are
interested around the topic. So they can also now give me more, not just
what they would like to know, and in that way I suddenly infuse the
content that I am aware of which they are not aware of. And bring that,
and integrate that with the curriculum and their own prior knowledge and
their interest and in that way I develop curriculum around that.

335 3. *What are you going to do today?*

E: Today I am going to follow on those questions and interest and what they
would like to know, that they have raised in the previous lesson. And then
take that further in terms of them digging some of the core knowledge as I
have said earlier. That is in the syllabus, that I will infuse with the
340 questions that they and the interest that they have. And then later on, then
for them to put that knowledge together in a form of poster which they
must then present to the peers and the panel.

345 3. *When is the presentation?*

E: I am hoping that the presentation will be tomorrow, but then we have to
take learners own pace into account and think it might need another two
days. Because they have to negotiate the construction of their' own
knowledge in the poster and then ready to answer the questions from the
350 panel on what they have done.

5. *At the end of the session what are you hoping to have achieved?*

355 E: I am hoping them, to have known the different type of elements that are
found in the soil. From the question that they have raised in their papers,
and then take them to the periodic table which scientists have already
compiled for us in terms of the elements. Then I would like them to look
at these, carbon, gold, iron, hydrogen and calcium. And specific those that
will be evident in the soil or could come up like iron. And then they will
360 be able to tell us which symbol or letters or formula, will represents these
elements or compound that will see later on. Coming from the staff that
scientists have done, and this enhances their knowledge of matter and
materials. What type of phases and then these types, which is elements,
compound and mixture. And then that finally lead into how then these
365 elements combine as compound and diagrams and word sums and
chemical symbols and formula making up these the way scientists write it.
And then we will use a balloon and ask them how does the gas get into the
balloon? Is it a gas or a liquid or a solid? And what gas they think it is? If
it is a gas. And if it is a liquid? What liquid it is? And in the glass of water
370 they drink daily, what phase is that water? Will that water be an element
or be a compound? They will then be naturally gets to that stage, having
known what these things are made of? And then mixtures of cause will
help us to take us to soil and make up a compost heap that we will make
later on. And then design such a compost heap using ordinary material that
375 they found at home. And then making sure that the animals that can live in
the compost, like earthworms and more other animals that that we will be
doing in the next unit which is life and living. And you can see the bright
of animals that will be coming across and of cause making food webs and
that kind of thing. But this is a unit that follows matter and materials

380

Day: 7. Date: 04-09-2006.
Grade: 8B. Venue: Educator's classroom
Observed lesson: Time: 9H45 – 10H30

1. *Did you achieve your outcome today?*

390 E: Yes, we achieve it, eh...the learners managed to present their portfolio board of their knowledge that have constructed. They didn't work completely on their own they also asked me to assist here and there to come up with the product that you see in front of us.

2. *But, do you think they have learnt about this matter and materials?*

395 E: Ja, you have seen what they have put together and the way they actually struggled to get to this stage shows that it was very engaging on their part. And when the children are engaged then they learn more.

3. *What are you going to do now from here?*

400

E: Eh... they have presented now, now that they have learnt about different elements, compound and mixture in the soil. And the types of soil where these meso-organisms will be found, then we will now go to such a spot within the school grounds and collect a sample of soil in place where there is loamy soil, leafy soil matter. To try to find out what is the variety of soil that these meso-organisms that are found there. Then they will bring some samples to the class to identify these organisms in the soil in their natural habitat. And they will use the identification sheet in their notes their worksheet book. They will actually identify the variety of meso-organisms found in the soil.

405

410 4. *Can you explore the philosophy that guided the instruction and application of real world problems in science classroom?*

E: Eh... they have presented now, now that they have learnt about different elements, compound and mixture in the soil. And the types of soil where these meso-organisms will be found, then we will now go to such a spot within the

415

school grounds and collect a sample of soil in place where there is loamy soil, leafy soil matter. To try to find out what is the variety of soil that these meso-organisms that are found there. Then they will bring some samples to the class to identify these organisms in the soil in their natural habitat. And they will use the identification sheet in their notes their worksheet book. They will actually identify the variety of meso-organisms found in the soil.

5. *What are the implications of teaching Natural Sciences using real world problems?*

E: The driving question that is also on top of each board drives them to be able to see how they can solve the problem, engage in the learning and then finally construct the portfolio boards with all the understanding that they gained in the lessons that took place prior to this. So, for me the challenge here is for the learners to have the resources such the portfolio boards themselves and to also get some of these real world kinds of items such as nails, copper, lead and in their clean state and in their rusted state. So that they can see how an element has changed to a new substance, which then became a compound. And then put these on the board and be able to identify them using for instance a periodic table of elements that they also have in their workbooks.

435

6. *Why did you choose soil as the point or as something that you are going to use to teach matter and materials?*

E: This unit is a sub unit of a broader unit that talks about conservation. What are the varieties of different soil meso-organisms that live in the soil? Where do they live? Which type of soil they live in? And then later on they come and identify them in their natural setting. And then use the identification sheet even then does the classification of life and living organisms in their natural setting. Soil is the major component for them to be able to identify this variety of diversity of meso soil organisms.

445

7. *How are you going to assess them?*

450 E: They assess using the rubric when they present it and the panel that will then listen to each child input and then fill questions to the learner that is presenting in terms of what is on the board and in terms of what they enjoy about learning and what they learnt.

455 8. *Does this assessment contribute to their marks?*

E: Yes, this assessment contributes to their performance assessment tasks that are part of their learning programme.

460 10. *What do learners use to make these colours on their portfolio boards?*

E: Ja, the colours these are the resources we are talking about. Things like koki pens and that I have to go and buy them. Its fourteen rands each koki, that is red, blue and black. But, it is a challenge teaching this way, its take time for them to be able to work together and come up with something like this.

465 You see we planned to do it over a week but now it stretched to three week, which is close to a month. We started on the seventh and today is the fourth it come closer to a month. Ja, but last week I was not here, so we have to move to now. But in actual fact you have to take five days. To me I don't think it's the easy way of teaching? You need to have more time. Ja, but you cover a lot of things learning this way. Ja, you can cover quiet lot of things, the skills that come through as well, communication skills, negotiation skills and making decision and all the critical outcomes come through here.

475 That is what good about it, although it takes time but learning it maximizes.

APPENDIX: B 3

SEMI-STRUCTURED OBSREVATION SCHEDULE

Date: 07/08/2006 to 04/09/2006 Time: 09h45 to 10h30

480

1. Physical setting.

The physical setting involves the physical environment (including resources) and its organization.

485

School name: News Secondary School

Location:

Rural.	Semi-rural.	Urban.	Semi-urban.
			X

School Type:

GET	FET	Both GET and FET
		X

490

4		
Facility.	Availability	Comments
CLASSROOM FACILITIES.		
Grade 8classrooms. (permanent)	Yes	Learners move from one class to another.
Grade 8 classrooms. (temporary).	NO	
Desks per classroom.	18	
Writing board (s).	1	
Dedicated display area (for charts).	Yes	
Educator's table.	Yes	
Educator's chair.	Yes	
Cupboards.	Yes	
Textbooks.	Yes	
Stationary (papers, exercise books etc.)	Yes	
Writing aids (pens, pencils, calculators etc.) for learners.	Yes	
Science corner.	Yes	
ADMINISTRATIVE FACILITIES.		
Principal's office.	Yes	
Deputy principal's office.	Yes	
Head of department's offices	Yes	
Staffroom.	Yes	
EDUCATIONAL FACILITIES.		
Library.	Yes	
Library books.	Yes	
Library shelves.	Yes	
Science laboratory.	Yes	
Laboratory equipment.	Yes	Very few.

Computer laboratory.	No	
Computer (s).	No	
Video Camera recorder.	No	
Television.	No	
Video recorder.	No	
Radio.	No	
Overhead projector.	Yes	
Photocopy machine.	Yes	
Posters.	Yes	
Internet.	No	
RECREATIONAL FACILITIES		
Sports field.	Yes	
Sports equipment.	Yes	
INFRASTRUCTURE		
Toilets.	Yes	
Security system.	Yes	
Electricity.	Yes	
Water availability.	Yes	
Access by road.	Yes	

2. Human setting

495 The human setting involves the organization of people, the characteristics and make up of the groups or individuals being observed.

Learner's information

Grade.	No. of learners.	F	M	Learners doing Natural Sciences.	F	M
1						
2						
3						
4						
5						
6						
7						
8	220			All Grade8.		
9	225			All Grade9.		
10	240					
11	198					
12	217					

How do learners get to school?

They walk.	Travel by buses.	Travel by taxis.	By their parents transport.	Travel by bicycles.
Yes	Yes	Yes	Yes	No

500

Educator's information

Principal.	Deputy principal.	Head of Departments	Educators.
Yes	Yes	Yes	Yes

School's language policy

English medium school, they also offer Afrikaans and Isizulu. English is the language of teaching and learning. Learners can choose between Isizulu and Afrikaans.

505

Language used	English.	IsiZulu.	Afrikaans.	Other.
Learner's home language	Yes	Yes	Yes	-
Teacher's home language	Yes	Yes	Yes	-
LoTL	Yes			
Language used in Natural Sciences classrooms during teaching and learning.	Yes	Yes		
Language used during group discussions	Yes			
Natural Sciences educator's home language.	Yes	Yes	Yes	Isixhosa

510

3. Programme setting

Programme setting involves pedagogic styles, curricula and their organization.

515

What kind of curriculum is being followed and how it caters for teaching and learning in context?

[OBE] RNCS, NCS NATED 550. The educator is using these documents when developing learners workbooks and activities. Learners environment is used teaching and learning
Learners context is used, e. g. soil, animals, home cleaning materials, parents, earthworms and rats.

What characterizes the pedagogic style of the educator? How does the style cater for teaching and learning in context?

Project-based, context-based and problem solving approaches are used during teaching and learning.
Learners are allowed to use their environment during teaching and learning.
Examples used during teaching and learning are not taken from the textbook, but the learners context is used. Teaching is learner centered. Learners are willing to ask questions and they are active during class discussions. Learners are always sitting in group during teaching and learning.

520

How does the educator engage his or her learners in the teaching and learning situation? How are learners engaged in context based learning?

The learners are asked to read the information in the workbook that involves their context.
Pictures from local newspapers are used. Resources are taken from the learners environment e. g. soil, and plants etc Learners are asked to relate the topic to their context.
Learners are encouraged to bring learning material from their environment and homes.
The educators keep on asking questions throughout the lesson.
Learners are asked to explain their statements. Group discussions are encouraged.
Learners are encouraged to participate during class discussions and ask questions.
All learners views are accepted, they are not discouraged by telling them that they are wrong, all answers are discussed until the learners discover that the answer is wrong.

525

How does the educator prepare the teaching and learning tasks, for teaching and learning in context?

The educator prepare the activities beforehand in the learners workbook and the learners context in the classroom. The educator ask learners a day before to bring resources from their context to the classroom. The educator provide the learners with the resources e. g. soil, portfolio boards.
The educator prepares activities for both individual and groups. The textbooks are used to prepare the workbooks and activities not during teaching and learning.
Lesson is prepared according to the learners needs. The lesson is prepared from the learner's context to the content.
Learners' prior knowledge and experience is considered during the preparation of tasks.
The activities involve the learners and allow them to give new ideas about the topic.

How are the learners being assessed? How does assessment cater for teaching and learning in context?

Assessment is sustained and continuous. The learners do activities and submit them for assessment. Discussions are open and based on learners' responses, they are asked to explain why they are saying that or why they are surprised.
From their explanations they are assessed.
They work in groups and produce the portfolio boards based on what they have learnt.
They present their portfolio boards to the class and they are assessed. Each member of the group present and assessed.
They are asked to explain whether they have learnt or not from the discussion that led to the production of the portfolio boards by using materials form their homes and environment.

530

4. Interactional setting

535 The interactional setting involves formal, informal, planned, unplanned and verbal, non-verbal interactions that take place during observation.

What happens in the Natural Sciences classrooms in terms of interaction that are taking place?

Interactions	Comments.
Formal	The workbooks are given to the learners with the activities. The learners do the activities on their own and ask questions where necessary from the educator. The educator keep on asking questions throughout the lesson and the learners also ask questions. Some learners ask irrelevant question to the topic. Learners are involved in group and class discussions all the time. They work hard in discussing the content to be included in the portfolio board based on the question they posed with the aim of solving the problem.
Informal	Learners are allowed to work during break times as groups and also to come to the educator for clarity and assessment.
Planned	The educator plans the activities in such a way that the learners are actively involved throughout the lesson. Planning involve the learners in planning for the following activities by asking them to bring the relevant learning materials.
Unplanned	Learners ask any question and the educator do not throw away the irrelevant question. They discuss it until it is clear to every one that it is irrelevant or not. Sometimes the learners come up with new ideas out of the discussion. Educator asks probing questions to activate the learner's minds to think about the topic.
Verbal	Educator interacts with the learners by asking many questions and allows learners to respond and to think about the topic. Learners are willing to answer the questions posed. They involve in small discussions most of the time during teaching and learning.
Non-verbal	Educator identifies the passive learners and look at them, and the learners start to work after the look. The learners use their heads and hands to indicate if they understand or not it the educator is mentioning something.

APPENDIX: B 4

CLASSROOM OBSERVATION OF CLASSROOM ACTIVITIES

Data collected at a News Secondary School.

Educator: (T).

Learner: (L).

Day one.

Date: 07-08-2006

Period 3.

Venue: Educator's classroom.

Time: 9H45 –10H30.

Grade: 8B

T: Take out your workbooks and do activity 5. (The educator writes the question on the board). [Write a short paragraph (10lines) where you explain how soil is useful to.

- i. Plants.
- ii. Soil meso-animals living in the soil.
- iii. Humans.]

At the end of that number three 3, see page 8 information sheet. Page 8 is about new ideas for you to answer that question. We will need to know this so that we can start with the new one. Let me give you one minute to complete those questions. Some people write very slowly.

T: What are you looking for? You haven't been writing all this time. Where is your pencil? Why don't you take a pencil and write with it. Your mother said, bring the pencil and you took another one. Why do take another boy's pencil.

L1: To use it to write.

T: Heh, to write. Ok, when I am done, you must come to me so that we can sort things out. I said you must the sheet stretched down this thing here. In fact you never listened to me, to the instructions given to you. Ok, those who didn't finish must finish during break time. Lets stop here now. Can you stop there those who haven't finish will finish during break time.

Ehm, I said at the end of number 3 you must say, you must write there see page 8, because there are some ideas for you. There in the information sheet, you will need that

information for this activity. You will need that information when you look at the next session.

T: Let's go back to page 3. What is on top there? What is right on top there? There is a topic. Can someone read it out first, it is written there at the box right on top of the thing.

T: Again.

(All learners read: Soil study).

T: Another information there.

(All learners read: Earth and beyond)

T: Now these pages back up to page 11, they all dealt with, what?

(All learners say: Soil.)

T: How does soil ehm, fit with this area earth and beyond? Does it fit in or does not fit in.

Put your hand up if you know.

L 2: It fit in.

T: Explain how soil and earth and beyond fit in?

L 2: Because soil is in the earth.

T: Again.

L2: Because soil is in the earth.

T: Yes that's the only place you can find soil. You can't go up in the air and find soil.

How many types of soil do we find in this world? We can classify soil in three different types. It looks like you didn't learn it. Give us one. Ja.

L 3: Clay.

T: Clay, right, you?

L 4: Sand.

T: Right, sand, you?

L 5: Loam soil.

T: It's not loam, its loam soil , say?

L 5: Loam.

T: All of you.

(All learners say: Loam.)

T: Right, the second part of this book is of ours will deal with new topic that is on page 12.

(All learners turn to page 12)

T: Are you all on page 12. I will ask you to read the first 3 paragraphs. The first 3 paragraphs.

(All learners read the first 3 paragraphs quietly.)

5 T: The time I have given you is up. You must not read all this. I will ask you few questions. Look at the topic at the top please. Is the topic the same as the first one? What is the difference between the two? What is the topic?

10 Do not worry about the second page of those three paragraphs. I ask you to leave. That is what you should be reading about, put this one, one side, you will finish during break time.

Please look at the page number?

Look at page number 12.

Ok now you have read the first 3 paragraphs.

What is right on top of the end, yes?

15 L 6: Soil study and matter and materials.

T: Again.

L 6: Soil study and matter and materials.

T: Is it the same or is it different? Tell me. Tell where it is the same and where it is different?

20 L 6: Sir, it is different. The first one is soil study and earth and beyond, and this one is soil study and matter and materials.

T: Is there something else? Is it different or is the same? Because of this one, but this here. What do you want to say?

25 L 6: Sir is different. Nothing is the same, Sir. There are nothing different, because in the first topic there was soil study and in the second study there is soil study also.

T: All right, they are both soil study. So as we said the overall of this eh...this programme we are using here, is on page one. Look at page 1, right on top.

L 7: Environment.

30 T: Environment is some place where you live in or some place out there, or some place where we all live, and this whole earth is one massive environment. But even where we

stay or where we live is the environment. This environment is the whole area the people that live in, the animals, the grass, the plants and everything else.

The second topic under environment is called conservation. The conservation meaning that you look after something.

35 The focus of this whole unit talks about what? Can you read the next heading is quite long? Longish. Can you read all of you?

All learners read: What diversity animal like in and on the soil.

T: Can you speak loudly please?

All learners read: What diversity animal like in and on the soil?

40 T: Loudly?

All learners read: What diversity animal like in and on the soil?

T: Right, we are talking about animal life these animals we are speaking about are huge animals such as elephants, or giraffe, or dogs, or pigs or we are talking about what? Put your hands up, you.

45 L 8: Ants or grasshopper.

T: Loud.

L 8: Ants or grasshopper.

T: What are their sizes?

L 8: Smaller.

50 T: They are smaller, because certain animals are huge animals like elephants and giraffe. Here we are talking about animals that are much smaller like ants, what is the other one?

L 8: Grasshopper.

T: What is smaller than the other one?

L 8: Ants.

55 T: You said ant or grasshopper, anything smaller? Anything smaller, which one? Yes.

L 9: Intwala (lice) Sir.

T: Intwala, where do we find intwala? Put your hands up. Who has the answer? Siyitholaphi lento okuthiwa intwala, ihlalaphi?

L 10: In the pigs.

60 T: In the pigs, yes, wena (you)

L 11: Yes Sir, inside here. (The learner is pointing her head).

T: Have you seen it in the dogs?

(All learners say: Yes Sir.)

65 T: Right, so we are talking about these animals, they are not very small like bacteria are very small. We have various bacteria and we need a microscope to see them. But these ones, we are talking about are called meso- organisms. We can see them with our eyes. Intwala siyayibona angithi. (We can see lice, isn't it?)

(All learners say: Yes Sir.)

T: I ants, we can see them.

70 All learners say: Yes Sir.

T: U fly, siyayibona angithi. (We can see it, isn't it).

(All learners say: Yes Sir.)

T: U locust, naye siyambona angithi. (We can also see it, isn't it?)

75 T: So, our topic, this one that said matter and materials. So let me link up. The first one was earth and beyond, that talked about soil. Soil is important for these organisms, these small ones, ants and locust and so on.

Look at that question which said how is the soil important to these animals? Big ones and small ones, so if we have to go and look for these animals, so ehm..., like what? Ants and mosquito think about the animals I am going to ask you.

80 Think of an animal the one that you see, the one that you like, the one that you hate and the one that you scared off. And I am going to ask you why you are scared, where does it stay?

Ok, let us start with you. where it stays? Where does it stay? Ok, let's start with you, wena?

85 L 12: Mosquito.

T: Where does it stay? Kulaphi la ihlala khona?

L 12: Emanzini amile. (Still water)

L 13: Ants.

T: Where does she stay?

90 Learners laugh.

L 13: They come from the floor, ground, table, and roof.

T: Where?

- L 13: On the ground.
 T: On the ground. Wena (You).
- 95 L 14: Frogs.
 T: Where does it stay?
 L 14: In the river.
 T: What is your animal?
 L 15: Star fish.
- 100 T: Where does it stay?
 L 15: In the see.
 T: Did you see it there?
 L 15: No Sir.
 T: I am asking you the animal that you have seen. The favorite one, the one that you are
 105 scared off. You like it or you scared, you throw it away. Ngisho lokho. (I say that). I will
 come back. Wena (you).
 L 16: Elephant.
 T: Where does it stay?
 L 16: In the bush.
- 110 T: Ok, wena (you)?
 L 17: Snakes Sir.
 T: Isnake , ngesiZulu kuthiwa yini? (What is the name of snake in Zulu?).
 L 18: Inyoka.
 T: Ihlalaphi inyoka? (Where does the snake stay?).
- 115 L 19: Ihlala ehlathini. (It stays in the forest).
 All learners laugh.
 T: Ngizonibuza ngokudla. (I am going to ask you about food) Idlani le animal? (What
 does this animal eat?). Your animal?
 L 20: Shark.
- 120 T: Where does it stay?
 L 20: See.
 T: By the see. What does it eat?
 L 20: Meat.

- T: Meat, your animal?
- 125 L 21: Dog.
- T: Those are the big ones. We want the small ones, you?
- L 22: Fish.
- T: You?
- L 23: (Quiet).
- 130 T: I will come back to you, which means you are not concentrating. You see, he is holding his chin. You must not hold your chin, just relax. I will just come back to you. You.
- L 24: Cockroach.
- (Learners laugh.)
- 135 T: You?
- L 24: Cockroach.
- T: Just explain, whether you hated it? Or you liked it?
- L 24: At home.
- L: Just explain where did you see it in the home, in the roof, bedroom?
- 140 L 24: In the bedroom.
- T: You?
- L 25: Izenze. (Tick).
- T: Now, please tell me, what does it eat, this one eat?
- L 25: Blood Sir.
- 145 T: It eats blood, uyasazi lesi silwane. (Do you know this animal).
- Learners laugh.
- T: Here is one of these meso-animals. [Animals are in the Daily News paper.] Uzosinika igama laso.(You are going to give it the name).
- Learners start to talk and make noise.
- 150 Uzositshela (You are going to tell us). What is its name? Zulu name, Xhosa name, nesi Sotho name.
- (Learners say hawu!)
- T: Ungayisabi, ayilumi, ayinamlomo. (Do not be afraid, it does not bite, it does not have mouth). When we were doing Grade3, Majozi scared lezi zinto lezi (these things).

- 155 Ngiyibambe ngiyibeke la (I take it and put it here). Athi (he said) Hhi-Hhi Hhi-Hhi. Bese ngiyahamba futhi (then I go away), he said Hhi-Hhi Hhi-Hhi. And I said, come closer ngizoyibeka la kuwena (I an going to put it here on you). Abaleke (he ran away).
So, who has seen this one? Wena, awusho, uyibone phi? (You, tell us, where did you see it?).
- 160 L 25: Sir, ngayibona enhlabathini.
T: Awusho ngesingisi manje. (Say it in English now).
L 25: I have seen it on the soil.
T: What type of soil? We have learned about three types of soil. Let us not say soil. Now we need to give the name of the soil.
- 165 L 25: Sandy soil.
(Other learners say mmh, mmh...)
T: I did not think that you have to be exited about what she has said.
L 26: Lum soil.
T: Loam soil, say loam soil.
- 170 L 26: Loam soil.
T: Ithi (say) L O A M, u loam is loam just like u brum. Loam uno O. Say it.
L 26: Loam soil.
T: W ho has seen the animal?
L 1: I have seen it Sir,
- 175 T: Where, in the muddy areas? Where?
L 1: Sir.
T: Where did you first see it, in town, ehm... in Johannesburg, in Newlands or at home? Le ndawo (this place).
L 1: At home.
- 180 T: What kind of soil?
L 1: At home, Sir. Sir, I saw it at home Sir. That day Sir, it was raining at home, so ehm... and the other day the soil was muddy ehm...it is wet, the soil was muddy. It saw it eating mud.
T: Can it eat mud? So...yes. You have got it. Does this animal eat mud? Your animal eats
185 blood? Your animal is?

L 27: Worm.

T: This worm? (In the cover of the book).

L 27: No Sir.

T: Which worm?

190 L 27: Millipede.

T: Millipede is a worm. What does it eat?

L 27: Mud.

T: Where did you see it, by the house or where by the town?

L 27: By the ground.

195 T: There is ground by the house or you play soccer?

(Learners laugh.)

T: Ok, ok that is good you have ground by the house. Ok if you have a big yard you can have a ground by the home lawa esikhuluma ngawo (the ones we are talking about). Ok this animal, you? Have you seen this animal? Uyasesaba noma awusesabi (are you scared if it or not).

200

L 27: Ngiyasesaba. (I am scared).

T: But, ayilumi, ayinamlomo, ayinalutho (it does not bite, it does not have mouth, it does not have anything).

So, bantwana (children). Ok, so anyone who must bring one for us in a tin. You must put a little bit of soil and put some leaves and bring one for us. You must bring one. So where is this place where she must go to find this animal? She is a learner, she will go with a stick. Call big brother, because she is scared of it. Ok.

205

It looks like which animal? It will help you to describe.

L 27: It looks like the snake.

210 T: But it is slower this one. If it comes for you, you do not have to run because it can't run. It have no legs, no eyes, no mouth, it can't see lutho lo (nothing this one).

L 27: It looks like a snake.

T: What does it mean?

L 27: It looks like a shongololo (millipede).

215 T: That boy next to you, ask him for a millipede. That's the one that looks like it, but that's a centipede.

Now you see all these animals that live in the soil. You said you are going to bring to us. Who else is going to bring us, one? You bring us one, put it in the tin or put it in a plastic. Who will bring us sand, you will bring one. Now when you dig the soil you will find

220 more animals besides lo. Bakhona abanye futhi (There are other ones).
Give me the names of those animals that you find.
L 1: Ants.
L 5: Earthworm.
T: Yiyo ke le (This is the one). Which other one besides ulo (this one)?

225 L 28: Snails.
T: You are also scared of the picture? You see them on the TV. You saw someone was eating it, eat its meat.
L 28: Yes Sir.
T: Its meat, different meat

230 T: mhh..., our question that we want to find out.
What is the topic? On our sheet at the corner there.
(All learners say: Matter and materials.)
T: I can't hear.
L 28: Matter and materials. (Loud)

235 T: All of you.
(All learners say, Matter and materials. (Louder)
T: Can we say that these animals that live in the soil, that they want something from the soil?
(All learners say: Yes Sir.)

240 T: Or they don't want something from the soil?
(All learners say: Yes Sir.)
T: What is the thing they want in the soil?
L 29: Food.
T: Let's write these things down, they want food. What else they want? These things like

245 ants, snakes, and earthworm.
L 29: They want food.

T: What else they want in the soil? O ants' laba, no snail, no earthworm bafunani lapha enhlabathini (these ants, and snails and earthworms, what they want from the soil).

L 30: Mud.

250 T: Udaka (mud). Bathi bazolwenzani udaka (What are they going to do with mud). Balufaka phakathi udaka, kuphi, esiswini noba lapha emilenzeni? (Do they put mud inside, where, in the stomach or in the legs?).

(All learners laugh.)

L 30: Esiswini (In the stomach).

255 T: Loludaka lapha esiswini lwenzani? (what do this mud do in the stomach)

L 30: Luyasuthisa, (To full up the stomach) Sir.

All learners laugh.

T: They want mud to full their stomach. What else they want?

L 31: Shelter.

260 T: They want shelter.

L 32: Roots.

T: They want roots for what?

L 32: To eat Sir.

265 T: So ... some of these they are eating roots, they are eating. What else they want, abo ants, nabo earthworm, yini le abayifuna la enhlabathini (ants and earthworms, what is it that they want from the soil)?

L 33: Rotten leaves.

T: What they want is rotten leaves. Rotten leaves also are food, rotten leaves.

You said roots, you said rotten leaves, what else?

270 L 34: Water.

T: We can say water goes with the food. Don't write these things down. Don't write it down. What else they want in the mud in the soil? You said soil is lose one and as loamy one. Who said angeke zihlale khona (they can't live there)? Akekho (No one). There are no fragments of pieces of animals and plants.

275 Remember we said is organic that contain fragments of pieces of animals and plants. What these animals want there in the soil with all that.

L 35: Shelter.

T: What else you think they want in the soil.

L 35: Dust.

280 L 36: Leaves.

T: For 1 and 2. Now if you look at that top one, food. What type of food do you think they need? Someone said leaves, rotten leaves. Let's try to give some more examples.

L 37: Rotten food.

T: Leaves, fragment of animals, bone, so. What question do you still have in your mind?

285 About all these animals that there are in the soil, that they say there must be some water, endaweni eyomile angeke ziphile khona (they can't live in dry areas). Like you said the water goes to the loan. Sizifumana kuloan (we get them in loan). Iloan has got all the loamy types of soil, akhona ku loan (they are found in the loan). If kukhona le tap evuzayo (if there is a leaking tap), there is water there. So lezi zilwanyana uzozithola (you will get these organisms). If there is no water and is very hot angeke uzithole (you can not get them).

290

So, what question do you have in your mind about the topic? I topic ithini (what is the topic)?

(All learners say: The matter and materials.)

295 T: And is for whom? For these small organisms. Sizohamba siyobuka lapha kuloam (we have to go to observe the loam), we have to go to the place, one with loam not one with sand.

Do you have any question in your mind about this matter and materials? Do you have any question in your mind?

300 You are not interested into, what are the different types (inhlobo) yale materials ela kule sand ekuhlala lezi zilwanyana (this materials, this soil where these organisms live)? Are you not interested? Heh...

L 38: Sir, do ants have bones?

305 T: Yileyo wena ointerested kuyo (that is what you are interested in)? She wants to know if ants have bones.

Do you remember the topic? It is about matter and materials. Ask any question. Do you have any question ngento okuthiwa yimatter and materials (about this thing called matter and materials)?

Where is the picture?

310 L 5: Here Sir.

T: Show the learners the picture. This matter and materials for lezi zinyo ziphile kangaka (these healthy things).

Do you have any question about lento kuthiwa imatter ne materials (this thing called matter and materials)? Ukhona umbuzo onawo (do you have any question)?

315 Lets think about matter and materials (manje sizibuze) about izilwanyana(organisms).

La lezi zilwane ziphila khona, zithola I life khona, zihlala khona kule matter ne materials (these organisms live there, get life there, stay there in this matter and materials). Asibuze imibuzo (lets ask questions) around these things? There kuthiwa (they say) imixe eioam nesand (is the mixture of loam and sand). Asibuze, (let's ask questions) around those

320 things?

Do you here this?

L 6: Yes Sir.

L 6: What are the....

What are the different types of matter found in the soil?

325 L 6: Do worms die?

T: Yes.

L 5: How long does the material stays in the soil?

T: How long does it stay (lapha) in the soil ukuthi ithole impilo (to get life)? She wants to know that.

330 L 10: How does the worm breathe under the ground?

T: How does the worm breathe under the soil?

Can we stop there for today?

The end of the lesson 1.

Day 2. Date: 08-08-2006.

335 **Grade: 8B. Venue: Tom's classroom.**

Period: 2. Time: 9H00 –9H45.

(The educator displays the picture of the earthworms on the wall in front of the learners. The picture is taken from Daily News paper of Wednesday 02-08-2006. He also displays

the textbook with the worm drawn on the cover of the textbook. He writes the main question on the flip chart and followed by the questions raised by the learners yesterday.)

Why do soil animals need soil?

1. Do ants have bones?
2. What are the different types of matter found in the soil?
3. Do worms die in water?
4. How long does the material stay in the soil?
5. How does the worm breathe under the ground?

T: Some of these animals that we are talking about eh...These animals we are talking about here are called meso-organisms. Now, there are other ones called macro-organisms. There are also other ones called micro-organisms. But now we are not talking about this one (micro), and this one (macro) organisms. There are the smaller ones; we are talking about, like worms. Some people are talking about worms here. You also noticed that there are different types of worms. There is one like this (the one on the newspaper) and there is one like this (the other one on the cover of the book). There are other ones with different colours. And some worms, they are in the water they sit in the surface like mosquito larva, they look like worms. They turn into mosquito like that. So, there are different types of worms. But now in the soil we do have these organisms. We have millions and millions of these organisms.

There is quite a lot, so there are a lot of these. These here are very small (micro) you can't see them with your eyes. They are like bacteria or germs there are in the air right now. These organisms are in the air, you either breath and its smell. We are not looking at these (micro) because we can't see them. We do not have microscopes and all this.

These are big ones (macro) like giraffe and elephants, they are very big. Macro means very big. We have the shop called Macro. Did you hear about the shop called Macro?

(All learners say: Yes Sir.)

T: There is a lot of things here just a few tins of fish or few things that people can buy in here, there is a lot you can buy.

(All learners say: A lot.)

T: Macro means big, strong. Here for use macro means big organisms. You can't hold in our hands. These are too heavy we can't hold a giraffe in our hands. These small ones are

370 meso ones, like a small rat, or a small worm or a small snake. These ones that are meso-organisms.

Now your questions, there was a question that I pose to you.

Why do they need soil? You mentioned some others. Let me write the first one to the additional work that you gave to me.

375 Some said for mud.

Some said for rotten leaves.

Some said for rotten food.

Some people said roots, there is roots in here you saw these things. I don't think you are guessing, but you tell us if you are guessing. Let's get what some people said, pieces of
380 leaves.

Some people said bones (amathambo), pieces of leaves and pieces of animals. That is the food that's in there.

Who is the food that you mention there? Who is this food for heh...

L: For worms.

385 T: For worms, only worms heh...

L: For every animal.

T: For every animal, every animal that is there, they choose, they pick and choose just like you, isn't it. Do you think that people pick and choose? May be you don't know that you pick and choose.

390 If your mother goes to do groceries, she buys lots of things, isn't it. Sweets, chips, nuts. Yes.

L: Raisins.

T: Raisins. Let's talk about things that you can eat now. Not things that you must not bake the food. Right.

395 L: Fruits.

T: Fruits.

L: Grapes.

T: Grapes.

L: Apples.

400 T: Apples.

L: Chips.

T: Chips.

L: Orange.

T: Orange.

405 L: Chocolate.

T: Right, when you go to the fridge, you eat all of them before.

(Learners laugh.)

What do you think they eat this organism?

(All learners say: They eat small leaves.)

410 T: They also pick and choose, or there is a piece of leaves there, there is a piece of orange there, there is a piece of locust leg there or they choose.

Just like you and me, they pick and choose this way. The thing is we are too big, big we are macro. We can't go and make our selves small, go underground and check what they are eating and, so that we write it down.

415 (All learners say: Yes Sir.)

T: We can't do that isn't it?

(All learners say: No Sir.)

T: You see the movie that said I strum the kids.

(All learners say. Yes sir.)

420 T: Did you saw that one.

(All learners say. Yes sir)

T: The person become that this small and they could go into the small spaces. Do you know what I said, isn't it? May be one can change some of you, go there and see what they eat? What they pick and choosing? Why they eat these things that they pick and choose, these things that are under the ground? Like worms, like locust legs grass. Why they eat them? Yes?

425 L: They want to live.

T: Yes they want to live, they want to grow, and they want to have energy?

T: Why do you pick and choose, chips or veggies, so that you can do what?

430 (Most of the learners say, So that we grow.)

T: So you can eat them, so let us ask, why do you eat them? So you can? You?

L: Grow, grow up, and be strong.

L: Survive.

T: Have what?

435 L: Energy.

T: Have energy. What else?

L: Be healthy.

T: Behave well and be healthy. Why you are leaving behave out?

L: Be fat and be fat. (All learners laugh.)

440 T: All right, so now I want to ask you one more question. This thing about this material I am going to write this one matter and materials that we are talking about. What, what is very ehm...I want to know what is this thing you are so interested in? This one is even sick, I know. This one put them off. What are you interested in this thing called matter and materials. Now before you answer that question.

445 Yesterday, some people say they will bring us some soil and some earthworm. Can you bring it now so that we can see it you said you are going to bring it.

L: No sir. Njabulo.

L: I did not bring.

T: Why Njabulo?

450 L: It was raining yesterday, sir.

T: Louder.

L: It was raining yesterday, sir.

T: That is easy for us to get soil. We want soil that is wet that got the animals. Just answer the question. Where is the soil, you promised us soil.

455 L: Sir.

T: Just explain, to the class where is the soil?

L: I did not find it, sir.

T: All right you didn't find it. I will come back to you just now. Who else promised us the soil? Yes Thobile?

460 L: you asked me sir and I said I will try sir.

T: Yes, did you try?

L: I didn't find.

T: I will come back to you, who else? There were four people. Right Precious, who is Precious? (Learners laugh.) She. (He pointed at her.) You put a point. You said you will
465 find. Did you try?

L: No Sir.

T: Why you didn't try? I will come back to you, you will explain why you didn't try. Someone else promised us will try. (All learners laugh.) Sorry the laughing thing please mayiphele nya manje, angiyifuni (stop the laughing now, I don't like it). It's wasting our
470 time niyayibona (can you see.) Tell us why you did not bring.

L: It wasn't there.

T: It wasn't there, where was there?

L: In the mud.

T: What wasn't there in the mud? Lets see for us, who can get the soil for us on
475 Thursday? Are you stretching or you are trying to answer? Yes. Who else? You, Thobile you promised us yesterday.

L: Yes Sir.

T: You will bring something on Thursday?

L: Yes Sir.

480 T: Ok, now let us answer this question here about this thing about soil. Where these things live? These things like ants and all these things. I want to know, what are you really interested to know? What are you really interested to know, anyone? Think about it. Two people are now really interested in. Kukhona lento nyani kudala ufuna ukuthola ulwazi ngalento. Ufuna ukubuza ke ngiyibhale (There is this thing you are interested to
485 learn about for the long time.)

If you haven't got an interest, you know coming to school is like a sad thing. You just come here because your mummy chased you away this morning. She said go hamba (go). And you come here because the principal said, hey why you are late, come in the gate, you see everyone is chasing you.

490 (The girl entered the classroom.)

Yini le obowuyoyibuza lapha? (What is it that you were asking for?)

L: Sand.

T: Sand, you wanted loam, if its sand they can't live.

- L: Sir, sand and loam. She didn't allow me to enter the classroom.
- 495 T: It is a pity she does not let you in because you had a lot of problems angithi (isn't it).
- L: No Sir.
- T: You come late to class and make noise. That is why I asked you not to give names out. Take your sit then you go during break time uyilande (collect it.)
- L: Yes Sir.
- 500 T: Sizoyibona ukuthi injani (We will look at it and see how it looks like.) All right, let us be here, what is it that you are interested in. This thing like soil and these things that live there. Something that has been worrying you all along since primary school or this high school or may be one day you will go to the University you are still worried about it now. All right you first.
- 505 L: How long do earthworms live?
- T: You must talk about soil too. You must link this to soil and matter.
- L: I want to know how long they live in the soil.
- T: These animals.
- L: Yes Sir.
- 510 (The educator writes the question on the board.)
- T: This side, I will come here. Yes.
- L: Sir, I want to know if just ehm...go to the river and check in the mud and get the earthworm out of the mud and put it in the bowl, and then give it the food that I eat, will they eat it?
- 515 T: That is a good question. Very good one she wants to know if, if ehm...if I remove the organism from the soil and place it in the bowl and give it some of my own food, will they eat it? Right lets try at the back there.
- L: Does the soil and this thing they live in help them to communicate with each other? Or do they talk to each other.
- 520 T: We must link to this thing here, (so that is no1, 2 and 3). Do they communicate with each other in the soil? But let's come to this side now, yes.
- T: Sir, how they breath sir?
- T: How they breathe?L: Yes.

T: That question we asked yesterday already. We wrote it there. You are interested how
525 they breathe, where?

L: In the soil.

T: Yes that is the same as one we asked yesterday. Lets come back this side now. Wena
sowubuzile, yebo. (You, have you asked, yes.) Yes.

L: Sir ngifisa ukwazi ukuthi lezi zilwanyana ziyalala yini uma sezidlile?

530 T: Oh, does the organisms sleep when they finish eat?

L: Yes Sir. [The educator writes the question on the board]

T: We must talk about the soil, ukuthi inhlabathi isiza kanjani uma sezidlile bese ziyalala
uyabona (does soil help them after eating and then they sleep, you see.)

L: Yes Sir.

535 L: Sir, what type of material is inside the soil.

T: Yes, carry on a little bit more.

L: What type of material is in the soil?

T: What type?

L: Yes Sir, because sir we can say ehm...like over the soil, like papers, like some type of
540 materials. I am asking, what type of materials inside the soil?

T: Yes, like papers, oranges rotten cabbage like all that. That does what?

L: That helps these organisms to live.

T: That helps these organisms to live that are the better one. To help these organisms to
live and be healthy, because some of these worms they look so healthy isn't it? They are
545 fat already some of them are very thin. May be they ate the wrong food. (Learners laugh)

The one that is skinny may be they didn't eat the right food. Let us go to the questions
there. Let us go to the questions there. All right you, you, and then you next and then you
next I will come back to you soon.

L: Sir, how do these organisms get each other pregnant?

550 T: How do these organisms get each other pregnant?

L: Yes Sir.

T: Ok, how do these organisms reproduce? Reproduce means they mix with another they
are the same kind they never mix with another one.

L: Sir, they can help each other when somebody is sick when they are inside the soil, sir
555 bayakwazi ukusizana? (Can they help each other?) [Some learners laugh and others start to talk.]

T: All right, now please keep quiet everyone's question is important. Everyones question is important. Your mother sent you to school hambo funda (goes and learn) please now siyafunda (we are learning.)

560 L: Sir bayakwazi ukusizana uma ngaba oyedwa egula? Mangaba besaba kwisoil bayakwazi ukusizana (do they help each other if they are sick? If they are afraid in the soil, do they help each other?)

T: Who are these organisims? I don't know ukuthi ziyagula na? (if they become sick?) Some of them ilocust igula kanjani? Wena. (How does a locust get sick? You.)

565 L: Sir ehm...if you put them in clay, if you take two earthworms and put them in clay how long will they live?

T: All right, how long will they live in clay?

L: Sir, if you take them out of water will they live die?

T: Talk louder.

570 L: Sir, if you take the worms out of water it will die or live?

T: If you take them out of soil will die or live? Now lets have two more questions. Someone hasn't ask, if you have put you hands down, wena? (You)?

L: How the soil helps the animals to grow?

T: Louder.

575 L: How the soil helps them to grow?

T: How the soil helps them to grow? That question is the same as the ehm...yah...that top one to live. Uyabona iyafana. (Can you see that it is the same?) To leave means izokhula. Let's make the last one now; you can come back during break time to ask me. [Learners laugh] Yah, did you say how they reproduce?

580 L: No Sir, how they mate?

T: Mate and reproduce kuyahambisana (is one and the same thing) you can't make a new earthworm ungamatanga, uyabona iyahambisana lento. (If you don't mate, can you see its one and the same thing?) There is last one Sisa?

L: How they communicate in the soil?

585 T: Its the same one, how they communicate? All right, sizogcina ngawe ke? (you will be the last one?)

L: How do these organisms see or find their way in the soil or smell?

T: All right, how do these organisms find their way in the soil, some of them have got no eyes all right that's a different question?

590 Right you can stand up and go.

Day 3. Date: 10-08-2006.

Grade: 8B. Venue: Educator's classroom.

Period: 1. Time: 8H15–9H00.

T: We are going to move on today with what we started, the questions that we wrote
595 down are still there. Before we do that lets check first with those people who said they will bring us sample of soil and what kind of animal there. Can they put their hands up, lets see. Put your hands up those people bathe bazolettha (they will bring) something. Noba iyodwa nje abayilethile manje bese siyisebenzisa lapha emagroupini (Even one thing that they managed to bring so that we will use in our groups.) Yes Siboniso.

600 L: Sir, my mother said I must not take the sand.

T: And then what did the teacher said you must take these things?

L: Yes Sir.

T: Now where are they?

L: Sir, I left them at home.

605 T: So when do you bring them? Do you bring them on Christmas day

L: Sir, bekunetha izolo (it wa raining yesterday.)

T: You are talking facing down, you are doing something. Leave that thing so that you can talk sikwazi ukumuva on thina. (so that we can move on.) Yes?

L: Sir, my mother said she will get one for me.

610 T: Pardon.

L: My mother will get for me.

T: Will get for you? Did you ask you mother, why don't you go get, thatha ispade uthole lento uyifake ephaketheni uyivale, uyabona, besemina ngizoyiphatha, uzamile loko? (take the spade find this thing put it in the pocket and close, do you see, then I bring it. Did you
615 try that?) See now you are scratching your finger nails now. Lalalela uma

ngikhulumanawe bese uphendula ngifuna ukuya komunye umuntu manje isikhathi sizodleka. (Listen when I am talking to you, and then answer I want to proceed to another person the time will be waisted). Yes.

L: Angikwenzanga. (I did not do it.)

620 T: Why ungakwenzanga lokho? (you did not do that?)

L: Sir kuthiwe ngizolimala. (it was said that I will be injured.)

T: Uzolimala uma ubamba iphakethe wena yena athathe lento ayifake wena bese usinika. (You will be injured if you hold the pocket and she take this thing and put it in, then you give us.)

625 L: Uthe ziyalimaza Sir. (She said they are dangerous Sir.)

T: Eziphi izinto, I earthworm iyalimaza. (Which things the earthworm will cause injury.)

L: Kusho yena (She is the one who said so.)

Y: I earthworm iyalimaza. (The earthworm will cause injury.)

630 T: Why didn't you say, uthisha uthe I earhworm ayinamlomo, ayinapoison, futhi ayinamehlo, ayiboni ukuthi ubani oyityathayo.ushilo lokho noba (teacher said the earthworm do not have mouth, do not have poison, and then do not have eyes, do not see who is taking it, did you say that?) or you just kept quiet.

L: Angikushongo (I did not say) Sir.

T: Siboniso talk louder please.

635 L: Angikushongo (I did not say) Sir.

T: Why ungashongo lokho? (Why you did not say that?)

L: Sir, uzothi ngiyaphendula.(she is going to say I reply.)

640 T: Ok, so ieducation yakho kusho ukuthi ke manje ayizuhamba kahle uma akakusizi and uthi musa ukuyithinta lento. Yiyo lento oyishoyo. (So your education will not be right if your mother does not help you and is saying you must not touch this thing, that is what you are saing.)

L: Yes Sir.

T: All right, so that is what Siboniso said. He twice promised us to get soil, because he was very curious to learn about nature, isn't it Siboniso?

645 L: Yes Sir.

T: And when he went home his mother saw him digging in the garden, is that true? Please ngicela ukuthi ku true lokho? (Please say if it is true?)

L: Yes Sir.

650 T: Or, when your mother did say ungayi laphayana. (Do not go there.) Did you first ask them, or ukubona nangu wena uzama ukuthola lento le? (Did she saw you trying to get this thing?)

L: Sir, ngiqale ngabuza. (I started by asking.)

T: Or uqale wababuza wathini ke? (how did you start questioning?) Talk louder.

655 L: Sir ngithe ngingazithatha leza zinto ama earthworm? Sir (I said, can I take these things the earthworms?)

T: Yes.

L: Uma uthe cha ungazithathi, futhi uzogula. (My mother said, no do not take these things, and you are going to be sick.)

T: Zizokulimaza futhi uzogula. (They will injure you and you will be sick.)

660 L: Yes Sir.

T: Right, siyejabula ukusho kanjalo. (we are happy if you are saying so.) Asimnike izandla uSiboniso sonke. (Let us give Siboniso a round of applause.)

T: So Siboniso is respecting what mother and father said. Isn't it.

L: Yes Sir.

665 T: He doesn't go to the garden and take these things. When mother said do not go there. And the teacher explained to Siboniso that the earthworm do not have eyes, do not have poison and do not have nothing isn't it. Yes, may be there is another reason why moyher said do not take the spade. Not to take these things with the hands or did not wash their hands after doing these things. So mother may be protecting Siboniso or Siboniso is used
670 to doing that. So he may get sick because some soil has got germs. May be he does not wash his hands with soap. You must wash hands after this thing. Or it's my fault that I did not mention that once you finish you must wash your hands with soap isn't it? Then you go and buy bread. Then your mother will say, you know how to do these things you can't get sick. Did you say that?

675 L: No Sir.

T: You did not try to explain that you will do that and you will not get sick. You did not say so?

L: Yes Sir.

680 T: Ok, may be its my fault that I did not say anything. Who else said will bring these things, Thobile.

L: Sir I couldn't find the container to put it inside.

T: Ne plastic ayikho. (There is no plastic.)

L: So amaplastic asekhaya Sir amhlophe. (my home plastic are white.)

685 T: The plastic and Checkers, you tight then we will take it out. We do have things here. So your problem is, you couldn't find the pocket.

L: Yes Sir.

T: Ok, how do you feel about that?

L: Sad Sir.

T: Why do you feel sad?

690 L: Because I couldn't bring it to school.

T: Because you couldn't think and be creative and try to make plan to get the staff, because you twice made an attempt to get the staff, ok. Who else. Yes, you Londiwe?

L: Mina Sir ngiyikhohliwe kodwa ibingekho I earthworm Sir. (I forget it Sir, but the earthworm was not there.)

695 T: Angizwa. (I do not hear.)

L: Angiyitholanga iearthworm kodwa ngiyitholile inhlabathi. (I did not get the earthworm, but I got the soil.)

T: Nginike le nhlabathi ilungile. Sizoyibona ukuthi iearthworm ibikhonala yahamba iyofuna ukudla that is why ulethe into engenayo iearthworm. (Give me this soil it's ok.

700 We will see if the earthworm was there, then it went away to find food that is why you brought this thing without the earthworm.)

L: Ngiyikhohliwe phezu kwetafula ekhaya. (I forgot it on the table at home.)

T: Wayikhohlwa. (You forgot it.)

L: Yes Sir.

705 T: Second time you did not bring this thing you promised us.

L: No, first time.

T: Ok , wena (you) Londiwe?

L: Sir, I was going think, Sir, I was going to go to my mother garden and look for soil and the earthworms. Sir, I think that the earthworm hide there Sir.

710 T: Did you look for soil?

L: Yes Sir.

T: Where did you get the soil? Tell us about the place where you went.

L: Sir, I went to my mother's garden.

715 T: So you went to your mother's garden. Ehm... Londiwe went to her mother's flower garden. That is where she thinks earthworms are hiding. What type of soil is there?

L: Loam soil.

T: Loam soil. Is there any sand soil?

L: No.

T: Is there any clay?

720 L: No, sometimes is mixed up.

T: Any mixture, because loam is a mixture of sand and clay soil. Did you see it?

L: No.

725 T: When you dug there, did you find the soil? And the soil you thought is loam soil and the things that were in there when digging was what animals. What animal did you thought was there?

L: Sir, I thought it was earthworm.

T: Earthworm.

L: So when you were digging, did you find earthworms, did you find ants, did you find locust even if it's a broken leg.

730 L: Yes Sir, I found some dead ants.

735 T: Some dead ants. So in the soil, but at least she did these things even though alone and mummy said no. But, whatever she did you can't take away from her. [All learners say , yes Sir]. She knows what she did and she knows what she saw. She will ask more questions latter on if she needs to know anything. Then we have questions that we wrote down there. Some of them she will answer the questions, because she actually saw them. She needs a memory later down, isn't it? Lets give her a big hand because she tried. Ehm... who is next? Maswazi?

L: I was not at home for two days.

740 T: All right, what he says, he was not at home, the whole night or evening or the whole morning. The two days he was not at home. So, this place where you were there, there were no soil or were in the car for two days. [Learners laugh.] Please don't do that we want his answer too. So, you were in the car the whole day and the whole night. You never got out.

L: I got out.

745 T: So, there is soil where you were? Just say yes not a long story asiyifuni (we don't need it). Inhlabathi ibikhona? (Is there any soil there?)

L: Yes.

750 T: So, ubuwazi ukuthi kunento okufanele uyenze. Uzamile ukubuka le ndawo obukuyo ukuthi le soil ikhona le nhlobo? (did you know that there is this thing that you are suppose to do. Did you try to look at the place that is there soil there, and what type of soil?) Did you do that?

L: Yes Sir.

T: Oh, so that is good, see that is what you did. He knew his task as you do and he knew his soil, whatever, and he did look. Did you find anything?

755 L: Yes I looked for soil.

T: What were you looking for? Just tell us what you were looking for.

L: Worms.

T: So you were looking for worms. You did not look for soil first?

L: I did.

760 T: What type of soil was there? Clay, sand or loam?

L: Sand.

T: Sand, so did you find anything?

L: Worms.

T: What worms?

765 L: This one, [pointing at earthworms.]

T: Who can tell us what type of worms are these worms? Yes?

L: Earthworms.

T: You know the worm that you saw. What colour is that worm?

L: Red.

770 T: Red, ehm... the color of the soil. What was the color of the soil?

L: Brown.

T: Brown, so at least he got something. Lets give Maswazi a big hand. He saw the color of the soil and the worms at this stage. Who else? The last one, wena (you) anyone else? Ok, so now we, we have an idea that these things we are talking about in our science that
775 are actually real things, isn't it? [All learners say: Yes, Sir.] Or are not real, what do you think?

L: They are real.

T: Tell us why they are real and what these children just said now? Bayahamba bayobheka inhlabathi babone amaeearthworms enhlabathini (they go and look at the soil
780 and see these earthworms in the soil). And these,(lezi zinto) zikhona kuleli lizwe leli hayi ukuthi azikho la. Zikhona (these things exist in this world, not that they do not exist, they exist.) So iscience ikhuluma ngezinto eziconcrete (the science deal with concrete things), they are real. Uthini wena yebo noba qha (what do you say, is it true or false). And they are in the soil, where these organisms stay and they are the small ones. We are not talking
785 about the elephants.

So what I will give you now is the sample of some soil. Each one in a group with one sample. I will call the group to come closer, then take out a piece of paper so that one of you can write. Nizobhala lokhu lezi zinto enizozithola kulenhlabathi engizoninika yona.(You are going to write the things that are in the soil that I am going to give you.) If
790 you see a dead animal, you write dead locust leg, a dead ant. If there are any plant or dead plant you write what plant, like a dry stick or a leaf or dead leaves. If you see only sand, stick, diamond or iron or whatever. Nizoyibhala phantsi. (You will write it down.) Write a heading there, Types of matter found in the sample of the soil.

[Learners are in six groups already, they come together and discuss.]

795 Take a pencil, don't pull . somebody must write while somebody is looking. Don't shake, take the pencil and spread slowly.

[Learners found, rotten leaves, rotten food, rotten food and leaves. They are discussing in IsiZulu and mention the findings in English. Loam soil, sandy soil, rotten roots, dry soil, iron, stones, orange peels, dry roots, beach sand and moisture.]

800 Please don't be rough with these things there is only one person holding and spreading. Once two people holding and spreading the soil is going to split on the table. I will give you two minutes to get as many things as you can. Can you tell me what is one of them.
[The learners are discussing and there is lot of noise, the educator is moving around helping the learners.]

805 Please do not say metal just tell what type of metal iron, zinc, gold, brass. Any moisture? Did you find anything?
L: Yes, moisture.
[Some learners are saying yini le , yini le (what is this, what is this)]
T: Right, lets stop now, and sit down do not touch anything. Now you got your list there,
810 two minutes. We have two minutes discussion. At the bottom of page twelve asiyibhalanga na? (Did we write it?) What is the name of the first one? The atoms are very far, the particles are scattered. What type of a substance is that? If you were to guess, what thing that one will be?
L: Loam soil.

815 T: Not type of soil. Now?
L: Liquid.
T: Yes, liquid and another type of matter?
L: Gas.
T: Yes gas. That group have got all the answers. They even found the gas here. Please put
820 your paper down, not writing. So we have two types of matter, that group said.[All learners in that group said a liquid and also a gas. So now let me think and the other group to be asked the third one ngoba ayikho enye indlela (there is no other way). Oh engathi baningi ngala (it seems as if they are maby this side). Let me just ask, yes wena (you)?

825 L: Moisture.
T: Moisture, is moisture a gas or a liquid? They gave us two the gas and the liquid. Is moisture a gas or a liquid? Wena (You)?
L: Solid, Sir.
T: Is a gas or a solid?

830 L: Yes Sir.

T: Is moisture a solid or a gas or a solid?

L: A gas, Sir.

T: A gas, so we still have other learners, so we ask another group now that group said liquid, gas, what about the third one? Let's hear from you. This one has got a mouth shut
835 when we learn here.

L: Solid.

T: Solids, right, now in those three diagrams which one is solid? First one, or second one or third one?

L: Second.

840 T: Why ukhethe yona (Why do you choose this one?)

L: Because they are...

T: Khuluma ngama atoms. (Talk about atoms.)

L: Because, Sir, atoms are not more than air.

T: What else can you say about atoms?

845 L: They are stuck together.

T: They are very tightly packed, stuck together. Hey uyamuzwa, ufundile ngamasolids ngendlela angazanga ufunde kanjani. (Hey can you here, she have learned about solids without knowing how she learned). All right, so we are going to write there and say solids, and solids is the thing we can sit on it. Can you feel your chair? Put your hand on
850 the chair. Is your chair a liquid a gas or a solid? You, you.

L: Solids.

T: Why you say is solid?

L: It is hard.

T: It is hard. The solid in other words is hard, isn't it? [All learners say, Yes Sir.] Write
855 hard down there, there are two lines you can put more lines. We said atoms are tightly packed, and somebody said it is hard. What does somebody say? What does somebody say the atoms are not moving but in real life they are moving, but they move very slowly, because they are so tight? There is no space to move, now look at them, and look at them. If that one wants to move now and go somewhere you can't, I don't. [Learners say
860 blocking, blocking there.] All right, and now, so we said they are not moving, they are

hard atoms are not moving, atoms are together, they are packed together tight and we said solid is hard. Lets chose another one there and give it a name. Yes.

L: No one.

T: Give us the name first and then we will see which one.

865 L: Gas.

T: Gas, which one we say is the gas?

L: No one.

T: The first one, so let's write a gas there. Why do you say is a gas? Anyone can answer. Ok let's hear from here, and see why you say is a gas?

870 L: Because, atoms are separated out.

T: Because, the atoms are spread out, they are spread out. Anyone else would like to add to these words. Ama atoms anjani? (How are the atoms?) All right, we will come back to these words later on. Sibhala la wena (We are writing here you), you are counting lines here you. Right can you say that again, why that one is a gas?

875 L: The atoms are spread out.

T: The atoms are spread out, and what else Thabsile?

L: The atoms are separated.

T: The atoms are separated, what else can you say? All right, lets leave that one. There is one more now that does not get a name. Wena (You)?

880 L: Liquid.

T: Liquid. Ok, tell us why that is a liquid?

L: The third one, Sir.

T: Ok, lets write down liquid. Then lets ask you why uthi illiquid leyana? (Why do you say it is a liquid that one?) Khuluma ngama atoms (talk about atoms) ama atoms' anjani?

885 (How are the atoms?)

L: Because Sir, they are not so many.

T: They are not so many; you mean they are very few.

L: Yes Sir,

T: Or, you say they are not so few.

890 L: Sir, they are not so few.

T: They are not so many and they are not so few.

L: They are not so few.

T: Ha, uyabona, udescriber kahle, uthi la kwi liquid ama atoms are not so many plus they are not so few. Kusho ukuthi kugas mangaki. (you see, she describe good, is saying in
895 liquid atoms are not so may plus are not so few. This means that how many in the gas.

L: Sir, maningi.(they are many.)

T: Ku gas maningi. (In gas they are many.)

[Other learners are saying Hawu Sir.]

T: Kodwa ukuba asilaleli, asibuki, asi observi, iscience sizoyibulali. Yebo, wena. (But if
900 we do not listen, we do not look, we do not observe we are going to kill the science. Yes, You)

L: Atoms are few.

T: In the gas the atoms are few. Some are not writing they are looking at some others. What is wrong, you do not get it? You must pick up whatever you can. In science you
905 observe and pick up whatever you can, and some of the atoms are what? Yes?

L: Are stuck.

T: Are stuck and some are not stuck. Angthi nina amehlo enu aniwasebenzisi , anikwazi ukubuka kwenzekani lapha?(You do not use your eyes, you can't see what is going on there isn't it?) You are writing by the third one. This time is writing by the first one. In
910 the first one we said they are separated. In the third one, some of them are stuck, some of them are not stuck. That is why we wash with water, because some are stuck and some are not stuck. That is why sifaka isandla kumanje. (we can put our hands now.) Isandla singasifaka etafuleni (Can we put our hand into the table.) [All learners say No.] Ama atoms anjani? (How are the atoms?)
915 [All learners say, they are stuck] Are stuck, very tight, you can't put your hand here. Can you put your hand in water?

L: Yes Sir.

T: Why singafaka isandla emanzini? Anjani ama atoms? (Why you can put your hand in water?) How are the atoms?

920 L: Sir.

T: Ama atoms anjani? Singafaka isandla? (How are the atoms? Can we put our hands?)

L: Ahlukene. (They are separated.)

T: Yes, say it in English now. The atoms...

L: The atoms are separated.

925 T: Ugas sithe abathashani nokuthashana, manje wena asho enye into uyezwa? (We said the gas, they do not touch each other, can you here that you are saying something else?)

L: Some of them are stuck and some are not stuck.

T: Yes in the liquid, some of the atoms are stuck and some of them are not stuck. Uthole ithuba lokufaka isandla laphaya. (You get the chance to put your hand in there.) In the
930 gas can you put a hand in the gas? Yes or no? You? Can you put your hand in the gas, put your hand. Can we put a hand in the gas? How are the atoms? Are they separated? That is we can put out hands. Can atoms hurt you? [All learners say, no]

Can we put our hands in water? Very fast or very slow? [Some learners say very slow, some say very fast.]

935 Right you can go now.

Day: 4

Date: 14-08-2006.

Grade: 8B.

Venue: Educator's classroom.

Period: 3.

Time: 9H45-10H30.

(The educator gives the learners their papers they wrote during the observation of the
940 sample of soil.)

T: Some people are changing the words in these papers. I don't want you to change the words, you do not write where you finish writing sit quietly. You wrote some of the thing here, say some of them are liquids, gases and solids. You get the new sheet out, a new sheet please. That one you don't write I will ask you questions just now a new sheet.

945 What are the things that are found in the sample of the soil? Yes?

L: Rotten leaves.

T: Pardon, it is written on that piece of paper lento engikunike yona (this thing I have given to you.) Ok, yes somebody else please. Yes.

L: Orange peels.

950 T: Orange peels, yes please.

L: Tissue.

T: Ok lets say paper. Yes.

L: Stone.

- T: Stone. Yes.
- 955 L: Roots.
T: Roots, those that come from plants. Sticks also come from the plants.
L: Loam.
T: Ok loam.
L: Rotten leaves.
- 960 T: Rotten leaves. There is one peace that everybody found there, no one is mentioning that one.
L: Iron.
T: Iron, some call it something else last day.
L: Steel.
- 965 T: Yes someone say steel. Right, name one that is not a solid, anyone, yes?
L: Hair.
T: Hair do you think hair is a liquid, solid or a gas.
L: Solid.
T: Pardon.
- 970 L: Solid.
T: Lets name one that is not a solid. Yes?
L: Water.
T: Water, is water running in the tap or what kind of water is it?
L: Water that is found in the loam soil.
- 975 T: So, is it steam is it? Yes?
L: Moist.
T: Moist. We have seen the moist soil. So it is moisture. You see, water comes in different names. Let's use something that is not a liquid and that is not a solid, yes?
L: Oxygen.
- 980 T: Oxygen, did you see oxygen there?
L: No sir.
T: You didn't see it?
L: Yes Sir. We smell it.

T: We smell gas we smell the gas. So lets put smell down. Let me highlight this one
 985 smell. Smell normally has got certain smell. Its got a nice smell like a perfume or a
 pungent smell like rotten leaves in the bush, or maybe when a person make a park its not
 a such pleasant smell it's a pungent smell. We call it pungent into enukayo (thing that is
 having a bad smell). Even when the animal dies, dead horse you have to hold your nose
 when you pass there, isn't it? Who has smell rotten horse before or a rotten dog please
 990 ziyafa izinja laphaya (dogs are dying out there.) [Learners laugh.] A rotten horse smell
 just like a rotten dog but it is just a bigger animal and that means more smell but it is the
 same. Call it pungent smell. [All learners say pungent smell.]
 Some of them are pleasant smell like perfume. Who has smell perfume? [All learners
 raise their hands. Lets hear from that point what smell did you smell here? Was it
 995 pleasant smell or unpleasant smell one? Pleasant or pungent?
 L: Pungent.
 T: Pungent like what? Like a dead dog or rotten leaves?
 L: Rotten leaves.
 T: Rotten leaves, ok what other gas in the soil?
 1000 L: Spider web.
 T: Spider web is a gas. [Learners laugh.]
 T: Why does somebody laugh? She thinks spider web is a gas, ugas ngumoya ngesiZulu
 umoya (in Zulu gas is air). Somebody has seen umoya (air), by the way gas is umoya
 (air). Some think, some do not think, so some think. Yes?
 1005 L: Carbon dioxide.
 T: Carbon dioxide, right, you see it?
 L: Solid. [Learners laugh and say ha ha ha ha...]
 T: Why somebody is saying ha ha ha.
 L: Smell it.
 1010 T: Why you change when some are saying ha ha ha.[Learners laugh.] We all like
 whatever you are saying. We all like it. Nothing is a jungle in this class. So those people
 that are saying ha ha ha they do not mean is jungle but they are just surprised. I need to
 know why they are surprised when she is saying solid. Njabulo. Why are you surprised
 when she is saying said carbon dioxide is a solid?

- 1015 L: Because Sir we can't see a gas we smell it. But carbon dioxide,
 T: Ja, but when he says gas we can't see carbon dioxide. Have you burnt papers for your house before or grass or anything?
 L: Yes Sir.
 T: What comes out of that burning?
- 1020 L: Smoke.
 T: What color is it black or brown or grey?
 L: Grey.
 T: Is that a gas, a liquid or a solid. Wena (You.)
 L: Sir, it is a gas.
- 1025 T: So you can see a gas sometimes.
 L: Sometimes.
 T: Wena uthe angeke siyibone , lo uthi uyibonile. Wena you get surprised ngoba uthe (You said we can't see it, this one said I have seen) the gas you can't see it. Manje uyavuma ukuthi (Now do you agree that) you can see it.
- 1030 L: Yes Sir.
 T: So, why you are so surprised when she said she saw it?
 L: Yes.
 T: So people must not get surprised in science you must try to make sense of it ungayilahli (do not throw it away). Yingakho amascientist kungamascientists (That is why scientists are scientists.) The scientists study and ask good questions. If they don't ask questions they will say ha ha ha... If somebody is saying the world is not round is flat. In the olden days they used to kill people out there if the people are saying the thing is flat. Only one person said, may be the world round like a ball is not flat and he was worried whether they will kill him or not. But today we all know that persons idea help
- 1040 all of us, isn't it?
 [All learners say, yes Sir.]
 T: But how is the world.
 All learners say round.

1045 T: Round, can you see that in science we do not throw ideas away we question them and check some more. We do not say ha ha ha. If you get surprised it means that you must learn more isn't it?

[All learners say, yes Sir.]

1050 T: It does not mean that you must throw it away, so that is the whole idea. Right, let us now look at page thirteen. They tell us more things about things about these materials that is, in the soil or on top of the soil. On page thirteen there, they say that you may have noticed from activity one that we did on the last page, that matter is made up of tiny particles called what?

[All learners say, atoms.]

T: Because of variety of different substances where?

1055 [All learners say, in the soil.]

T: I can't hear you?

[All learners say, in the soil.]

T: There is also different kind of what?

[All learners say, atoms.]

1060 T: Atoms. Because, each thing is made different from the other one.

[All learners say, yes Sir.]

T: Somebody was telling us the other day that these things are different. So if they are different then they are made up of different substances. And you said a piece of iron as big as your fist. Hold up your fist.[All learners hold their fists.] And a piece of what?

1065 That also as big as what, yes? Make it different, piece of what?

L: Gold.

T: Piece of gold. Where is your fist? Hold up your fist that is like a fist of what?

L: Iron.

T: He takes another same size as the piece of iron, piece of what?

1070 L: Glass.

L: Glass or wood isn't it?

T: The piece of iron (insimbi engaka) and the piece of wood (inkuni engaka) like a hand fist. Which one has got more particles of matter? Which one has got less particles of matter? What idea abanye engathi iidea abanayo abalaleli abanye (some don't have an

1075 idea and some don't listen.) Let me ask you again. The piece of iron (insimbi engaka) and the piece of wood (inkuni engaka) which one has got more particles inside the matter? Which one has got less particles the matter?

[Learners say mmh mmh...]

Only five minutes to get up, engathi abanye (some people) they are still thinking , ok lets

1080 give them the chance to think .Which one has got more particles le (this) matter ngaphakathi (inside)? Let us ask someone who has not put her hand up, wena (you) igama (your name)?

L: Sinenhlanhla.

T: Sinenhlanhla, yebo, khuluma (Yes, talk).

1085 L: Iron.

T: Sentence. Salt has got more particles than vinegar, but khuluma ngalokhu (talk about this.) [Learners laugh.] iron has more particles than wood, especially if they areuma lezi zinto ziya... (if these things are ...)

L: Equal.

1090 T: Yes ziyalingana (they are equal), equal say all of you.

All learners say: iron has more particles than wood especially if they are equal.

T: Equal in size. Repeat all of you?

All Learners say: iron has more particles than wood especially if they are equal in size.

T: All right, lets look at the list there especially on page thirteen. Asifunde lapha phezulu

1095 (lets look on top there.) What is the name?

L: Carbon.

T: The next one.

L: Gold.

T: The next one.

1100 L: Iron.

T: The next one.

L: Iron.

T: The next one.

L: Hydrogen.

1105 T: The next one.

L: Calcium.

T: the last one.

L: Copper

T: One of these, how many are they?

1110 All learners say: Six.

T: And these substances or materials we can find them in the soil, isn't it?

All learners say: We can find them.

T: Which one that you find in the soil that is written in your papers?

All learners say: Iron.

1115 T: Up again.

All learners say: Iron.

T: Iron, yes we see the irons in the soil. But because we find a piece of iron some of us in the soil sample here. But others didn't have or it was there but they didn't see it. May be it was in the ...

1120 L: Soil.

T: In the soil, which soil?

L: Loam soil.

T: May be it was in the loam or may be it was in the, what else there?

L: Clay.

1125 T: May be it was in the... there?

L: Stone.

L: Grass.

1130 T: May be it was in the stone, may be we need to crush the stone grind and melt it, the iron goes one side and the dirt goes one side. Like in this picture here. Where is my picture? (He looked and pointed at one the pictures displayed on the wall.) There is the picture there. They grind the ground they take from the mines and put under high heat and they start melting and they take it out and put it in different pots. Iron goes one side, dirt one side and gold one side. With that gold they make jewellery outfit or they sell that thing. When your mother buys a wedding ring it is made up of gold. What other metal is
1135 there?

T: Diamond.

T: Diamond. What other metal is there?

L: Silver.

T: Silver. How many mummies' ring have you seen? Who have seen a mummy's ring?

1140 Put your hand up. When you go home today let us ask mother, yini le material eyenziwe ngayo ? (What is the material that is used to make your ring?) Who can guess , eka ma wakhe yenziwe ngani? (Your mothers ring is made out of what?)

L: Yenziwe ngegolide (It is made by gold) Sir.

T: Gold,,for sure.

1145 T: Yes Sir.

T: I gold ine symbol inegama symbol okanye ngu A, B, C. izinto ezinjalo (The gold is having a symbol, name, symbol or is A, B, C things like that.) Do you think you know the symbol?

L: No Sir.

1150 T: Ibhalwe ngaphakathi mhlawumbe ino A kodwa uzoyibona but sizoyifunda khona manje. (It is written inside may be it is having A but we are going to learn it soon.) Whose mother has got a copper ring?

[All learner laugh.]

Whose mother has got a diamond on the ring?

1155 L: Diamond.

T: Your mother. Ok now please let's stop laughing. We said in science we don't laugh. With our ideas we ask questions we don't laugh. All right, so there is diamond, my mothers ring hasn't got a diamond. I must check now I never asked her whether there was diamond in the ring. Only now, so that I can go back and ask. Wena uma wakho unayo

1160 iringi noba akekho uma? (Your mother have the ring or you don't have mother?)

L: Akekho uma. (I don't have mother.)

T: Akekho, siyabonga. Nobaba akekho.(You don't have mother, thank you. You don't have father too.) Oh, kufanele ubuze kugrany, ugoto ukhona? You need to ask you grand mother, do you have grandmother?

1165 L: Yebo. (Yes.)

T: Unayo iringi ugoto? (Does your grandmother have a ring?)

L: Yebo unayo. (Yes she is having it.)

T: What thing is made up of? The iron, copper, gold, diamond and things like that?

L: Iron.

1170 T: All right you will tell us next time. Or you don't tell us because you don't know?

[All learners laugh.]

L: Yes.

T: Right Nontobeko is going to find out what is the matter and material in the grandmother's ring. All right lets go back to carbon, now each of these materials we find
1175 in the soil. Just like this boy said that this thing is inside the stone or inside the sand or on the ring or we cook it the pure gold is produced one side and dirt one side. Udoti (dirt) is mixture and pure gold is pure substance. Now let us look at these things, these we consider as pure gold even pure iron. What is it that it got on it? We have seen pure iron is clean and is hot but when it is old what's got on it? Yes, you?

1180 L: Rust.

T: What?

L: Rust.

T: The boy saw rust in the iron. What is the color of rust?

All learners say: Brown, brown.

1185 T: Its brown and sometimes is very dark but the iron itself it can be shinny. It can be shiny when it is new. So even your mother's ring, the gold one it look dark brown because it needs polish. When it is polished it looks like a brand new gold, isn't it?

All learners say: Yes Sir.

When it is pure, and when it got something put on it, udoti (dirt), udoti (dirt) it means
1190 sekuyini manje? (What is it now?) Sekuyi mixture na? (Is it a mixture or not?) What is the thing that is mixed there?

L: Iron.

T: The iron, did she take iron and rub it with gold?

L: No.

1195 T: Or she does the meeting without taking out the ring?

L: Yes Sir.

T: Or the brass?

L: Yes.

- T: So now when she is doing the washing, what is mixing with the gold?
- 1200 L: Water.
- T: Water.
- L: Jik.
- T: And Jik.
- L: Sta-soft, soap.
- 1205 T: And soap and acids and gases. Uyabona ushinhse umbala. (The color changes, do you see.) So the things that you say now, the materials that are pure, can become a mixture. When it does what?
- All learners' say: When it combines.
- T: Combine with...?
- 1210 L: Chemicals.
- T: With chemicals. Now when these substances like pure substances, like pure substances combine chemically, that is when we have substances called?
- All learners' say: Compound.
- T: Compound, and when these things like pure, like pure iron, shinny one, we said is a what? It is a compound or it is a pure substance.
- 1215 All learners' say: Pure substance. You see this thing here is not writing nicely now. So this is a pure one and when it is pure it only got one material or is got a mixture of others.
- All learners' say: One material.
- T: One substance, one substance and what is substance that starts with E, a what?
- 1220 Some learner's say: Elements.
- T: Elements, where did you find that word?
- Some learner's say: In the worksheet, we read.
- T: Some people are reading in the worksheet and some are not reading.
- L: Yes Sir.
- 1225 T: Some are sick and some are not sick.
- [All learners laugh and say: Yes sir.]
- T: Now, who is reading who well, who can read? Hands up. Uma isandla sakho asiphakami kusho ukuthi uyagula. (If your hand is not up it means that you are sick.)
- [All learners laugh and all hands are up.]

- 1230 T: Hayi sifunda kahle. (It means that we are reading well.) Let's carry on and let's look at that carbon. Carbon is a pure substance or is the mixture of chemicals. In a compound or it is mixed but they are not joined chemically. They did not combine chemically. T: These here, they also combine chemically
All learners say: Yes Sir.
- 1235 T: But how did they combine?
L: They mix. They combine physically.
T: Oh, physically. Where did you get this word?
All learners say: From the worksheet.
T: If people take raisins and nuts, is nuts a single substance or mixed?
- 1240 All learners say: Mixed.
T: Raisins are mixed.
L: Single, single.
T: Now, if you want a mixture between these two, what must you do with them?
All learners say: Mix them, mix them.
- 1245 T: Have you mixed that before?
All learners say: Yes Sir.
T: Yebo, wema Thobile, awusho uyimixile?(Yes, you, Thobile, can you tell us did you mix this?)
L: Yes.
- 1250 T: Why umixe lama nuts nama raisins ekhaya? (Why do you mix nuts and raisins at home?)
L: I mix them in the bowl.
T: You mix them noba uma uthe mixa? (You mix them or your mother asked you to mix?)
- 1255 L: Ngizimixele Sir. (I mixed it myself, Sir.)
T: Uma yena akamixi? (Your mother did not mix?)
[All learners laugh.]
T: Sekufika amavisitor la, abantu abafuna izinto ezinmandi, akakhiphi ibowl yama nuts afake endaweni eyodwa, ibowl yama raisins afake nawo. Uma sewufika wean nebowl
- 1260 yesithathu sewuyamixer. (When the visitors arrive, people want to eat nice food she does

not take out the bowl of nuts and bowl of raisins. Then when you arrive with the third bowl you mix them together.)

[All learners laugh.]

1265 T: All right, let's take another one, when you eat green mango's. Which two substances most people bayazimixer, bafake laphayana badla ama green mango's? (they mix and put there when they eat green mango's?)

[All learners laugh.]

T: Don't shout. Ngifuna ukubona laba bantu bayenzayo lento ekhaya. Wena, awusho wena. (I want to see these people they do this at home. You tell us.)

1270 L: I put curry powder.

T: Curry powder and what?

L: And salt.

T: You, you shout. You must not do that. You are spoiling his learning. Awusho futhi manje. (Repeat again now.)

1275 L: Curry powder and salt.

T: You take equal amounts or you take more?

L: Ngithatha ucurry powder omningi nosawoti omncane. (I take more curry powder and less salt.)

T: Ok, lets take measures, teaspoon measures or tablespoon measures or spade measures.

1280 [Learners laugh.] Listen, give him a chance please, he is making mixture now. Yes?

L: You take a teaspoon of curry powder and you put it in small salt.

T: What do you do with it?

L: You mix it.

T: You put it on top of each other or you shake a little bit? All right you stir it.

1285 Yes, you?

L: Sir, you put vinegar.

T: Oh! She put a third thing, so the mixture has got three substances now. [Some learners say sugar and knorox, Sir.] That is why you get so sick. [And sweet aid and sweet aid and chilies, Sir.] Ssh...all right, let's hold it now about all these things. If your mother arrive and ask for her curry powder, salt, vinegar, sweet aid, sugar and knorox. Is it possible to ukuthi lezi zinto uzihlukanise? (Is it possible for you to separate these things?)

1290

All learners' say: No Sir.

T: All right we will investigate that one later. We will have to investigate that later on, that how can we separate these things. Lets just take the easy one not all this mixture.

1295 [Learners laugh.] Salt and what?

All learners' say: And curry powder.

T: And curry powder.

Some learners added: Vinegar.

1300 T: No, let those two things, do not allow the situation to have too much, it will be difficult to separate them. Is it easy to separate these things?

All learners' say: No Sir.

T: No but if you mix it easily, ok let us take less than a teaspoon. The tip of the teaspoon the smallest one, you put only three to four dots of curry powder and three to four dots of sugar, can you separate this?

1305 All learners' say: Yes Sir.

T: Oh, now you can?

All learners' say: Yes you can.

T: Ssh...right you can separate. You can take in micro this thing.

All learners' say: No sir.

1310 L: It is easy to separate.

T: You see he says it is easy to separate. Are you going to do it? Or you take small salt and you pull it one side and pull curry powder one side. We see that is the smallest amount of curry powder. That one said he can separate it and you said you can not separate, why you can not separate?

1315 L: I can do it.

T: Oh you can.

L: Yes Sir.

T: What convinces you now that you can now separate it.

1320 L: Sir, Sir, you can, Sir, you can put Sir, you can put salt Sir and you can put curry powder together, they stick together.

T: But you do not have a lot, you have a little bit three grains of sugar one, two, three, and you put curry powder, but then?

L: Sir still...

T: Is it possible to separate sugar and curry powder?

1325 All learners' say: Yes Sir.

T: So if you can separate the little you can separate a lot, if you have got more time.

Some learners' say: Yes Sir.

Some learners' say: No, no...

T: All right lets come back now, mixture, can you see how they combine?

1330 All learners' say: Yes Sir, yes Sir.

T: Kubhaliwe. (It is written.)

All learners' say: Yes Sir.

T: Bakhombina kanjani? (How do they combine?)

All learners' say: Physically.

1335 T: You must read both words.

All learners' say: Combine physically.

T: The substances combine physically in mixture, all of you.

All learners' say: The substances combine physically.

T: But you did not say it, all of you.

1340 All learners' say: the substances combine physically in mixture.

T: In a mixture.

All learners' say: In a mixture.

T: And that means, is it possible to separate these substances or it is impossible?

All learners' say: It's possible, it's possible.

1345 T: Can you separate the nuts and nuts mixture now?

All learners' say: Yes Sir.

T: Oh, ok, can you separate apples and oranges placed in the bowl?

All learners' say: Yes Sir.

T: Oh, why is it possible to separate those ones, you?

1350 L: Because they are big.

T: What is big?

All learners' say: The oranges.

- 1355 T: You can call this one orange, one orange particle, and one orange. Two is two particles. Three oranges, is three orange particles, isn't it? These particles you can separate. How are the particles of curry powder and salt?
All learners' say: Mancane. (They are small.)
T: Kuzobanjani ukuwaseparator? (How will it be, to separate them?)
L: Kunzima ahlange. (It is going to be difficult the particles are packed together.)
T: Yes, kodwa kupossible noba akukhossible? (But is it possible or it is impossible?)
- 1360 L: It is possible.
T: Let's come back to this one, the compound.
T: When the boy burns the grass with what?
All learners' say: Matches.
T: The matchstick.
- 1365 All learners' say: The matchstick.
T: The matchstick adds what? It adds oxygen or adds carbon dioxide or adds water. What does the matchstick add?
All learners' say: Oxygen.
T: Oxygen helps izinto ukuthi zishe, angithi? (Helps things to burn, isn't it?)
- 1370 All learners' say: Yes Sir.
T: So its grass plus oxygen, when that grass finish burn or a paper? Can you separate the remaining things or you cannot do it?
All learners' say: You cannot do it.
T: What is left?
- 1375 L: Ash.
T: Uash angeke umthole back ugrass, angeke umthole back uoxygen. From the ash you cannot get back the grass and oxygen. Even you paper. What is the color of that paper when finish to burn.
Some learners' say: Black. Some learners' say: Brown.
- 1380 T: Is called what?
All learners' say: Ash.
T: Can you get paper back and can get the oxygen back.
L: No.

T: So, how they combine.

1385 L: Chemically

T: Yes, a compound is all the things combine....

All learners' say: Chemically.

T: Can you separate them?

All learners' say: No.

1390 T: Is it easy or very hard or it's not possible?

All learners' say: It's not possible.

T: Sometimes scientists can, but they need chemicals to separate them. They can't separate like orange, orange take one or apples take one, that's physical separation. They mix physically and can separate them physically. If they mix chemically and you separate

1395 them chemically, isn't it?

All learners' say: Yes Sir.

T: All right, so, what you have got there, let's name these quickly now.

L: Carbon.

T: Let's go to the bottom, you see there is a table there, that is scientists help us.

1400 All learners' say: Yes Sir.

T: They give names to all the possible elements in this world. And how many you think they found? There is a number there by the number 2.3. There is a number there.

All learners' say: One hundred and eighteen.

T: I can't hear.

1405 All learners' say: One hundred and eighteen. [Louder].

T: They have written a number in each box. What is the first number?

All learners' say: One.

T: What is the substance in there?

All learners' say: Hydrogen.

1410 T: What is the symbol for it?

All learners' say: H.

T: H. Let's look for Carbon in the table. Put your hand up the moment you find it, and tell us the symbol. Yes?

L: No six.

- 1415 T: Let's give him a hand, he found it. What is the symbol?
L: C.
T: Let us write C in each of those circles, those five there next to Carbon, put that capital C inside of each of those round ones. Round one is an atom. How many atoms of Carbon in that one? How many atoms of Carbon, you can count them.
- 1420 All learners' say: Five, five.
T: Now please put that capital C in each one. Now let's find Gold. Do you remember that girl that is going to find out what letter is written on the Gold? And I said it start with a what?
Some learners' say: C.
- 1425 T: With a C?
Some learners' say: A.
T: With an A, I am sure I said A. All right, let's look for Gold there. Who can quickly find Gold and give us the symbol? Put your hand the moment you find it. Yes, you?
L: Au.
- 1430 T: Au, no what?
L: Seventy-nine.
T: Seventy-nine. Let's give him a hand. You find it very quickly here is Gold. It starts with A, so it is Au. Right let's put Au inside of each of these five circles there. Capital a, is it a capital u also or it's a small u, quickly now. Capital a, small u, capital a small u. If
1435 you put both capital it's wrong. The scientists have agreed that Gold is capital a, and small u. Right, let's go for iron. Yes?
L: Number twenty-six.
T: Number twenty-six, let's all check quickly. Yes there is iron. What is the symbol?
L: Fe.
- 1440 T: Tell us how the letter are written
L: Capital f and small e.
T: All right, let's put capital F and small e in each of those five circles there. The next one is hydrogen. Hydrogen is number?
L: One.
- 1445 T: Number one. That's the one we said already. What's the symbol?

All learners' say: H.

T: Right, put the capital h in each of those circles there. Right Calcium. What is the number for Calcium?

L: Twenty.

1450 T: Number twenty. Good and what is the symbol?

L: Ca.

T: Put the capital c and small a in each ones, capital c and small a, capital c and small a. Right Copper, Copper. What is the number?

L: Twenty-nine.

1455 T: Twenty-nine. Symbol.

L: Cv.

[All learners laugh.]

L: No Cu.

1460 T: Now let's write capital c and small u, capital c small u in each circle, right. I think you did very well there. You worked like a scientists, you know now how a scientists name the substances, the matter and materials. From there we go on, for homework look at page 14 for homework.

All learners' say: Yes Sir.

T: No 2.4. In this table below write the symbol and the name of the first what?

1465 L: Elements.

T: Yes, first twenty elements. You must start with the heading, and top there it says the heading first. So what must you write in the heading, the first column.

L: Hydrogen element.

1470 T: It says the name write the symbol and the name of the first twenty elements. So one side you must put what?

L: Symbol.

T: Symbol and other column heading?

L: Name.

T: Name of the first element?

1475 L: Hydrogen.

T: Of the first what?

L: Of the first twenty elements.

T: Twenty elements. So now you must look at page thirteen from number one to what?

L: Number twenty.

1480 T: Right, you must write the name and the symbol of the first elements, the name and the symbol. I will check that tomorrow morning. If you finish at break time you can always come and show me and I will put marks for you. Let me collect the sheet the one that you wrote on. Can a group leader bring it quickly here to the front? Next time you will see how these elements combine.

1485 That is all.

You may go.

Day: 5 **Date: 15-08-2006.**

Grade: 8B. **Venue: Educator's classroom.**

Period: 2. **Time: 9H00-9H45.**

1490 T: Elements, you may not believe that of all one hundred and eighteen elements, all are made up and we wrote only the first 20. In the first column what they need you to put at the top there?

All learners' say: Symbols.

T: Symbols and the second column, what they need to put there?

1495 All learners' say: Name.

T: The name of the element not name.

All learners' say: The name of the element.

T: Can you read the first one? You take so much to read, which means that you can't read. Read the first one, if you can't read, read the last one there. If you take so much to

1500 read, it means you can't read. Read the first one.

L: Hydrogen.

T: Symbol?

L: H.

T: The last one read no fifteen.

1505 L: Hydrogen.

T: Symbol?

L: H.

T: You said fifteen is hydrogen and symbol is H. who can read no fifteen? Yes? Read no twenty?

1510 L: No twenty is gold.

T: Right, symbol for gold?

L: Au.

T: Let's go back to page thirteen. Let's look at number twenty. What is written down there?

1515 L: Elements.

T: Are you talking? This page eh page fourteen, what is number twenty? What did you write on the paper?

L: Gold.

T: Ok, what is your problem? There on the paper it says what? Number twenty say what?

1520 On page thirteen. Can you see?

L: Yes Sir.

T: Why are you touching your nose when you talk? Can you just talk like other children? Some person writes this thing for you, what happened?

L: I did it.

1525 T: You did it and number twenty you read in the block number seventy-nine. Why did you do that? You can't read this thing or you counted wrongly? Sit straight up you. Can you count or you didn't count?

L: I can count.

1530 T: You can count. What it means? Hey sit up straight you, because, see now we can't see your name on the tag move back of the desk, sit your back off. Right, so what happened, just explain what happened? Because the table says one to one hundred and eighteen, one, one and eight, and we said only twenty. Tell us what happened? So that we can also see, tell us where you did the mistake. So that they can avoid the same mistakes.

L: I did not count properly.

1535 T: Pardon.

L: I did not count properly.

T: All right, lets live that one, for number eighteen what you wrote there, look at page fourteen numbers eighteen. Can you see, the table is here but you look there?

L: Argon.

1540 T: Is he correct? Who wants to help him? Is he correct or he makes a mistake?
L: He is correct.
T: Correct, so who think they think they know what his mistake is?
L: I think he jumps to thirty-six.
T: Do you see thirty-six below eighteen? And he jumps to seventy-nine to get gold. Can
1545 you see that number one is on top? Can you go to number two there, what is number two?
All learners' say: Helium.
T: Helium. What is number three?
All learners' say: Lithium.
T: Lithium. Come again?
1550 All learners' say: Lithium.
T: And number four is?
All learners' say: Beryllium.
T: Number five.
All learners' say: Boron.
1555 T: Boron, boron, right and number ten?
All learners' say: Neon.
T: Neon, neon is that bright light that you see when you go to town? And then number
eleven is sodium. Number twelve?
All learners' say: Magnesium.
1560 T: Number thirteen.
All learners' say: Aluminum.
T: Aluminum, yes and number fourteen.
T: Number eighteen, I mean.
All learners' say: Argon.
1565 T: Argon, number nineteen?
All learners' say: Potassium.
T: Potassium, potassium and number twenty?
All learners' say: Calcium.

1570 T: Yes, calcium. Some of these substances are in your home and it is mixed with other chemicals. Have you seen the chemicals in your mother's cupboard or your dad's cupboard?

L: Yes Sir.

T: Where they put the medicines? Have you got the medicines cabinet at home.

L: Yes Sir.

1575 T: Where they keep some chemicals there?

L: Yes Sir.

T: Who can name one chemical in the medicine cabinet at home? Yes?

L: Dettol.

T: Dettol, is one of them another one, who has got dettol at home? Put your hands up.

1580 [All learners put their hands up.] All right we got dettol at home another one?

L: Shibhoshi (Jeys fluid.)

[Some learners laugh.]

T: Yes, another one, I want the one that is not a liquid now. Let's now give the one that is not a liquid, Yes, another one.

1585 L: Domestos.

T: Ok, that one is a liquid. Let us give the one that that is a powder now.

L: Sunlight.

T: Sunlight washing powder. Yes?

L: Blue death.

1590 T: Blue death.

L: Yes Sir.

T: What is that, can you explain?

L: Chemical.

T: Chemical, is it a liquid or a solid or a gas?

1595 L: Its powder Sir.

T: Powder, what they use it for?

L: To kill ants.

T: To kill ants. Yes, you?

L: Ethene.

1600 T: Ethene, what color is that?
L: White.
T: What is it, is it a solid, or a liquid or a gas?
L: Powder, but there is no powder in nature here matter comes in three phases, the solid, liquid and gas. So you must decide where it falls.

1605 L: Solid.
T: Solid. All right, because gas particles are far apart in the air and in the solid they are very close. In the liquid they flow, all liquids flow. There is no liquid that does not flow. That is why you must think about it. So domestos is a liquid, a solid or a gas?
L: Liquid.

1610 T: Why the domestos is a liquid? Can you please tell us? Why it is a liquid, the domestos? Have you seen the domestos?
L: Yes Sir.
T: All right tell us why it is a liquid?
L: Particles are not together.

1615 T: Particles are together. What does that mean?
L: It floats.
T: Louder.
L: It floats.
T: She says it floats. What floats on water, a cork or a stone, you? What floats on water
1620 cork or stone?
L: A cork.
T: Cork floats. The domestos, she said floats. Do you think domestos floats or it mixes with the water?
L: It mixes with the water.

1625 T: So, does it float or it mix?
L: It mixes
T: So, what is she trying to say? When she says it floats, you?
L: Sir, she is trying to say it flows.
T: She is trying to say that it flows. Did you saw she say floats. Which one is correct to
1630 say?

L: Flows.

T: Louder.

L: Flows.

T: Like what? What else flows?

1635 L: Like water, Sir.

T: It flows, when it does what? When you have water in a cup it stands still it does not flow.

L: When it is going.

T: From where to where?

1640 L: From the tap to the drain, Sir.

T: From tap to drain. Ok, even in the mountains when it rains. When it rains the water flows up the hill or down the hill or below the hill, yes?

L: Down the hill.

T: Down the hill, so it flows, do you understand? Flows means it moves, so which means that you know that the liquid can flow. One person in Grade8E mentioned water vapour. Do you think water vapour is something that flows like water in the valleys, yes you?

1645

L: Sir, it rises up, Sir.

T: It rises up. Do you think it is in the right column or it is the wrong column?

L: Sir, it is in the wrong column.

1650 All learners' say: Yes Sir.

T: Who agrees put your hands up? He is says the water vapour, the one that we found in the soil sample. he says it is the wrong column.

All learners' say: Yes Sir.

T: Who agrees with him? Put your hands up, lets see, if your hand is down it means you don't agree with him. Do you say it is in the right column? We won't come back. Let the child that says it is a liquid. So, you, what is your name?

1655

L: Khanyisile.

T: You take too long to say your name. What is your name?

L: Khanyisile.

1660 T: Khanyisile, is the water vapour in the right column or in the wrong column?

L: It is in the wrong column.

T: It is in the wrong column. Ok, you see when you make noise you make Khanyisile look very sad. Keep quiet Khanyisile is going to learn this on her own. Tell us Khanyisile, Grade8E put water vapour in the liquid, not solid and not gas. Is it in the right place or in the wrong place?

1665 L: It is in the wrong place.

T: It is in the wrong place. Tell us why you say it is in the wrong place?

L: It is having steam.

T: It is having steam. But this one said the liquids flow they are moving. They move from the tap to the drain. Does the water vapour do that?

1670 L: No Sir.

T: Why it is not flowing?

L: It is having gas.

T: How is it moving, you said water and liquids flow?

1675 L: It rises up.

T: It rises up itself.

L: Yes Sir.

T: Oh, so where is its place?

L: In the gas.

1680 T: Gas. I don't hear. What is its name?

L: Water vapour Sir.

T: Water vapour, all of you?

All learners' say: Water vapour.

T: Now, in that soil sample that we had it seems as if it has a little water in it and if you live this soil in the sun, what do you think will happen? That soil, you put a little of damp water in the soil so that the plants can grow. But you take that soil and put it in the sun, what do you think will happen, you?

1685 L: It is going to dry up.

T: It is going to dry up. How does it get dry?

1690 L: The sun heats it and then it becomes dry.

T: Yes.

L: You put it in the sun and it becomes dry and hard.

- T: What makes it to be dry and hard?
- L: The sun.
- 1695 T: The sun, what does the sun do to the soil? What drains the soil?
- L: It heats it.
- T: It heats it. What is coming out of the soil that is making it to be hard?
- L: The water vapour.
- T: Pardon.
- 1700 L: The water.
- T: The water, it flows or it comes out like something?
- L: It comes out.
- T: What is that called? When water is coming out, it starts with an E. Oh, so no one knows, you see now. Ok Thabile?
- 1705 L: Sir, it evaporates.
- T: Louder.
- L: It evaporates.
- T: All of you.
- All learners' say: Evaporates.
- 1710 T: Have you seen that before?
- Some learners' say: Yes Sir.
- Some learners' say: No Sir.
- T: You have never seen evaporation before?
- Some learners' say: No Sir.
- 1715 Some learners' say: Yes Sir.
- T: Where did you see it?
- L: Sir, I have never seen it sir.
- T: You have never seen water evaporates?
- L: Yes Sir.
- 1720 T: Have you ever washed yourself and your body is wet?
- L: Yes Sir.
- T: And you wait for a while an hour, two hours, three hours and is still wet?
- L: Yes Sir.

T: Is it still wet or dry?

1725 [Learners laugh.]

T: After an hour, two hours, three hours, you are still wet or it is dry without drying out with a towel.

L: It gets dry.

T: So, what happens to the water? You wipe it or it disappears on its own.

1730 L: Sir, it disappears.

[Learners laugh.]

T: There is a word in science that we use, who wants to help him? This girl gave us the word it looks like you did not hear her.

L: Sir, she is talking softly.

1735 T: Eh, you don't tell, it means you do not pay attention you don't listen carefully. You, you are too busy with that paper. Please put it here so that you stop worrying about where the paper is? Did you hear the word that she said?

L: No Sir.

T: Ok, someone help him, because he does not pay attention he is busy with the paper.

1740 L: Evaporates.

T: Yes you can say it now?

L: Evaporates.

T: Ja, water evaporates. What does it mean?

L: The water moves out.

1745 T: To where?

L: To the sun.

T: To the sun.

L: Yes Sir to the sun.

T: The sun is so far away people don't go there. All right do you think it goes to the sun?

1750 Lets look now on page fourteen again. You can notice there in that activity three there it says elements. Read all of you.

All learners' read: Elements in the soil and in the body of soil organisms such as rats or other living organisms. Study the table below that shows the different amounts of natural occurring elements that make up soil sample and a rat.

1755 T: Soil sample means a small amount of soil you took from the garden, it is called sample. All of the soil in this world is not the sample, but the one you take there and you come and put in a container so that you can study it is called sample. It is a little bit of soil, so that is why we call it sample. So in the soil sample that we have looked at. There are two columns there. The one said, elements that makes up the earth surface soil. Read
1760 all of you.

All learners' read: Elements make up the earth surface soil.

T: Read the other one.

All learners' read: Elements that make up the body of a rat living in or on the soil.

T: So, there are orgasms that live in the soil, and there are elements in their bodies and
1765 there are elements in the soil. Now if you read the first one I will give you one minute to read each one and look at the percentages, how much is it?

L: Oxygen.

T: No, read on your own quietly. And in the next one or in a rat only, in these elements in there. Most of those elements are in the table that you saw on page thirteen. Right you
1770 should be half way now with your reading quietly. Right let's look at the first column it says oxygen. How much percent of oxygen in the soil?

L: Forty-eight percent.

T: Forty-eight percent. How much percent of iron present in the soil?

L: Four percent.

1775 T: How much percent of potassium in the soil?

L: Two comma five percent.

T: Lets look at the rat body and I am sure that the rat eats something that was in the soil like plants, cheese and milk, cheese is made from the milk. So all the things that rats ate come from the soil. So these elements were in the soil. They grow they went into the
1780 roots and in the plant. The plant makes food, the cow ate the food and the cow makes the milk and its body and the same element and then rat ate the cheese. In other words the rat got these elements from the what?

L: From the soil.

1785 T: From the soil because all of them were in the soil and the rat eat the plant and the plant was nice and the cow ate it. And the cow don't like dead plants, they like what kind of plants?

L: Fresh.

T: Fresh. What color is it?

All learners' say: Green.

1790 T: Have you seen the cow eating grass?

L: Yes Sir.

T: Tell the other learners that have never seen it. Some people stay I town they have never seen the cow eating grass. And that grass grow...where does it grow?

L: In the soil.

1795 T: In the soil or there is no soil here only the plants. Sit straight up please. Right, so let's go on now. You see now these elements are in the soil and they eventually become part of an animal's body.

All learners' say: Yes Sir.

T: Put your hand up if you want to answer. Do you think we have elements in our bodies?

1800 L: Yes Sir.

T: Yes.

L: Yes Sir.

T: Ok, give us an example of some elements in our bodies. Ok, can anyone please tell us where do you think we get these elements?

1805 L: From the soil.

T: From the soil, only if you eat soil they come straight like that.

L: No Sir.

T: Tell us something that we ate and that thing comes from the soil.

L: Sir, we ate vegetables.

1810 T: Vegetables, yes, so the vegetables find their elements from where?

L: The soil.

T: How, please listen now. How do the vegetables get their elements in the soil?

L: Sir, the plants mix the elements in the soil.

T: How does it mix the elements? How do plants have that they take it out from the soil?

- 1815 L: Sir...
T: Tell us. What are those things that plants have that are in the ground? Yes?
L: Roots.
T: Roots. Who have seen some roots in the plant? What do roots do? You, what do roots do?
- 1820 L: They, they, they take the water.
T: All right, lets use the word that we use in science, so we can give it to her, yes?
L: They absorb the water.
T: Absorb, say all of you.
All learners' say: Absorb.
- 1825 T: They absorb the water. What is mixed in the water? Is the water pure in the soil?
All learners' say: No Sir.
T: It is mixed with something like what? If you take salt and you mix with what when you are cooking. The salt does it disappear in the water or you can see it, all of you?
All learners' say: It disappears.
- 1830 T: It is called it dissolves, say all of you?
All learners' say: Dissolves.
T: So, if there is salt in the ground or there is iron they will mix with water and also dissolves. And when it is like that what do the roots do?
L: Sir, they absorb.
- 1835 T: Yes they absorb. What the simple word is for absorbed?
L: They dissolve.
T: Ok, when you buy a tin of coke by the tuck shop. They give you a what? with a coke tin?
L: Straw.
- 1840 T: Straw. What do you do with a straw?
L: You suck.
T: You suck with a what? With a straw or a tin or a juice?
[Learners laugh.]
T: Even if there are two drops left, you suck that one too, isn't it?
- 1845 All learners' say: Yes Sir.

T: And what sound does it make

[All learners' make mncu...mncu... sound. That is the sound of the juice when it is moving up the straw. They all laugh.]

1850 T: Oh, so we some roots in this class. We have roots called human beings. Now plants have got their own roots. You see this one it is too tired for me not giving it water. It sucks its own water out of this water in this bottle. Look at these roots.

[The educator takes out a plant with white roots from the bottle with water in the classroom and shows the roots to the learners.] Did I put them there?

All learners' say: No Sir.

1855 T: So roots absorb what they absorb?

All learners' say: Water.

T: From where?

All learners' say: From the ground.

1860 T: Not from the bottle? This is what I make it this one. They suck it from the ground. And what is mixed in that water. Is it pure water or it has something in it?

L: It has got something soil.

1865 T: It has got soil matter and nutrients and dead plants, animals and their body, the elements in the body, they got rotten and they go into the soil and they mix with water on rainy days. That is why after the rain the plants are looking good or they look like growing fast.

All learners' say: Growing fast.

T: Yes, and food hide there because you don't come and cut the grass on the house, isn't it?

All learners' say: Yes Sir.

1870 T: The roots are the ones that do the job. Lets try to put it back here and then it carries on drinking as well. So do we also have elements in our bodies?

All learners' say: Yes Sir.

T: Like which animal?

L: Rat.

1875 T: The rat, the one we spoke about there.

All learners' say: Yes Sir.

T: Let's look at the rat again and at those elements, let's look at the rat. So in the rat's body what is the first element we mentioned?

All learners' say: Oxygen.

1880 T: Which one is the least of these elements in the rat's body?

L: Phosphorus.

T: Phosphorus is one percent. How much nitrogen in the rat's body?

All learners' say: Three percent.

T: Pardon.

1885 All learners' say: Three percent.

T: How much hydrogen in the rat's body?

All learners' say: Ten percent.

T: Yes, hydrogen you see. Let's do that question at the bottom there. Which element is found in the large amounts in a rat and in the earth's surface soil?

1890 L: Oxygen.

T: Do not shout, let's write it down. Number (b), when the two oxygen's combine, look at the diagram at the bottom there. The first circle is the atom of oxygen. Let's write the word, what is the symbol of oxygen?

All learners' say: O.

1895 T: Let's write the O below there, the first circle and there is oxygen it is the same, exactly the same atom. Let's write another O. There is a dotted line below there. Let's put an arrow below that arrow. What happens to the two circles there, the two atoms? Are they separated or they combine?

All learners' say: They combine.

1900 T: So, let's write, how many symbols of oxygen must we write, its one or two?

All learners' say: Two.

T: No in science we write one and then we put a number?

All learners' say: Two.

T: Yes, we write small two. We write small two, is it on top or at the bottom?

1905 L: On top.

T: No.

L: On the bottom.

- T: In mathematics this small two is a squared. There is no O squared. We say O two. So write a small two like a small baby at the bottom there not under zero, slightly this side.
- 0 So that is oxygen, is that oxygen element or is it oxygen compound?
- L: Compound.
- T: Pardon.
- L: Compound.
- T: Do you remember we said yesterday, compound is when elements combine together
- 5 chemically? So it's an opposite of compound. Lets write there number (b). When two oxygen atoms combine they form an important gas. What is the name of the gas?
- L: Oxygen compound.
- T: When hydrogen atoms combine they form an important gas, what is the name of this gas?
- 0 L: Hydrogen compound.
- T: Because when H goes with H and O go with O.
- [Learners laugh.]
- T: So what is it, what does O stand for?
- All learners' say: Oxygen.
- 5 T: Yes, so the answer is oxygen. Is it oxygen atom or oxygen gas?
- All learners' say: Gas.
- T: Oxygen gas. When you have separated we say the atom when it is alone. Once they combine that is the compound. So oxygen element or is it oxygen gas?
- All learners' say: Oxygen element.
- 0 T: We said an element is only one thing it does not combine with other things, now they have combined. So is it oxygen atom, element or oxygen gas?
- All learners' say: Oxygen gas.
- T: Let us see how the oxygen gas is formed, two oxygen atoms combine and then form a gas. You see now the gas in the air that we breathe in how is made? Do we breathe in
- 5 oxygen element or we breathe in oxygen gas?
- All learners' say: Oxygen gas.
- T: Yes, we don't breathe in element. We breathe in a gas. All right, now on page fifteen you will look at those at home and try and do those at the bottom there. Just like we did at

1940 the bottom of page fourteen. There is the table there, find the symbol of hydrogen is H, oxygen is O, combine them.
You may go now.

Day: 6 **Date: 24-08-2006.**
Grade: 8B. **Venue: Educator's classroom.**
1945 **Period: 1.** **Time: 8H15-9H00.**

The observation of the learner's preparing their portfolio boards.

1950 The educator divides the learners into three groups and asks them to submit their questions to the educator and give the name to their groups. The learners give their questions to the educator. The learners take ten to fifteen minutes discussing their name. Some learners wanted to be called Squata-camp and Kwaito. But some learners decided that they must think of the word about what they are learning about. They asked the educator about what type of name they must use and the educator mentioned that it must be the scientific name.

1955 Group 1's name is Nature.
Group 2's name is Meso's.
Group 3's name is Earthworms.

1960 The educator writes the questions in the chart so that it is easy to for one to read it at a distance. The learners start to work using different things they have collected from their homes.

The first group decided to bring newspapers and magazines.

The second group decided to bring dry roots, dead ants, water placed in plastic bag, loam soil with fertilizer, orange peels, papers, pens and white chart.

1965 The third group decided to bring loam soil, sandy soil and fragments of plants, orange peels and curry powder.

The educator provided the learners with the portfolio board to paste what they wish to display. The educator pastes the questions for each group on the portfolio board.

Group1.

What does matter and materials in the soil look like?

- 1970 Group 2.
What type of materials is in the soil that helps organisms to live?
- Group 3.
What does matter and materials in the soil come out and used by animals?
- The learners start to discuss and paste materials on the portfolio board and use the educator as the resource.
- 1975 They use their home language Isizulu and English during the discussions. The educator gives them the following instructions to be followed during the discussion.
They must choose their group leader to control the discussion and to make sure that all group members are involved during group discussions.
- 1980 One person must talk at a time in each group.
All members of the group must be involved.
As the learners are discussing there is noise in the classroom. The educator reminded them what they have learned. He showed them the sample of soil they have used in one of the lessons and the charts with the information learned about matter and materials. The
- 1985 forty-five minutes period is not enough for the learners to finalize their portfolio boards and the educator request them to come and work during break time.
- Day: 7. Date: 04-09-2006.**
Grade: 8B. Venue: Educators's classroom.
Period: 3. Time: 9H45-10H30.
- 1990 For the first fifteen minutes the learners are finalizing their portfolio boards. The educator is helping them to finalize their portfolio boards.
The educator put the portfolio boards on the table in front of the class.
Eh, one person in a group must come up and explain to us what they have displayed. Right now, closing up please I don't want to see any one talking. Group leaders will go or you will volunteer or group leader will go on their own, to talk and the sheet is there in front of you that you will use for assessment each one was given to you. Today only three people will go each group will choose one person. Next time, tomorrow or next week each person will come here and explain how board is displayed. What is that on the board? And we will ask him a few questions. I will ask you a few questions and you will
- 2000 be assessed on how you answered the questions. When you come up you read the

question and you say what is written on the board. We give you three minutes to talk after three minutes you stop. Lets start with the first board, eh... group leader you come up or someone else come up on their own or group leader may point at someone. Ok come up now. Give us your name and you say what is displayed.

2005 My name is Njabulo and I am representing the Nature group. The topic or what is our topic is that:

What does matter and materials in the soil look like?

Eh... H is hydrogen element you see. H is hydrogen this is what it looks like. And then O is oxygen and then C is carbon dioxide atoms. And then mixture, mixture is like cake.

2010 Cake mixture you see. And then juice, you put some sugar water, color mixture. And then curry powder and some salt that is a mixture. You see, that here is curry powder and some salt. And then you come to compound, and then you see here that is carbon dioxide that we breathe. And then water is H_2O you take two of hydrogen and then one oxygen that is water. And then iron oxide, you can see here its iron oxide. And how to make glucose, its hydrogen and then carbon dioxide and then eh... oxide eh...oxygen. Its hydrogen, carbon dioxide and then oxygen and then hydrogen. And there is some sugar web.

2015

All right, three minutes I finished lets ask you some few questions.

2020 Q 1. Can you explain how the atoms form or joined to form a compound? Use one of them there is either water or carbon dioxide. How atoms or element join up to form a compound?

L: Eh... like or you take one of them, water you take the hydrogen and you take the oxygen and you take the two of the hydrogen and one of the oxygen then it will be the water formed.

2025 Q 2. So what is the best example?

L: There is it Sir.

Q 3. Say it?

L: When you take two hydrogen and one oxygen it becomes water that is the compound.

Q 4. Do you mix them physically or you mix them chemically?

2030 [The learner is quiet.]

Mixture lets look at the mixture for instance cake. What was mixed to make cake?

L: Yes Sir, it was...

T: At home when mummy makes cake what does she mix?

L: Dye, sugar, water, and cake flour Sir, sugar, veg, and water.

2035 Q 5. How does she mix it, physically or chemically?

L: Sir physically.

T: Physically.

L: Yes Sir.

2040 Q 6. Are you saying that the compound is also joined, the compound like water. As you showed that's the water.

L: Yes Sir.

T: Those elements join physically and you said that mixture also join physically. Q 7. Is that correct or you want to tell us how the compound are formed?

L: Sir, compound is formed by mixing Sir.

2045 T: Mixing, ok lets stop now.

Q 8. What did you enjoy about learning this way?

L: Sir, I got to know how to mix things Sir. How does the water forms. I got to know that Sir, and then and we work as a group and is nice to work as a group. Sir, and then I learnt that...

2050 T: All right, just what continue.

L: I learnt that by mixing things Sir, you can mix sugar when you don't have juice, may be you can take sugar, water. Or like glucose you can take sugar and water and then salt so you will have glucose.

T: Ok, lets give him a hand.

2055 [All learners give him a round of applause.]

T: Lets have someone from the middle board. Please come up quickly. Give us your name. You talk for three minutes and then you stop. Lets give her a space to talk. May someone close the door please?

2060 L: My name is Lihlithemba. I am representing the earthworms. Eh, eh, our question is how does matter and materials in the soil come up and used by the animals?

This section is sand soil the other section is loam soil and this is rust, water, mineral salts, loam soil, locust, sand and carbon dioxide.

Loam soil helps plants to grow. The plant help eh...and...and...

T: Talk louder please?

2065 L: The plants help the locust with the food and loam soil helps ants for, for shelter. And this is a plant and this is mineral salts.

T: Right, your time is up.

Q 1. How do these mineral salts come out of the soil?

L: They come out eh...

2070 T: Answer the question on top said, how they come out of the soil? Can you explain that in a one-minute? All right tell us how the plants get hold of these mineral salts from the soil, these compounds and elements in the soil? How does the plant get them?

L: Water.

T: How does water help?

2075 L: Sir the plant suck water.

T: Is there anything mixing the water that plants suck up?

L: Yes Sir.

T: What mixed in the water?

L: Soil.

2080 T: Soil. How does the locust get hold of these things that are in the plant?

L: Sir, the locust digs the hole, Sir.

T: The locust digs the hole to get them out the plant.

L: Yes Sir.

T: All right, what is it that you enjoy about working like this?

2085 L: Sir, I didn't enjoy.

T: I can't hear you, speak louder we are videoing this.

L: Sir, I didn't enjoy because we were working hard, Sir.

T: So you like working hard. What did you learn?

L: Sir, I learn that loam soil helps the plant to grow.

2090 T: What is in the loam soil that is not in sand that helps the plant to grow? Name one thing that is in the soil that helps the plant to grow, name one thing?

[She is quiet.] All right, name one thing that is in the soil that helps the plant to grow?

L: Water.

2095 T: I don't see option written anywhere at the bottom, because these things at the bottom are at the bottom of the soil there and these things helps the plant to grow. All right lets give her a hand.

[All learners give her a round of applause.]

T: One person please. Your name and read your question please?

L: My name is Londiwe. Our topic is:

2100 What are the different types of matter and materials in the soil that help soil organisms to live?

Here we are comparing different types of soil, sand soil, loam soil and clay soil.

2105 Here are the symbols Fe is the symbol of iron. Cu is the symbol of copper. When you mix like, a tin, tin and copper you get brass. Here we have the symbol Pb of lead. Like the pencil lead. Like here we have aluminium like here we have the sample of foil. Here we have the symbol of carbon, which is like a sample of diamond is one of the diamonds. Here we have the periodic table of elements, elements that are found in the soil.

What is in food?

2110 We have different types of chemical substances that are mixed in the food, for example proteins, carbohydrates, fats, vitamins and mineral salts.

T: All right, eh...you see about sandy, how sand is useful, and what element is in the sand?

L: Sir, we have silicon like glass.

T: Is that useful?

2115 L: Sir is useful.

T: How do they make glass?

L: Sir, Sir, glass like that little thing eh...

T: So the glass that is found on the soil that people use it or they use the sand or they do something on it before they get the glass?

2120 L: They do something to the sand.

T: What they do to the sand?

L: Sir, they put it in the machine. Sir, they have the machine that they use to separate the sandy soil and the glass. They separate glass, diamond, iron and copper from sand by using the machine.

2125 T: I thought there is diamond and brass that makes the glass. You said that there is a machine that separate. All right all those elements that you mention there, iron, copper, gold and tin. Dou you find them all in loam soil or you also find some of them in the sandy soil?

L: Sometimes you find all, sometimes you find some.

2130 T: Tell us how gold comes out of the soil?

L: How gold? Sir, they put the, the, they burn the gold so that the gold can come out of the soil. And they put it.

T: So if I go the garden and fetch some loam soil and burn it so that gold is coming out or there is special soil that only makes such thing?

2135 L: Sir, they use special soil.

T: Where in this country today they get such soil?

L: Johannesburg.

T: Louder.

L: Johannesburg.

2140 T: Oh that is why it is called the city of gold.

L: Yes Sir,

T: All right the periodic table, who helped us by putting all these elements in the table?

L: The scientists.

T: Do you know the scientists?

2145 L: I am not sure.

T: Oh you are so not sure. What did you enjoy about learning this way?

L: Sir, I enjoyed it because we find that there are more than one hundred elements in the soil that helps us, and that helps the meso-organisms to live in the soil.

T: Lets give her a hand please.

2150 [All learners give her a round of applause.]

All right class, so that comes to the end of our presentation today. Next time we will get three people from each group. Today we have got one person from each group to come and speak here. All the groups did very well. The other people will come the other day You can go now.

2155

APPENDIX: B 5

CURRICULUM DEVELOPMENT PRELIMINARY ANALYSIS

SOURCES OF RESEARCH.	POST TEACHING AND LEARNING INTERVIEWS.	MAIN SEMI-STRUCTURED INTERVIEWS.	CLASSROOM OBSERVATIONS.
CURRICULUM DEVELOPMENT.	<p>We planned to do it over a week but now it stretched to three week, which is close to a month. We started on the seventh and today are the fourth it come closer to a month.</p> <p>I suddenly infuse the content that I am aware of which they are not aware of. And bring that, and integrate that with the curriculum and their own prior knowledge and their interest and in that way I develop curriculum around that.</p> <p>The workbook begins with the topic that is designed in the curriculum. Now they have a clear topic that needs to be taught. It is also skills based that are clearly laid out in the in the standards in the policy documents. Then when the learners bring to the fore around certain core areas in the syllabus. I would first begin my activities by asking them what they already know about the topic. So the learners will engage with me and be very happy to explain these things, because it is the staff they know around the topic.</p>	<p>The experience of teaching Natural Sciences in Grade8 is transformative for me.</p> <p>The apartheid education did not give us skills as scholars to help learners to understand school science.</p> <p>Even the training that the teachers received in those apartheid days it was transition mode. It was not learner action based where learners take responsibility for their own learning. So it was completely rote learning. Children simple just regurgitate what the teacher said to them. They sit quietly. They are passive in the class.</p> <p>But in Natural Sciences and at that time it was called General Science and it was a mix of all other subjects. But now Natural Sciences is more focused and it integrates in other learning areas since the introduction of OBE and Natural Sciences.</p> <p>Natural Sciences allow the space now to do this through</p>	<p>[OBE] RNCS, NCS and NATED 550, the educator is using these documents when developing learner's workbook and activities.</p> <p>The educator prepares the activities beforehand in the learner's workbook and the learners context is involved in each and every activity and examples.</p> <p>Newspapers, charts and plants are available in the classroom.</p> <p>The educator asks learners a day before to bring resources from their context to the classroom.</p> <p>The educator provides the learners with the resources e. g. soil samples, portfolio boards and charts.</p> <p>Resources are taken from the learners' environment e. g. soil, ants, rats, trees etc.</p> <p>Learners are encouraged to bring learning material from their environment and homes.</p>

And then I will follow up that by asking them all the things they are interested around the topic. So they can also now give me more, not just what they would like to know, and in that way I suddenly infuse the content that I am aware of which they are not aware of.

using projects even the more action and only learning.

It has brought about changes, but these changes are all at theory level. There are in some body's mind that is not in the classroom. And teachers have a little input in the curriculum changes. They merely on the receiving end of policies that are shaped at a higher level, and in practice they must now make sense of those theories and then interpret them in the way that learners can be engaged in their own learning. I think there is still a long way to go in South Africa for teachers to be grabbed in with the idea of allowing learners into interacting with their own learning and taking responsibility.

So those real issues they bring from their communities within them. I then place purely in the curriculum. They are accommodated in that way. So the whole idea of using projects, its then there to help the learners to bring those experiences that they have. And that knowledge eh, whether it is traditional or

		western or knowledge that they have obtained from somewhere.	
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COMMENTS: What is the pattern or trend being developed?

I see two types of changes that are transformative and theoretical.

- **The change for the educator is transformative.**

“The experience of teaching Natural Sciences in Grade8 is transformative for me. The apartheid education did not give us skills as scholars to help learners to understand school science.

- **The change for other educators is theoretical.**

“It has brought about changes, but these changes are all at theory level. There are in some body’s mind that is not in the classroom, and teachers have a little input in the curriculum changes.” “Eh, and even the training that the teachers received in those apartheid days it was transmission mode.”

I see that the policy documents, the learners and their contexts are involved in the process of developing the curriculum.

- **Curriculum development happens around the learners.**

“Then when the learners bring to the fore around certain core areas in the syllabus. I would first begin my activities by asking them what they already know about the topic. So the learners will engage with me and be very happy to explain these things, because it is the stuff they know around the topic.”

“Integrate that with the curriculum and their own prior knowledge and their interest and in that way I develop curriculum around that.”

- **The learner’s context is considered when planning and developing the activities.**

“The educator prepares the activities beforehand in the learner’s workbook and the learners context is involved in each and every activity and examples.”

“The educator asks learners a day before to bring resources from their context to the classroom.”

“The educator provides the learners with the resources e. g. soil samples, portfolio boards and charts.”

“Resources are taken from the learners’ environment e. g. soil and plants.”

“Learners are encouraged to bring learning material from their environment and homes.”

“So those real issues they bring from their communities within them. I then place purely in the curriculum. They are accommodated in that way. So the whole idea of using projects, its then there to help the learners to bring those experiences that they have. And that knowledge eh, whether it is traditional or western or knowledge that they have obtained from somewhere.”

The curriculum documents are used when developing the workbook.

APPENDIX: B6

2160 TEACHING AND LEARNING PRELIMINARY ANALYSIS

SOURCES OF RESEARCH.	MAIN SEMI-STRUCTURED INTERVIEWS.	PRE AND POST TEACHING AND LEARNING INTERVIEWS.	CLASSROOM OBSERVATIONS.
<p>TEACHING AND LEARNING.</p>	<p>The experience that is transformative for me. Eh, the apartheid education did not give us skills as scholars to help learners to understand school science. Eh, and even the training that the teachers received in those apartheid days it was transition mode. It was not learner action based where learners take responsibility for their own learning. So it was completely rote learning. Children simple just regurgitate what the teacher said to them. They sit quietly. They are passive in the class.</p> <p>And I found that the learners participate more and are very interested in science. Their interest is shown by their questions that they ask, questions related to their daily lives in what happens at home, that they experience at home. Working around the house in matter and materials eh, playing with mud on rainy days</p> <p>They ask questions all the time. When immediately the child ask question, that is the moment the child get responsibility and interest in their learning. They want to know more from the more knowledgeable adult or peer. Natural Sciences allows the space now to do this</p>	<p>The intention for today's activity is to find out from the learners what they anticipate? Because the problem solving, the project approach must begin with what the learners want to know, what they are interested in? So that they can be the one's who also be the part of finding the answers. The teacher is not going to give them the answers. They must discover that through further inquiry assisted by the teacher.</p> <p>Tomorrow will be the follow up of what questions they have and what interest they have and go into finding the answers ehm... series of answers. They co-ordinate what they found with the teachers assistance. Then they will present, ehm... will create and present a poster or a board which pulls this information they found to their questions and be able to present it to the class.</p> <p>The intention for today's activity is to find out from the learners what they anticipate? Because the problem solving, the project approach must begin with what the learners want to know, what they are interested in? So that they can be the one's who also be the part of finding the answers. The teacher is not</p>	<p>T: Take out your workbooks and do activity 5.</p> <p>At the end of that number three 3, see page 8 information sheet. Page 8 is about new ideas for you to answer that question. We will need to know this so that we can start with the new one. Let me give you one minute to complete those questions. Some people write very slowly.</p> <p>T: Let's go back to page 3. What is on top there? What is right on top there? There is a topic. Can someone read it out first, it is written there at the box right on top of the thing.</p> <p>35: T: Now these pages back up to page 11, they all dealt with, what?</p> <p>(All learners say: Soil.)</p> <p>How does soil ehm, fit with this area earth and beyond? Does it fit in or does not fit in. Put your hand up if you know.</p> <p>L: It fit in.</p> <p>T: Explain how soil and earth and beyond fit in?</p> <p>L: Because soil is in the earth.</p> <p>T: Right, the second part of this book of ours will deal with new topic that is on page 12.</p> <p>(All learners turn to page 12)</p>

	<p>through using projects even the more action and only learning.</p> <p>It has brought about changes, but these changes are all at theory level. There are in some body's mind that is not in the classroom. And teachers have a little input in the curriculum changes. They merely on the receiving end of policies that are shaped at a higher level, and in practice they must now make sense of those theories and then interpret them in the way that learners can be engaged in their own learning. I think there is still a long way to go in South Africa for teachers to be grabbed in with the idea of allowing learners into interacting with their own learning and taking responsibility.</p> <p>I think there is still a long way to go in South Africa for teachers to be grabbed in with the idea of allowing learners into interacting with their own learning and taking responsibility.</p> <p>My approach is eh, the hand-on approach and project based learning is an approach for me that works very well. It incorporates the problem solving where learners must identify the problem, and the teacher can also bring some problems on the table, and so can their elders in the community bring problems to the fore, which the learners also experience, in the context, which they live. And in that</p>	<p>going to give them the answers. They must discover that through further inquiry assisted by the teacher.</p> <p>Today the outcome was to get the names of different elements. Ehm...to get the names of different elements and making use of their experience in naming the different substances that matter, that soil is made of. And, eh, working from the list they compiled the last time in the previous lesson of the kind of material that soil is made up of.</p> <p>And I am glad they came to conclusion on their own. Where the sheets only helped them to consolidate their own ideas that they came with to their classroom. So I am quiet happy that I have achieved that, and I thought it was going to be difficult to get the stage of them identifying mixtures, compounds and elements. I think that went quiet well, eh making use of their own experiences.</p> <p>Tomorrow I would like to move on to looking how, how these elements that appears could combine together and combine in a chemical way to form compounds and the smallest part of which is there, the molecule. And we will make use of the worksheet page fifteen for them to arrive at the combination of elements to form compounds, using ordinary substances again like balloon, water, and glass, and how</p>	<p>T: Are you all on page 12. I will ask you to read the first 3 paragraphs. The first 3 paragraphs. (All learners read the first 3 paragraphs quietly.) T: The time I have given you is up. You must not read all this. I will ask you few questions. Look at the topic at the top please. Is the topic the same as the first one? What is the difference between the two? What is the topic?</p> <p>Do not worry about the second page of those three paragraphs. I ask you to leave. That is what you should be reading about, put this one, one side, you will finish during break time. Please look at the page number? Look at page number 12. Ok now you have read the first 3 paragraphs. What is right on top of the end. yes? L: Soil study and matter and materials.</p> <p>Is it the same or is it different? Tell me. Tell where it is the same and where it is different? L: Sir, it is different. The first one is soil study and earth and beyond, and this one is soil study and matter and materials. Environment is some place where you live in or some place out there, or some place where we all live. and this whole earth</p>
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	<p>way we bring those problems into the class, science classroom. The learners can then see that science is something that happens in everyday life, and is not something that is in the textbooks or that only belong to the teacher, or only belongs to the scientists wearing a white jacket in the laboratory.</p> <p>I design eh, learning experiences that learners can engage so it is a bit challenging to engage such, to design such experiences that allow learners to participate fully in their own learning.</p> <p>I use cardboard as power point presentation where learners can imagine that each board or each sheet or each poster that they prepare on certain aspects about what they wanted to learn, can be for me like a slide in the power point. there it is there. So I improvise a lot so that learners can actually engage and construct meaning and take to the peers in a group and take their learning to greater heights.</p> <p>Ja, problem solving is at the heart of project-based learning. The learners must formulate their own focus questions guided of course by the mentor who assist in shaping these questions. As they are still budding scientists and interacting with nature and materials on their own. Touching and feeling and asking questions and engaging. So</p>	<p>those things are formed and how possible these things combine and the product of such things and looking at diagrams and word sentences. And diagrams for using the symbol of compound and formula they come across in today.</p> <p>Now the poster stage, which I am trying to rush too, is to move from the mixtures. Because soil where these meso-organisms can be found is leafy, moist, loamy type of soil which is more of a mixture, but one will find compounds in there which are then used to make food in the plants in photosynthesis. And then, hence the soil actually helps these organisms to live because of the food that is in that type of soil. That comes the plant and the insects so that there is a food chain to see how those matter and materials has been actually transferred in the energy flow within the food chain. And in that way, then they will see that matter and materials that is in the soil actually is useful to support and sustain biodiversity in the soil of these organisms that live there which is the overall unit that conserving biodiversity.</p> <p>They would have understood what I told them, but going home and them doing it on their own showed me that the interpretation of this thing was not easy as I took it for granted that they would do it. So that, that, and that what I get it is that with those two who had made an era in</p>	<p>is one massive environment. But even where we stay or where we live is the environment. This environment is the whole area the people that live in, the animals, the grass, the plants and everything else. The second topic under environment is called conservation. The conservation means what you look after something. The focus of this whole unit talks about what? Can you read the next heading is quite long? Longish. Can you read all of you? All learners read: What diversity animal like in and on the soil. T: Can you speak loudly please?</p> <p>So, our topic, this one that said matter and materials. So let me link up. The first one was earth and beyond, that talked about soil. Soil is important for these organisms, these small ones, ants and locust and so on. Look at that question which said how is the soil important to these animals?</p> <p>I am asking you the animal that you have seen. The favorite one, the one that you are scared off. You like it or you scared, you throw it away.</p> <p>Just explain, whether you hated</p>
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	<p>the approach eh, that is problem solving begins with focus questions and sustained engagement from a learner side in trying to answer these questions assisted of cause by the knowledgeable adult or peer.</p> <p>Eh, I let them share the questions. I let them raise the problems. I let them ask what issues are and all issues that are raised by any learner as far as the topic is concerned focus around the topic. Eh, hence the topic needs to be broad enough in my presentation of experiences that allow them to engage in their learning.</p> <p>Eh, every day problems, because it is not my problem, it is a problem that learners raise. They say what the problem is around the topic. Even, if the kind of problems raised that are peripheral to the topic. I try to bring those, focus them more and in assisting them as a mentor for them in their growth as budding scientists.</p> <p>Yes, all the problems that are raised are real world problems. If the learner says what is soil made up of? What makes clay soil different from loam soil? Why do mango tree grow so well in my neighbor's house and in our yard the tree is so small it does not want to grow? Why I do not get many mangos of fruit like my neighbor? And yet we plant it, bought it at the same time and shop. That is already an</p>	<p>following the table, they couldn't really follow properly. I think he got a better chance on how to move from one to twenty in this table. So I had to a little bit more time here, so I found that part the learners had to get a better understanding and interpretation of this table on their own and so that slows us a little bit down. And then they are coming to grips with the element in the soil and the elements in the animal body that took a little bit along for them also to interpret that way. That these elements that are in the soil eventually do end up in the animal's body, because the animals get the elements from the soil indirectly by eating these things. So that link was necessary as well. And I took for granted that there will be a natural move over to this. Where as the way that the understanding and the fact that I use that plant some roots by chance that they could see that roots have this job of getting elements from the soil.</p> <p>So I need another week or two weeks for learners to internalize and make sense, play and discuss and we need more of that.</p> <p>Ja, but if we give them more time to think and probe, and the period sometimes is get cut and all that. So that affects the working in problem solving because some problems are messy. The route to the right answer is a bit messy. They need to get their hands dirty with problem solving. They can't sit neatly and get</p>	<p>it? Or you liked it?</p> <p>Just explain where did you see it in the home, in the roof, bedroom?</p> <p>Ok, so anyone who must bring one for us in a tin. You must put a little bit of soil and put some leaves and bring one for us. You must bring one. So where is this place where she must go to find this animal? She is a learner, she will go with a stick. Call big brother, because she is scared of it. Ok.</p> <p>It looks like which animal? It will help you to describe.</p> <p>Now you see all these animals that live in the soil. You said you are going to bring to us. Who else is going to bring us, one? You bring us one, put it in the tin or put it in a plastic. Who will bring us sand, you will bring one. Now when you dig the soil you will find more animals besides lo. Bakhona abanye futhi (Are any other learners).</p> <p>Give me the names of those animals that you find.</p> <p>Can we say that these animals that live in the soil, that they want something from the soil? (All learners say: Yes Sir.)</p> <p>T: Or they don't want something from the soil? (All learners say: Yes Sir.)</p>
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	<p>investigation problem for them to solve. So the issues are brought to them by them to the learning situation.</p> <p>So the whole idea of using projects. Its then there to help the learners to bring those experiences that they have. And that knowledge eh, whether it is traditional or western or knowledge that they have obtained from somewhere. That knowledge then is constructed further in the group interaction with others and with of course more knowledgeable person like teacher.</p> <p>Using problems and project in the learning of children is not a new thing, as I said earlier that, it is a sustained way of learning. It is not a once off, and it is linked with many other aspects that learners deal with in their daily lives. So this kind of learning is ongoing, hence the assessment will also then be ongoing. Because, when you monitor assessment, which will be then developmental, where they interact and ask questions and make mistakes leading at the end to a more performance kind of summative assessment. Where they then construct their own meaning and explain that to each other in the form of presentation or a showpiece.</p> <p>Then when the learners bring to the fore around certain core areas in the syllabus. I would first begin my activities by asking them what they</p>	<p>everything. Like I planned neat activities. But what was happening in their minds is that messy kind of thinking process and they need more interaction and more discussions.</p> <p>I will say let's aim for Thursday because I need more time to involve them before they can produce the posters.</p> <p>You have seen what they have put together and the way they actually struggled to get to this stage shows that it was very engaging on their part. And when the children are engaged then they learn more.</p> <p>They would have understood what I told them, but going home and them doing it on their own showed me that the interpretation of this thing was not easy as I took it for granted that they would do it. So that, that, and that what I get it is that with those two who had made an error in following the table, they couldn't really follow properly. I think he got a better chance on how to move from one to twenty in this table.</p> <p>So I need another week or two weeks for learners to internalize and make sense, play and discuss and we need more of that.</p> <p>But if we give them more time to think and probe, and the period sometimes is get cut and all that. So that affects the working in problem solving because some problems are</p>	<p>T: What is the thing they want in the soil?</p> <p>For 1 and 2. Now if you look at that top one, food. What type of food do you think they need? Someone said leaves, rotten leaves. Let's try to give some more examples.</p> <p>What question do you still have in your mind? About all these animals that there are in the soil, that they say there must be some water,</p> <p>Yileyo wena ointerested kuyo (that is what you are interested in)? She wants to know if ants have bones.</p> <p>Do you remember the topic? It is about matter and materials. Ask any question. Do you have any question ngento okuthiwa yimatter and materials (about this thing called matter and materials)?</p> <p>Do you have any question about lento kuthiwa imatter ne materials (this thing called matter and materials)? Ukhona umbuzo onawo (do you have any question)?</p> <p>Lets think about matter and materials (manje sizibuze) about izilwanyana(organisms). La lezi zilwane ziphila khona, zithola I life khona, zihlala khona kule matter ne materials (these organisms live there, get</p>
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	<p>already know about the topic. So the learners will engage with me and be very happy to explain these things. because it is the staff they know around the topic. And then I will follow up that by asking them all the things they are interested around the topic. So they can also now give me more, not just what they would like to know, and in that way I suddenly infuse the content that I am aware of which they are not aware of.</p> <p>Today I am going to follow on those questions and interest and what they would like to know, that they have raised in the previous lesson. And then take that further in terms of them digging some of the core knowledge as I have said earlier. That is in the syllabus, that I will infuse with the questions that they and the interest that they have. And then later on, then for them to put that knowledge together in a form of poster which they must then present to the peers and the panel.</p> <p>I am hoping that the presentation will be tomorrow, but then we have to take learners own pace into account and think it might need another two days. Because they have to negotiate the construction of their' own knowledge in the poster and then ready to answer the questions from the panel on what they have done.</p> <p>And they will use the identification sheet in their notes their worksheet</p>	<p>messy. The route to the right answer is a bit messy. They need to get their hands dirty with problem solving. They can't sit neatly and get everything. Like I planned neat activities. But what was happening in their minds is that messy kind of thinking process and they need more interaction and more discussions.</p> <p>I found that part the learners had to get a better understanding and interpretation of this table on their own and so that slows us a little bit down. And then they are coming to grips with the element in the soil and the elements in the animal body, that took a little bit along for them also to interpret that way.</p> <p>And they will use the identification sheet in their notes their worksheet book. They will actually identify the variety of meso-organisms found in the soil.</p> <p>To me I don't think it's the easy way of teaching? You need to have more time. Ja, but you cover a lot of things learning this way. Ja, you can cover quiet lot of things, the skills that come through as well, communication skills, negotiation skills and making decision and all the critical outcomes come through here. That is what good about it, although it takes time but learning it maximizes.</p>	<p>life there, stay there in this matter and materials). Asibuze imibuzo (lets ask questions) around these things? There kuthiwa (they say) imixe eloam nesand (is the mixture of loam and sand). Asibuze (lets ask questions) around those things?</p> <p>(T: He displays the picture of the earthworms on the wall in front of the learners. The picture is taken from Daily News paper of Wednesday 02-08-2006. He also displays the textbook with the worm drawn on the cover of the textbook. He writes the main question on the flip chart and followed by the questions raised by the learners yesterday.)</p> <p>Why do soil animals need soil?</p> <p>T: They also pick and choose, or there is a piece of leaves there, there is a piece of orange there, there is a piece of locust leg there or they choose. Just like you and me, they pick and choose this way. The thing is we are too big, big we are macro. We can't go and make our selves small, go underground and check what they are eating and, so that we write it down.</p> <p>(All learners say: Yes Sir.)</p> <p>T: We can't do that isn't it?</p> <p>(All learners say: No Sir.)</p> <p>T: You see the movie that said I strum the kids.</p>
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	<p>book. They will actually identify the variety of meso-organisms found in the soil.</p> <p>The driving question that is also on top of each boards, drives them to be able to see how they can solve the problem, engage in the learning and then finally construct the portfolio boards with all the understanding that they gained in the lessons that took place prior to this. The driving question that is also on top of each boards, drives them to be able to see how they can solve the problem, engage in the learning and then finally construct the portfolio boards with all the understanding that they gained in the lessons that took place prior to this.</p> <p>The learners managed to present their portfolio board of their knowledge that have constructed. They didn't work completely on their own they also asked me to assist here and there to come up with the product that you see in front of us.</p> <p>You have seen what they have put together and the way they actually struggled to get to this stage shows that it was very engaging on their part. And when the children are engaged then they learn more.</p> <p>Then they will bring some samples to the class to identify these organisms in the soil in their natural</p>		<p>(All learners say. Yes sir.)</p> <p>T: Did you saw that one.</p> <p>(All learners say. Yes sir)</p> <p>T: The person become that this small and they could go into the small spaces. Do you know what I said, isn't it? May be one can change some of you, go there and see what they eat? What they pick and choosing? Why they eat these things that they pick and choose, these things that are under the ground? Like worms, like locust legs grass. Why they eat them? Yes?</p> <p>T: All right, so now I want to ask you one more question. This thing about this material I am going to write this one matter and materials that we are talking about. What, what is very eh...I want to know what is this thing you are so interested in? This one is even sick, I know. This one put them off. What are you interested in this thing called matter and materials. Now before you answer that question.</p> <p>Yesterday, some people say they will bring us some soil and some earthworm. Can you bring it now so that we can see it you said you are going to bring it?</p> <p>Why you didn't try? I will come back to you; you will explain why you didn't try. Someone else promised us will try. (All</p>
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	<p>habitat. And they will use the identification sheet in their notes their worksheet book. They will actually identify the variety of meso-organisms found in the soil.</p> <p>Philosophy is based on the philosophy of constructivism and also use of the process of a project based learning, where learners construct their own meaning and knowledge in a social small group of learners working together. The portfolio boards were constructed by a group of learners but it was presented by a single learner that represented the group. All other members will also get the similar opportunities to come and explain what they learn and how they learnt and how this has helped them to learn.</p> <p>The driving question that is also on top of each board drives them to be able to see how they can solve the problem, engage in the learning and then finally construct the portfolio boards with all the understanding that they gained in the lessons that took place prior to this.</p>		<p>learners laugh.) Sorry the laughing thing please mayiphelenya manje, angiyifuni (stop the laughing now, I don't like it). It's wasting our time niyayibona (can you see.) Tell us why you did not bring.</p> <p>Ok, now let us answer this question here about this thing about soil. Where these things live? These things like ants and all these things. I want to know, what are you really interested to know. What are you really interested to know, anyone? Think about it. Two people are now really interested in.</p> <p>Kukhona lento nyani kudala ufuna ukuthola ulwazi ngalento. Ufuna ukubuza ke ngiyibhale (There is this thing you are interested to learn about for the long time.)</p> <p>All right, let us be here, what is it that you are interested in. This thing like soil and these things that live there. Something that has been worrying you all along since primary school or this high school or may be one day you will go to the University you are still worried about it now.</p> <p>That is a good question.</p>
<p>COMMENTS: What is the pattern or trend being developed?</p> <p>Experience of teaching.</p> <p>I see two experiences of teaching Natural Sciences, transformative and theoretical.</p>			

"The experience that is transformative for me. Eh, the apartheid education did not give us skills as scholars to help learners to understand school science. Eh, and even the training that the teachers received in those apartheid days it was transition mode. It has brought about changes, but these changes are all at theory level."

I see learner's involvement, teaching approach and the role of the educator during teaching and learning.

Learning is not rote learning but it is learner centred, learners take responsibility of their own learning and learners are actively involved during teaching and learning.

"You have seen what they have put together and the way they actually struggled to get to this stage shows that it was very engaging on their part. And when the children are engaged then they learn more."

"Then when the learners bring to the fore around certain core areas in the syllabus."

"I found that part the learners had to get a better understanding and interpretation of this table on their own and so that slows us a little bit down."

"And I found that the learners participate more and are very interested in science. Their interest is shown by their questions that they ask, questions related to their daily lives in what happens at home, that they experience at home. Working around the house in matter and materials eh, playing with mud on rainy days."

Learner's context and the environment are taken into consideration during teaching and learning.

"They will actually identify the variety of meso-organisms found in the soil."

"Every day problems, because it is not my problem, it is a problem that learners raise. They say what the problem is around the topic. Even, if the kind of problems raised that are peripheral to the topic."

"All the problems that are raised are real world problems. If the learner says what is soil made up of?"

"It incorporates the problem solving where learners must identify the problem, and the teacher can also bring some problems on the table, and so can their elders in the community bring problems to the fore, which the learners also experience, in the context, which they live."

"I am asking you the animal that you have seen. The favorite one, the one that you are scared off. You like it or you scared, you throw it away.

Just explain, whether you hated it? Or you liked it?

Just explain where did you see it in the home, in the roof, bedroom?"

Teaching approach.

Teaching involves hands-on, project based, problem solving approach.

"Using problems and project in the learning of children is not a new thing, as I said earlier that, it is a sustained way of learning. It is not a once off, and it is linked with many other aspects that learners deal with in their daily lives. So this kind of learning is ongoing."

"Because the problem solving, the project approach must begin with what the learners want to know, what they are interested in? So that they can be the one's who also be the part of finding the answers. The teacher is not going to give them the answers. They must discover that through further inquiry assisted by the teacher. "

"But if we give them more time to think and probe, and the period sometimes is get cut and all that. So that affects the working in problem solving because some problems are messy. The route to the right answer is a bit messy. They need to get their hands dirty with problem solving. They can't sit neatly and get everything. Like I planned neat activities. But what was happening in their minds is that messy kind of thinking process and they need more interaction and more discussions."

"Philosophy is based on the philosophy of constructivism and also use of the process of a project based learning, where learners construct their own meaning and knowledge in a social small group of learners working together. The portfolio boards were constructed by a group of learners but it was presented by a single learner that represented the group.

"Using problems and project in the learning of children is not a new thing, as I said earlier that, it is a sustained way of learning."

"My approach is eh, the hand-on approach and project based learning is an approach for me that works very well. It incorporates the problem solving where learners must identify the problem, and the teacher can also bring some problems on the table, and so can their elders in the community bring problems to the fore, which the learners also experience, in the context, which they live."

"To me I don't think it's the easy way of teaching? You need to have more time. Ja, but you cover a lot of things learning this way. Ja, you can cover quiet lot of things, the skills that come through as well, communication skills, negotiation skills and making decision and all the critical outcomes come through here. That is what good about it, although it takes time but learning it maximizes."

"Because the problem solving, the project approach must begin with what the learners want to know, what they are interested in? So that they can be the one's who also be the part of finding the answers. The teacher is not going to give them the answers. They must discover that through further inquiry assisted by the teacher."

The role of the educator during teaching and learning.

Educator act as a mediator of learning and as a mentor during teaching and learning.

"I try to bring those, focus them more and in assisting them as a mentor for them in their growth as budding scientists."

"They must discover that through further inquiry assisted by the teacher."

"They co-ordinate what they found with the teachers assistance."

Conclusion:

Experiences of teaching Natural Sciences are transformative and theoretical. Educator act as a mediator of learning and as a mentor during teaching and learning. Teaching that involves hands-on, project based, problem solving approach is a sustained way of learning. Learning is not rote learning but it is learner centred. Learners take responsibility of their own learning and learners are actively involved during teaching and learning.

APPENDIX: B7

ASSESSMENT PRELIMINARY ANALYSIS

SOURCES OF RESEARCH.	MAIN SEMI-STRUCTURED INTERVIEWS.	PRE AND POST TEACHING AND LEARNING INTERVIEWS.	CLASSROOM OBSERVATIONS.
ASSESSMENT.	<p>Using problems and project in the learning of children is not a new thing, as I said earlier that, it is a sustained way of learning. It is not a once off, and it is linked with many other aspects that learners deal with in their daily lives. So this kind of learning is ongoing, hence the assessment will also then be ongoing. Because, when you monitor assessment, which will be then developmental, where they interact and ask questions and make mistakes leading at the end to a more performance kind of summative assessment. Where they then construct their own meaning and explain that to each other in the form of presentation or</p>	<p>They assess using the rubric when they present it and the panel that will then listen to each child input and then fill questions to the learner that is presenting in terms of what is on the board and in terms of what they enjoy about learning and what they learnt.</p> <p>The assessment sheet given to them before, the rubrics given to them before they come and present actual why they are constructing the boards? And then they are quiet used to the questions or criteria on the assessment sheet. So that they can actually then be able to meet each of the criteria while they are presenting their boards.</p> <p>This assessment contributes to their performance assessment tasks that are part of their learning programme.</p>	<p>The educator assesses the learner's activities in their workbook.</p> <p>I will ask you a few questions and you will be assessed on how you answered the questions.</p> <p>Group leaders will go or you will volunteer or group leader will go on their own, to talk and the sheet is there in front of you that you will use for assessment each one was given to you.</p> <p>Next time, tomorrow or next week each person will come here and explain how board is displayed. What is that on the board? And we will ask him a few questions. I will ask you a few questions and you will be assessed on how you answered the questions.</p>

	<p>a showpiece.</p> <p>I will follow up that, by asking them all the things they are interested around the topic.</p> <p>They have to negotiate the construction of their' own knowledge in the poster and then ready to answer the questions from the panel on what they have done.</p>		<p>All right, three minutes I finished lets ask you some few questions.</p>
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Comments: What is the pattern or trend being developed?

Assessment is for learning.

“Using problems and project in the learning of children is not a new thing, as I said earlier that, it is a sustained way of learning. It is not a once off, and it is linked with many other aspects that learners deal with in their daily lives.”

“They have to negotiate the construction of their' own knowledge in the poster and then ready to answer the questions from the panel on what they have done.”

“I will follow up that, by asking them all the things they are interested around the topic.”

“This assessment contributes to their performance assessment tasks that are part of their learning programme.”

Assessment is ongoing.

So this kind of learning is ongoing, hence the assessment will also then be ongoing.” It is not a once off, and it is linked with many other aspects that learners deal with in their daily lives. So this kind of learning is ongoing, hence the assessment will also then be ongoing. Because, when you monitor assessment, which will be then developmental, where they interact and ask questions and make mistakes leading at the end to a more performance kind of summative assessment. Where they then construct their own meaning and explain that to each other in the form of presentation or a showpiece.”

“Next time, tomorrow or next week each person will come here and explain how board is displayed. What is that on the board? And we will ask him a few questions. I will ask you a few questions and you will be assessed on how you answered the questions.”

Conclusion.

Assessment is continuous and is done for learning, and grading (Summative assessment)

APPENDIX B 8

Categories of curriculum development

In the component, curriculum development, the following categories come to the fore.

1. Curriculum changes.
2. Curriculum implementation.
3. Curriculum documents.

Each category is characterised by the following.

Curriculum changes are

- At theory level;
- In somebody's mind and;
- At a higher level

Curriculum implementation

- Educators have little input;
- Educators receive, make sense and interpret the policies;
- Educators allow learners to participate fully;
- Educators integrate the content with the learner's prior knowledge and interest.

Curriculum documents:

- NCS Policy documents.
- Workbooks

APPENDIX B 9

Categories of teaching and learning

In the teaching and learning component the following categories come to the fore.

1. Teaching experience.
2. Learner's pre-knowledge and interest.
3. Learner's context.
4. Knowledge construction and problem solving.
5. Educator as a mentor.
6. Time factor.

Each category is characterised by the following.

Each category is characterised by the following.

- Teaching experience:
- Transformative.
- Use of learners experience when teaching.
- Hands on approach and project based learning.

Learner's pre-knowledge and interest:

- Learners learn by beginning with, what they want to learn? and what are interested in?

Learners engage in activities by:

- Exploring their interest.
- Recognising the prior knowledge.
- Digging some of the core knowledge

Learner's context:

- Learners learn from their environment.

- Learners ask questions related to their daily lives.
- Learners interact with people in the community and the people in the classroom.
- Learners raise real word problems.
- Learners raise every day problems that are not educator's problems.
- Learners bring samples to the classroom.
- Adults also bring problems to the fore which the learners experience in the context.
- Learners see science as something that happens in everyday life.

Knowledge construction and problem solving.

- Learners construct their own meaning and explain to peers in a group.
- Learners put knowledge together in a poster and present it to the peers and panel.
- Educator is not telling them or is not giving them the answers.
- Learners are the part of finding answers.
- They all want to talk.
- Learners ask questions all the time.
- They make their own conclusions.
- Learners take learning to greater heights or learning is maximised.
- Learners are engaged and they learn more.
- Project based learning incorporates the problem solving.
- Using problems and project is not a new thing but it is a sustained way of learning.
- Learning is not once off but it is ongoing.
- Problems are messy. And problem solving is also messy.
- What happens in learners mind is messy kind of thinking process.
- Learners need more interaction and discussions.
- Problem solving begins with focus questions and sustained engagement.

Educator as a mentor.

- Learners discover things through inquiry assisted by the educator.
- Learners coordinate what they found with the educator assistance.
- Learners try to answer questions with the assistance of the knowledgeable adult or peer.
- Learners want more from the more knowledgeable adult or peer.
- Learners ask for assistance here and there.
- Learners focus more on the problems and the educator assists them as a mentor.

Time factor:

The time constrain for teaching project based learning. Time is needed for the learners to:

- Work together.
- Internalise.
- Make sense, play and discuss.
- Think and probe.
- Negotiate the construction of their own knowledge.
- Take learners own pace into account.

APPENDIX B 10

Categories of assessment

In the assessment component the following categories come to the fore.

1. Assessment for learning.
2. Assessment for monitoring.

Each category is characterised by the following.

Assessment for learning.

- Assessment tasks that are part of learning programme
- Assessment contributes to the learner's performance.
- Assessment for grading (Summative assessment).

Assessment for monitoring

- Monitoring is developmental.
- Educator use rubrics to assess the learners.
- Assessment leads to summative assessment.

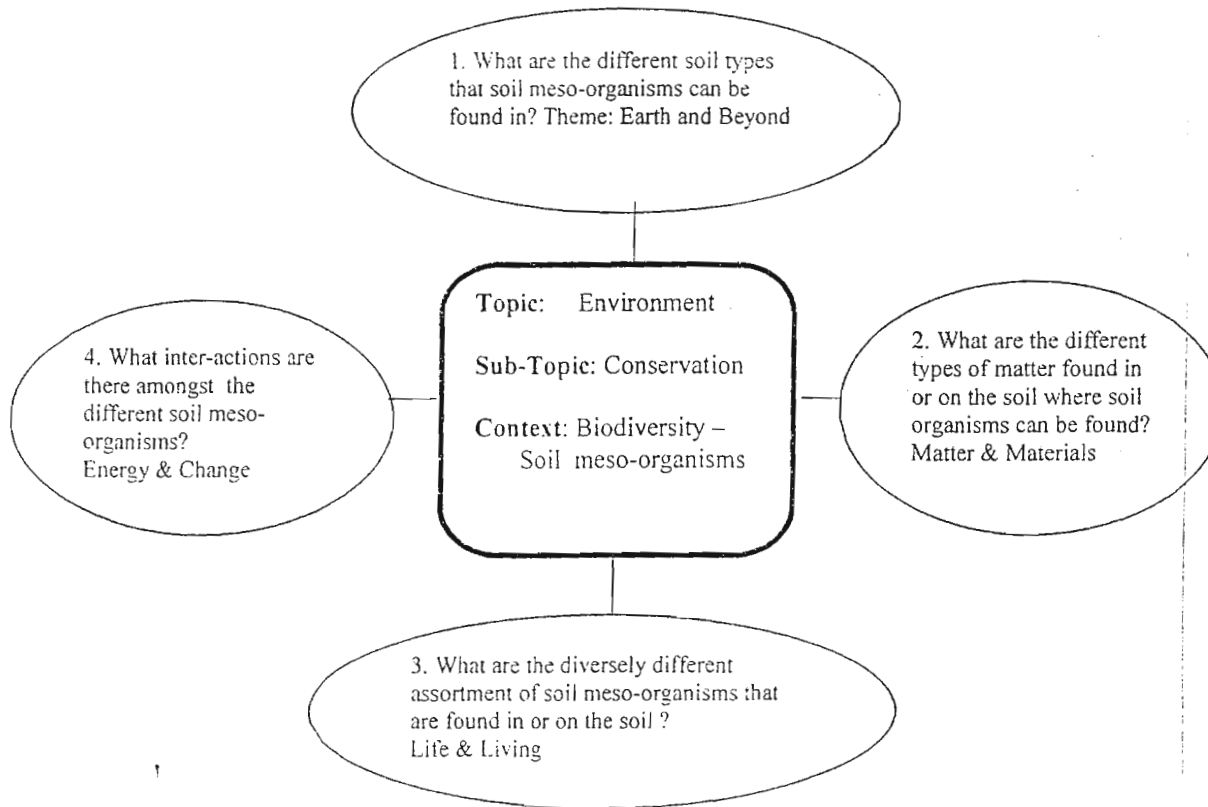
APPENDIX: C1

LESSON PLANS

Topic or Context of Learning: Environmental Learning Activity – Conservation

Sub-Topic: Biodiversity amongst soil meso-organisms

Graphic Organizer of the topic: Essential Questions for project work, context and lesson activities



LESSON PLAN

(See next page)

the appropriate soil type where soil meso-organisms would be found in abundance - see p. 6 of the Probe.				
Activity 5: Skill: report/paragraph writing on the usefulness of soil to living organisms (half a page).	...	Individual activity.	45min	Educator assessment
Activity 6: Educator briefing on matter and material in soil. Revision of particle nature of matter, and phases of matter. Activity 1 in Probe, p. 12.	Task sheet (see p. 12 in Probe).	Educator input Work followed by small group discussion	5min 20min	
Activity 7: Skill: access information (select relevant scientific data, identify and record data). Learners identify different elements (name and symbol of each) from a given table of elements. See activity 2 on p.13 & 14 of Probe.	Task sheet pp.13-14 in Probe	Small group discussion.	45min	
Activity 8: Skill: drawing (draw diagrams and word equations of atoms and compounds in chemical reactions). Learners work individually and in small groups to write word equations, draw diagrams and write equations for chemical reactions using symbols for common substances e.g. Water, Carbon dioxide, etc. See activity 3 & 4 on pp. 14-15 in Probe.	Worksheets	Educator led discussion and small group work.	90min	Educator assessment
Activity 9: Interactive educator led discussion on mixtures in everyday life and home, e.g. curry powder and salt mixed to eat green mangoes, sugar water, nuts and raisins, etc. physical combinations and ease in separating component parts. Soil mixtures – sand and clay, water and mineral salts when it rains, rotting plant or animal matter in the soil to form compost. Learners complete activity 5 in Probe on p.16.	Flip chart, kokis	Whole class interaction with educator leading interactions using flip chart drawings.	50min	
Activity 10: Learners work in small working groups to narrow down the key focus questions they posed on their interests on the topic (matter and materials), in order to apply knowledge gained to construct portfolio boards to present this before a panel for assessment.	Portfolio boards, pictures, text, koki's, etc.	Group negotiations and discussions	180min	Panel assessment rubric
Activity 11: Learners work in small working groups to construct their group's portfolio-board.	Knowledge gained, card-board sheets, written text, graphic text,	Group negotiations and discussion.	180min

in the local school/home garden soil, identify the body parts and feeding habits of each. Design a model of a compost heap using waste material (e.g. coke plastic bottles). Look into possibility of making a compost heap by recycling left over waste materials such as vegetable waste.	
Critical and Developmental Outcomes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 12	

Description : Learning Activities and Assessment:				
Description Focus	Resources	Teaching/Learning Methods	Duration	Assessment Strategy
Introduction. (Teacher input, and issuing of first two pages of the probe.) Learners are introduced to the context of learning. See page 1 and 2 in the Science Probe/Workbook. And the above graphic organiser reflecting the 4 broad themes and focus questions	Science Probe/Workbook	Teacher input	15min	
Activity 1: Recognition or prior learning, and soliciting learner interests on the topic, or context of learning. Learners work individually to complete the questions asked (see p. 2 of probe).	RPL task – questionnaire.	Individual task	30 min	Teacher, formative. Questions & answers
Activity 2: Skill: gather information (access data). Teacher input: on soil and its importance to life and biodiversity. Group-work. Activity 1 & 2 in Probe. Learners access relevant information on soil using given text in probe – pp. 7-8. How soil is formed, types, and importance to life.	Probe – information text pp. 7-8	Educator briefing. Group-work, discussion	10min 45min	Educator assessment, question and answer. Rubric.
Activity 3: Skill: investigation. (Plan and conduct investigation) and communicate findings (identify and record data, share findings or conclusion). Activity 3 in Probe. Learners work in small groups to plan an investigation on the water-holding capacity of the 3 soil types. Apparatus is given, and main headings for the investigation.	Relevant apparatus, blank paper (see p.4 of Probe). Sample learner developed investigation plan	Educator briefing, and group-work and discussions	5min. 90min	Educator assessment. Individual responses to learner investigation plan sheet.
Activity 4: Extension activity. Learners first think and then work with a partner to complete the table on the characteristics of the 3 soil types, and then select	Worksheet	Think-pair-share.	45min	...

<p>become more endangered or extinct.</p> <ul style="list-style-type: none"> - Interactions amongst soil meso-organisms, food chains, food webs, energy transfer in a food chain, producers, consumers. Properties and uses of materials 	
<p>Learning Activities and Assessment: (see table below for specific learning activities and assessment tasks) Following from the above graphic organizer, the learning activities will based on the following investigative questions: <u>Tuning In:</u> Learner’s prior knowledge and interests will be solicited by their individual written responses to the RPL task questions (see RPL exercise in workbook p. 2. Their responses will be used to inform subsequent activities in this lesson plan.</p> <p><u>Finding out,</u> i.e., doing an investigation, recording, using information and reporting. Learners use the information sheets on soil in the Science Probe/Workbook to read, to assist their small project task team (approx. 5/6 members), in which they discuss the activities described in the activity sheets. with respect to the different study themes. The learners identify soil types in the school yard or garden at own home, and obtain the relevant soil samples discussed in the probe, in preparation for the classroom activities. Each project task team designs an investigation for data collection.</p> <p><u>Finding out,</u> i.e., doing an investigation, recording, using information and reporting. Each project task team is given a demarcated area on the map they prepared to conduct an investigation, using the designed or prepared tables, or other data capturing devices. Samples of soil containing soil meso-organisms may be collected for further study in the classroom, and then returned to the garden after use. Learners conduct a planned observation of animal or organism diversity in suitable loamy soil in a demarcated area. Learners identify possible culprits, causes or sources of loss of , or threats to, diversity of organisms.</p> <p><u>Taking Action,</u> Learners discuss and then list alternative solutions to the threats to biodiversity amongst soil meso-organisms. The following essential questions guide the activities and recording of information.</p> <ul style="list-style-type: none"> ▪ What alternative action is there to solve the problem? ▪ What is our Action Plan? <p>The learners use their knowledge, skills, values and attitudes gained in the above learning activities, to produce portfolio boards (1mX1,5m), one for each of the essential questions posed above. They select three learners, one for each section of the portfolio boards, to do a presentation to a selected target audience – using their investigated or researched findings as evidence, and, as a power of persuasion – to highlight the problem, or to prevent any further loss of biodiversity amongst soil meso-organisms.</p>	
<p>Planned Assessment Tasks for Recording:</p> <ol style="list-style-type: none"> 1. Research 2. Portfolio boards presentation of investigative findings 3. Debating (or defending an argument or position taken on pollution) 	<p>Resources: Local school (or home) garden, Science Probe/Workbook sheets, soil samples, science apparatus for conducting investigation (beakers, measuring cylinders, funnels, filter paper, soil types), Portfolio boards (1mX 1,5m) for display of evidence to each of the essential questions listed above, pritt, scissors, koki, pictures, photographs, waste or litter plastic bags, maps.</p>
<p>Expanded Opportunities: A classification or categorization of the different soil meso-organisms found</p>	<p>Teacher Reflection:</p>

<p>Lesson Plan: Pollution of local stream Grade:8 LA: Natural Science Date:</p> <p>Duration: 5 Hours</p>	
<p>Learning Outcomes and Assessment Standards: LO 1: Scientific Investigation AS 1: Clarify focus questions for investigation in order to identify factors to be considered in investigations, and plan ways to collect data on them, across a range of values AS 2: Conduct investigation and collect and record information AS 3: Consider the extent to which conclusions reached are reasonable answer to the focus question (and evaluate data & communicate findings) LO 2: Know, categorise, interpret and apply scientific, technological and environmental knowledge AS 2: Apply classification systems to familiar and unfamiliar objects, events, organisms, materials AS 3: Interpret information by translating tabulated data into graphs, and make predictions from patterns LO 3: Interrelationship between Science and technology, society and the environment AS 5: identify information required to make a judgment about resource use</p>	<p>Integration: LANG LO 4: Writing. Learners will write different kinds of factual and imaginative texts for a wide range of purposes MATH LO 5: Data handling. Collect, summarize, display and critically analyze data in order to draw conclusions and make predictions, and to interpret and determine chance variation AC LO 4: Analyze and use multiple forms of communication and expression in arts and culture AS 6: views & analyses communication within various forms of media & identifies obvious or hidden messages, bias, stereotyping or propaganda LO LO 3: Use acquired life skills to achieve and extend personal potential to respond effectively to challenges in his/her world or community TECH LO 3: Interrelationships between science, technology, society and the environment AS 2: The positive and negative impacts of products of technology on the environment</p>
<p>Links with Previous Lesson: A new lesson.</p>	<p>Links with Next Lesson: The 4 lesson plans are based on the 4 Natural Science themes and the lessons progress from theme 1 to theme 4 as indicated in the Science Probe or Workbook.</p>
<p>Core Knowledge: Interactions in the environment: - Soil formation, soil types, usefulness of soil to living things, properties of types of soil, enhancing soil in order to maintain diversity of in an ecosystem - Matter and material, particles/atoms, types of matter (elements, compounds mixtures), properties of matter, solute, solvent, solution, - Biodiversity, different types of soil meso-organism, classification, vertebrates and invertebrates. The prevention of the loss of biodiversity which is evident when species</p>	<p>Context: The local school garden (including the home garden of each learner).</p>

APPENDIX: C2:

LEARNERS WORKBOOK

NATURAL SCIENCE

Grade 8

Common Task for Assessment

July 2006

Learners Workbook

Part 1		
Part 2		
Part 3		
Part 4		
Total:		

School _____ :

Secondary School

Learner's Name :

Grade Educator :

Room Number:

[Exemplar Task for Assessment Developed By : T (17.07.06) *Third Draft*]

Phase Organiser : Environment
Context of Learning : Conservation
Focus for NS : Biodiversity animal life in & on the Soil

Introduction

1. What is Biodiversity?

Biodiversity is all life on our planet. You are part of it, and so is the locust, a rose, a mango tree and a lion. Everything that lives on Earth is part of biodiversity.

There is a general view that the world is a place of limitless resources, meaning that - there was enough of everything for people to use such as : birds, fish, plants, animals, trees and insects.

Well, this has all changed now. Human impact has increased dramatically since the Industrial Revolution, and we have learned that we live in a world of limited resources. We have seen that, as human populations have grown and spread, some species of animals (e.g. elephant) have been hunted down close to extinction. Vast as the world once appeared to be, we now know there are limits to its wealth. There are also limits to the amount of damage it can take before all life, even our own, is degraded or even threatened.

Many individual species are now under threat because of human influence. Not 'somewhere else', but everywhere, here in South Africa, around your school and your home. People are now starting to worry that the biological processes that sustain life are also at risk. We are often aware of a threat to a particular species and can usually do something to safeguard it, but the scale of the threat to biodiversity means that only a global conservation effort can succeed. (E.g. like the World Summit on Sustainable Development in Johannesburg in August 2002)

2. What are the main threats to Biodiversity?

Loss or severe reduction of habitats and species (biodiversity) are caused by human impact and a few examples are:

- 2.1. Hunting/gathering until nothing of the species is left
- 2.2. Over-extraction of water (e.g. damming of rivers) aquatic species further down stream die.
- 2.3. Pollution (e.g. oil spills, chemicals in rivers and sea from factories, and waste products from our homes)
- 2.4. Land degradation (e.g. mans unwise use of the soil - farming methods)
- 2.5. Alien species (introduced by man, these not useful to local species)

2.6. Human assisted climate change (this is a global problem and considered the single most important threat to biodiversity globally.

3. What can be done?

The World Summit on Sustainable Development will try to set a global framework to conserve biodiversity and natural ecosystems for the next 10 years. But **looking after wildlife, plants and the places where they live is up to each one of us.** It is one area where small projects can make a real difference to the local quality of life for everyone.

Feeding birds, noticing and caring for what grows locally, and growing local food plants in your vegetable garden will help to keep the *web of life* woven together. (See in Activity Number for a demonstration of how the web works, and some of the threads to it).

RPL Exercise: Recognition of prior learning:

Questions

1. In the picture of an ecosystem (page), there are both living and non-living things. Name 2 examples of each: (a) living things and (b) 2 examples of non-living things
2. Is there a relationship between the living and the non-living things? (yes or no)... Write a short sentence to explain your answer

3. Match the concepts in column A with the correct meaning in column B (draw lines to match them)

	<u>Column A</u>	<u>Column B</u>
3.1	conservation	(a) a group of like animals or plants that breed together to reproduce their own kind
3.2	interdependent	(b) the wise use of the earth's natural resources, so that they can support or sustain life for the future
3.3	species	(c) the wide assortment of and wealth of both wild and cultivated species that form vital parts of the earth's ecosystem
3.4	biodiversity	(d) rely on the support or existence of each other
3.5	ecosystem	(e) a natural system where living and non-living things interact together.

The above questions are to see what you know about topic in this unit (soil biodiversity). Next we would like to know the following from you: What would you like to know about this topic?

.....

- *Driving problem/focus Question: What are the different soil types where soil organisms (animals) can be found? and, How is soil useful to organisms living in and on the soil?*
- Purpose: To provide opportunities for learners to explore the three different types of soil (clay loam, sand), the properties and characteristics of each type, and the usefulness of each for supporting animal life. In order for the learners to gain a clearer understanding of the soil characteristics, they will conduct experiments and manipulate some of the soil types in order to make own conclusions on the usefulness of soil to organisms living on and in the soil.

Activity 1: Individual reading and group discussion. Read about soil on pages to and then write down the answer to the following questions:

- 1.1 What is soil made up of?
- 1.2 How is soil formed?
- 1.3 Name three different types of soil.

Activity 2: Pair-share. Work in pairs to answer the following question using information gathered from reading the above numbered pages. Write a short paragraph of 5 lines, stating why soil is important to life on earth.

.....

.....

.....

.....

.....

Assessment Rubric

Outcomes	Mark	Level	Level descriptors
<u>Skill:</u> Gather data Sub-skill: Select relevant scientific data	1-3	1	Few relevant facts picked out. Learner's findings do not reflect the relevant information supplied
	4-6	2	Limited number of relevant information is presented. Attempt is made to use relevant data in the findings communicated
<u>Skill:</u> Communicate findings Sub-skill: Share findings or conclusions	7-9	3	Most relevant information is presented. Most findings are based on the identified relevant data
	10-12	4	Excellent. All appropriate & relevant data is identified. Findings based on scientific data or data supplied.

Activity 3: Planning and conducting an investigation. Work in small groups of 6 learners where you (a) plan an investigation, and (b) conduct the investigation on: *the water-holding capacity of the three different types of soil.*

3.1. The investigation must have the following headings: Aim, Apparatus, Method and diagrams with labels, Observation, and Conclusion. Note, you will be supplied with 3 funnels, 3 measuring cylinders, equal amounts of water and 3 types of soil.

3.2. So, first plan your investigation on a sheet of paper, write it out clearly ^{on page 5} using the headings provided above, and then secondly, conduct the investigation, observe, and state the conclusion.

Activity 4:

In order for the learners to gain a clearer understanding of the soil characteristics, of the soil types in order to make own conclusions on the usefulness of soil to organisms living on and in the soil.

Individual task followed by think-pair-share: Answer the questions and complete the table below.

1. At home or on the school grounds, where must one go to in order to look for soil organisms (small animals in or on the soil), that is, their habitat(where organisms live)?

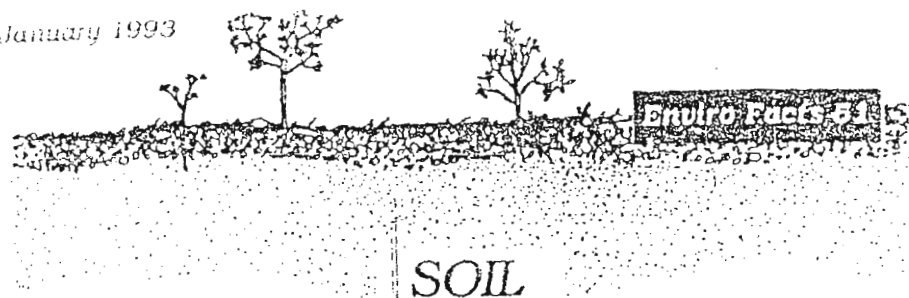
2. List the 3 types of soil in the table below, and then complete the different sections of the table below.

Soil type	Water-holding capacity	Soil particle size	Air content	State whether it contains compost or none
1.				
2.				
3.				

3. Which soil, would you say, is the best type for the habitat of small soil organisms such as ants, snails, spiders, locusts, millipedes, rats, earthworms, etc?

4. Explain why you chose this type of soil named above in number 3.

.....
.....
.....
.....
.....



Soil forms the upper-most layer of the earth's crust and is made up of inorganic and organic matter. The inorganic components are weathered rock, air, water and minerals. The organic components are the decomposing (rotting or decaying) fragments of plants and animals. The spaces between the small particles that make up the soil are filled with air or water.

Living plants (e.g. algae, lichen) and animals (e.g. earthworms, moles, termites) live in the soil and improve aeration and drainage. Some organisms, such as bacteria, play an important role in converting plant foods or nutrients, e.g. nitrogen, into a form that plants can use to grow.

SOME IMPORTANT PLANT FOODS OR NUTRIENTS	
Nitrogen	helps leaves and stems to grow
Phosphate	helps roots and fruits to develop
Potassium	stimulates overall plant health

As plants and animals die and decompose, humus is formed from their remains. Humus fertilizer and enriches the soil as it contains nutrients and improves the soil's ability to hold water and air. Thus, nutrients in the soil are used by plants and animals and are returned to the soil when they die and rot. In this way soil plays an important role in the recycling of nutrients.

FORMATION OF SOIL

Soil takes thousands of years to develop from parent rock - 10 mm of soil takes between 100 and 1000 years to form. The exact amount of time taken depends upon the speed at which the parent

rock weathers, i.e. is broken down into small particles. weathering occurs through chemical, physical and biological processes.

Chemical weathering is caused by the chemical action of water, oxygen, carbon dioxide and organic acids (secreted by lichens). Chemical weathering is very active in the humid tropics as it is accelerated by high temperatures and rainfall.

Physical weathering is caused by frost, temperature changes and salt crystallization. For example, in places where the temperature variation in one day is great, repeated cooling and heating of a rock surface will weaken it and layers sometimes peel off.

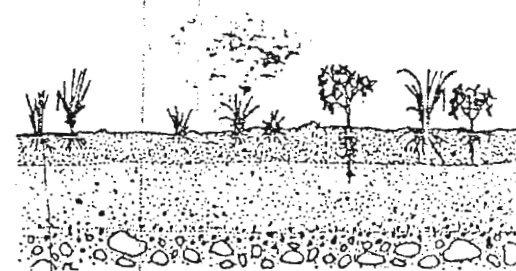
Biological weathering is caused by plants and animals. For example, tree roots in rock crevices grow and widen the crack. Burrowing animals such as rabbits, worms and ants bring soil and rock to the surface where they can be weathered by chemical and physical processes.

Pioneer plants such as grasses, lichens and moss grow on the loose, weathered particles of rock and add organic material to the developing soil. These plants also trap water and wind-blown soil, contributing to more plant growth and soil formation.

THE SOIL PROFILE

As soil is formed it develops layers or horizons which make up the soil profile. There are generally three horizons in soil.

Topsoil: the upper layer, about 100 - 200 mm deep, is where plants get their nutrients so that they are able to grow. Topsoil is often darker than the other layers as it is rich in humus. In addition to releasing nutrients for plants, humus improves the crumbly nature of the soil. When soil is crumbly it allows air to move through it, soaks up water, reduces runoff and erosion, and promotes plant growth. For topsoil to remain productive, humus must be constantly added to soil.

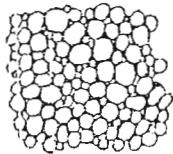
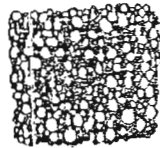


Subsoil: generally more clay-like, this layer acts as a reservoir (water store) for plants growing in the topsoil. When the sub-soil is exposed it erodes fairly easily.

Bedrock or parent rock: this is the underlying layer from which the first two horizons are formed.

TYPES OF SOIL

Soils can be classified according to the proportion of different-sized particles that they contain. Clay soils have a large proportion of the smallest particles and are the least suitable for plant growth. Because the particles are tightly packed, there are no spaces between them to hold enough oxygen for the plant roots and soil micro-organisms. By contrast, sandy soils have a high proportion of the largest particles, with big air spaces. Water drains through sandy soils very easily, making them equally unsuitable for plants. Soils which have approximately equal proportions of sand and clay are called loams and are best for plant growth because they contain enough air and can hold moisture.



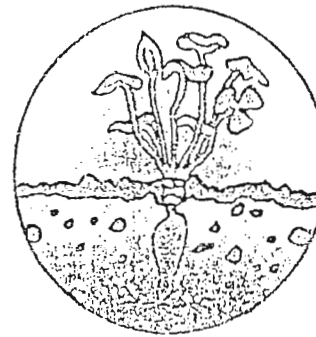
DID YOU KNOW?

- Almost everything we need can be traced back to soil: food, clothing, paper, timber, medicines, shade, and oxygen.
- Soil erosion is one of our worst environmental problems. South Africa loses about 300 to 400 million tonnes of soil each year!

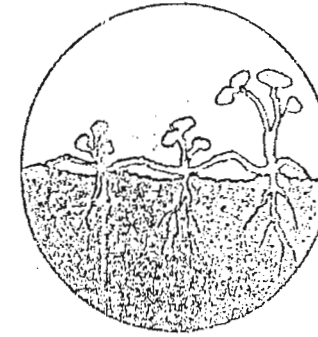
WHAT YOU CAN DO

- Reduce demands on the soil by not wasting anything that comes from soil.
- If you have a garden, care for the soil by adding compost to replace organic matter (see Enviro Facts "Compost").
- Avoid pesticides which might kill soil life.
- Rotate the plants you grow to keep the soil healthy.

Soil provides water and minerals for plants to grow and reproduce. It is the source of most of the earth's food for people and animals. Food from plants is the source of food for animals. Plant materials grown in the soil are used by all animals to build shelters for protection and for breeding.



Food for plants



Plant reproduction



Homes for organisms and animals

Soil shelters animals

Soil provides shelter from the climate and from predators for a variety of animals.

- **Termites** build nests in the soil to shelter from the heat. Large termite mounds are thickly dotted throughout the Okavango Delta in Botswana. Over thousands of years termites have built their nests above the seasonal flood waters of the Okavango River. In time the termite mounds have grown to become small islands. These are usually covered in trees and have become habitats for many species of animals.
- **Mongoose**s are good diggers in the soil. They burrow out underground tunnels to provide protection and breeding, or they live in old termite mounds.
- **Mole**rats burrow and eat underground tubers.
- **Aardvark**s dig into termite mounds in search of ants and termites. The burrows they dig while foraging for food may become homes where **Warthogs** or **Dat-badger**s holes protect their young.

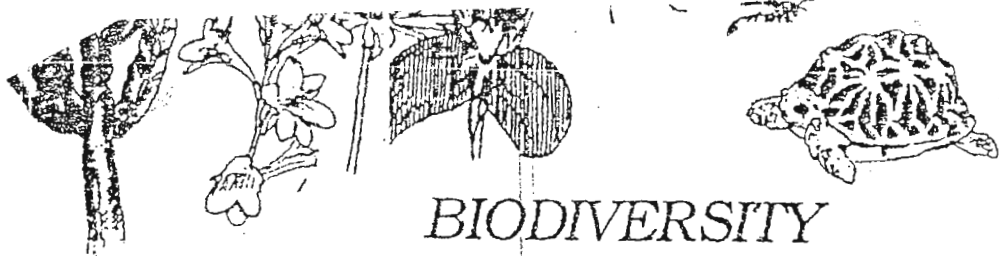
People make use of soil as a building material in many ways.

All over the world, people use the materials that are available in their own environment for building homes.

- They build homes using stone or clay bricks, or wood from trees grown in the soil.
- **Indigenous** homes in South Africa are built from thatching grasses and from wattle poles, packed together with clay.

The mud is used to make roofs for homes.

Wattle and daub is used for walls.



BIODIVERSITY

It is often said that variety is the spice of life. No intelligent investor confines his money to one or two shares. No one can sit stably and comfortably on a chair with two legs. No one remains fully healthy on a restricted diet. These facts are obvious, but the larger analogy that a varied base is vital for human existence fails to achieve recognition.

HRH Prince Bernhard of the Netherlands

The variety of living things around us is one of the greatest wonders of life on earth. Unfortunately this variety is being steadily reduced by the actions of people. This has serious consequences for the future.

Biodiversity describes the variety of life in an area, including the number of different species, the genetic wealth within each species, the interrelationships between them, and the natural areas where they occur.

MASS EXTINCTION

Remarkably, we do not know the true number of species on earth. More than 1,4 million have been identified, and it is estimated that the absolute number is between 5 and 30 million! Human destruction of the natural world is so serious that millions of these species are doomed to become extinct before they have even been named.

1000 to 10 000 times greater than before human intervention.

LOSS OF BIODIVERSITY - THE CAUSES

- Habitat loss:** All plants and animals rely on their habitat (the area where they live), for food, water, shelter and living space. Growing human populations requiring land for agricultural, industrial and urban development are destroying species' habitats on a huge scale.
- Pollution:** Various forms of pollution contribute to the loss of plants and animals. For example, marine turtles often mistake plastic bags floating in the sea for jelly fish, and eat them. This may choke turtles to death or prevent them from eating properly. Scavenging birds are vulnerable to poison baits put out by farmers in an attempt to control stock predators.
- Wildlife trade:** The huge international trade in wildlife threatens many species with extinction. Despite laws passed to protect threatened species, potential profits make illegal dealing worth the risk. For example, the rhino is hunted for its horn which is prized in Eastern countries as a dagger handle and for supposed medicinal properties. Cycads and many succulent plants are also traded illegally, whilst many parrot species are collected for the wild bird trade.
- Alien species:** When an alien species is introduced to an area it may have advantages which allow it to survive better than indigenous species, and thus may threaten these local species with extinction. Cape fynbos, for example, is threatened by Australian acacias which were originally brought in to stabilise the dunes. Alien species sometimes interbreed with indigenous species, as has happened with the domestic cat and the African wild cat.
- Poaching and hunting:** This is often, but not always, linked to trade in a particular species. The Africa wild dog, for example, has been in conflict with stock farmers for a long time and has

THE IMPORTANCE OF BIODIVERSITY

Possibly the best reason for the maintenance of biodiversity is summed up by American conservationist, Aldo Leopold:

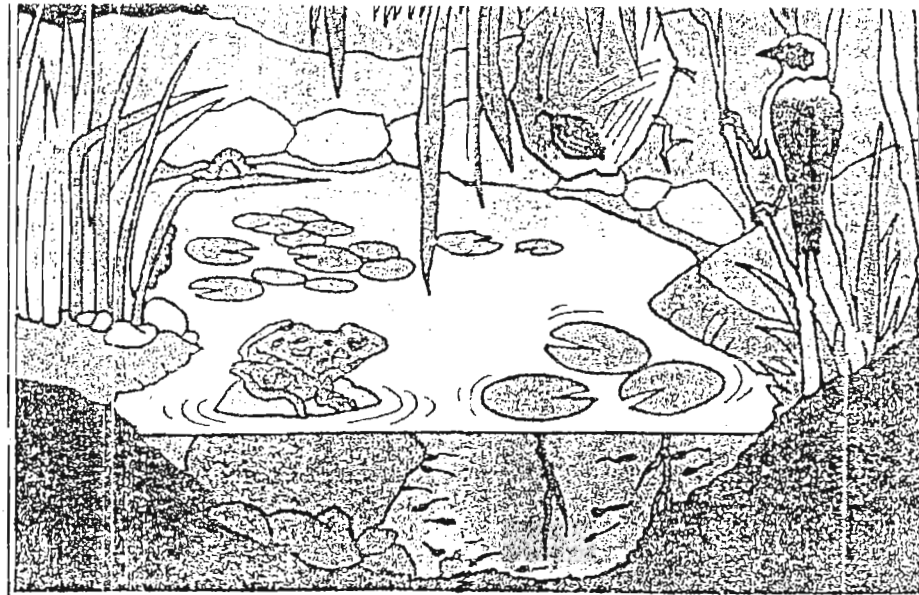
The first rule of intelligent tinkering is to save all the parts.

The variety of life on earth forms a huge gene pool which is the material on which natural selection works in the ongoing process of evolution, which generates more biodiversity. This gene pool is also a resource of crucial importance to humanity for food, fuel, clothing, shelter, and to maintain our health. Biodiversity enhances our lives in countless ways, from the development of new and improved food crops and medicines, to the sight of a flight of geese against a sunset. While modern technology has given people greatly increased power over nature, it has done little to reduce our dependence on biodiversity.

Living things do not exist independently of each other, or the non-living environment. They depend on one another in a variety of ways: think, for example, of a food chain. Together with the non-living parts of our environment (e.g. soil, water, air), living things form essential life-support systems such as the water cycle, the carbon cycle and several other nutrient cycles. *The pool of life is therefore much more than the sum of its parts.*

WHAT YOU CAN DO

- Demands for goods and services place pressure on the environment - the less we use, the less severe the pressure.
- When a conservation issue rears its head, make your voice heard - draw up a petition, contact your local MP, write to the Department of Environment Affairs and liaise with your newspaper.
- Become informed and talk about this issue to your friends, family and colleagues.



A balanced ecosystem existing within larger ecosystems

An ecosystem

We study the ecology of an area, an ecosystem, by looking at all the plants, all the animals, all the non-living things and the interactions between them.

The biotic (living) and abiotic (non-living) parts of an ecosystem

The biotic parts of an ecosystem, the plants and animals, rely on the sun's energy to survive. These living organisms need energy to live, grow, breathe and reproduce. Organisms that have died are also biotic. The abiotic parts of the ecosystem, the sun, water, soil and air, are the life support systems for the living organisms.

- Ecologists study the flow of energy, food and other nutrients through an ecosystem. There is activity in every living thing. All plants and animals are active. Plants may not seem very active, but they are constantly growing. This activity requires energy.
- Green plants absorb energy from the sun. Plants produce glucose and starch by combining the sun's energy with carbon dioxide and water. These foods give plants the energy to grow. Plants use nitrogen from the air and nitrates in the ground to produce protein which animals need so that they can grow. Plants are producers of food energy.
- Animals are consumers of food energy in an ecosystem. Consumers eat green plants or eat other animals. When plants and animals die, they decay and provide the soil with nutrients. Plants take water into their roots from the soil.

green or more than
organisms which
breed together to
reproduce the
own kind.

Interdependent
rely on the survival
or existence of
each other

ecosystem
a natural system
where living and
non-living things
interact together

producers
species that make
things

consumers
species that use
or eat things

... term of food is called a

- *Driving Question: What are the different types of matter found in or on the soil where soil organisms (animals) can be found? How can different types of materials be used to enhance the Earth's surface soil in order to make conditions conducive to organisms living in and on the soil?*
- Purpose: To provide opportunities for learners to explore the different materials in soil that can support the diversity of animal life in and on the soil surface.

Introduction:

You now know that everything around us is made up of matter. Matter in turn is made up of tiny particles called atoms. Matter is anything that occupies space and that has mass. Different substances also contain different amounts of matter, e.g. a piece of iron as big as your fist has more matter than a piece of wood as big as your fist - can you explain why this is so (or is the statement false?).

In PART ONE (Soil Study), we explored the different soil types and the properties of each - in preparation for the study of Biodiversity amongst animal life in & on the soil. In this part (PART TWO), we examine soil, the soil matter and other materials in the soil that are needed and are useful for living organisms in and on the soil.

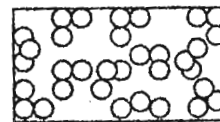
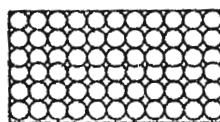
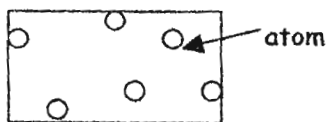
Everything around us is made up of matter, the air we breathe, the ground or soil we walk on, and, the water we drink - all consists of matter. On Earth, matter comes in different forms :

(a) element, (b) compounds, and (c) mixtures.

In the activities that follow, we will take a closer look at the above aspects in relation to soil and its links to biodiversity amongst soil meso-organisms.

Activity 1:

RPL exercise. Individual work followed by group discussion. Matter comes in three phases. In the diagrams below, name each of these 3 different phases and state the reason for your answer. The small circles represent the atoms making up the different phases of matter represented below.



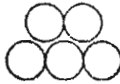
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Activity 2: Elements

You may have noticed from Activity 1 above that all matter is made up of tiny particles called atoms. Because of the variety of different substances in this world - there are also, different kinds of atoms. For example, there are substances such as:

carbon (made up of carbon atoms), 

gold (made up of carbon atoms), 

iron (made up of carbon atoms), 

hydrogen (made up of carbon atoms), 

calcium (made up of carbon atoms), 

copper (made up of carbon atoms), etc. 

Questions:

2.1. In the Table below (see no. 2.3) find the symbol for each of the above substances, and then write it in each of the circles next to that substance.

2.2. The above diagrammatic representations show you that each substance is made up of only one kind of atom. What do you and scientists call such substances?

2.3. There are many (118) different types of elements on Earth, both natural and man-made, and these have been carefully organized for us into categories by a Russian Scientist (Dmitri Mendeleev, 1869) on the **Periodic Table of Elements** appearing below.

1 H Hydrogen																	2 He Helium 4.0026
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium											13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Cesium	56 Ba Barium	57-71 Lanthanides	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89-103 Actinides	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Uu Ununium	112 Uub Unbium	113 Uut Ununtrium	114 Uuq Ununquadium	115 Uup Ununpentium	116 Uuh Ununhexium	117 Uus Ununseptium	118 Uuo Ununoctium
Lanthanides			57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
			89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Uub Unbinilium

2.4. In the table below, write the symbol and the name of the first 20 elements.

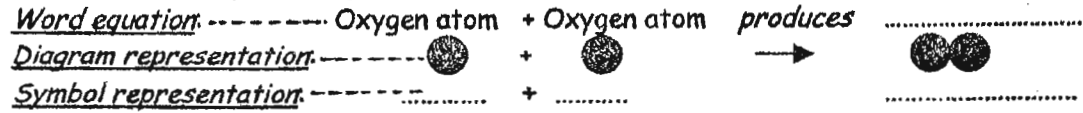
Headings here →	
1.	
2.	

Activity 3: Elements in the soil and in body of soil organisms such as rats or other living organisms. Study the table below that shows the different amounts of naturally occurring elements that make up a soil sample and a rat.

Elements make up the Earth's surface soil	Elements that make up body of a rat (living on or in the soil)
Oxygen 48%	Oxygen 65%
Silicon 27%	Carbon 18%
Aluminium 8%	Hydrogen 10%
Iron 4%	Nitrogen 3%
Calcium 3%	Calcium 1,5%
Sodium 2,5%	Phosphorus 1%
Potassium 2,5%	All other elements 1,5%
Magnesium 2%	
Hydrogen 1%	
All other elements 2%	

Questions: (a). Which element is found in large amounts on in a rat and in the Earth's surface soil?

(b). When two oxygen atoms combine (as in the diagrammatic representation below) they form an important gas. What is the name of this gas?



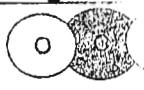

(c). Explain the importance of having oxygen as an element in the Earth's soil surface.

Activity 4: Compounds

The word *compound* means *things are combined*. Take a closer look at diagrammatic representation above when two oxygen atoms combine. Two or more different elements can also combine during a chemical reaction in a similar way to form a new substance. Complete the following statement:

Compounds are groups of two or more different which have bonded together chemically.

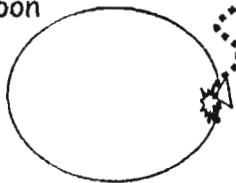
In nature, such chemical bonds occur all the time, for example, when a piece of wood or grass is burnt, they change into a new substance called **ash and carbon dioxide gas** (smoke). In the table below, you can see how 2 or more elements combine to form a compound. Find a partner and complete the table for those examples that you can, with your partner:

substance	plus	substance	produces	New substance	Diagram
1. carbon	+	oxygen	→	Carbon dioxide	 carbon dioxide
C	+	O ₂	→	
2. hydrogen	+	→	Hydrogen oxide (water)	 water
H	+	→	H ₂ O	
3.	+	oxygen	→	Iron oxide (rust)	
.....	+	O ₂	→	
4.					

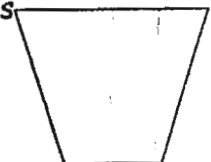
Note well: The new substance formed is called a element/compound (underline the correct one), and shows only one molecule of the new substance. An element is a pure substance it is made up of one type of atom only. If you have a glass full of water, does the glass contain one molecule of water, or does it contain many molecules of water? (A molecule of a substance is also said to be pure). Can you imagine a balloon filled with carbon dioxide molecules? How do you think these molecules got into the balloon? In the space below, draw a balloon filled with 5 CO₂ molecules, and a glass with 4 H₂O molecules.

Soil meso-organisms take in useful compounds as food e.g. water, nectar or sugar, starch, etc.

Balloon



Glass



Activity 5: Mixtures:

Substances that we call mixtures, are made up of two or more elements or compounds that blend or join without combining chemically. In our daily lives we are often using mixtures, e.g., sweets or cool drinks are good examples of a mixture of substances. We often mix water and sugar, or water and salt, etc. You can use ordinary physical means to separate the substances that you mixed together (e.g., you can sort the mixture of nuts and raisins by hand).

In relation to soil and improving the conditions for living organisms in the soil, you can mix different materials to form compost. **What is compost?** If you know, write your own or your group's answer below:

Compost is another name for soil that
.....
so that plants can
How is compost useful to soil meso-organisms?

In order to get a better understanding of compost, let us take a closer look at a mixture again. If you look at the examples given above, we notice that a mixture is **different** from an element or a compound (a compound being made up of a number of the same molecule, as in the glass of water, or balloon of carbon dioxide). Work in a small group and discuss this difference between a mixture and the pure substances (that is elements and molecules of a compound). Use the table below to list as many differences as you can.

Pure substances (elements & molecules)	Mixtures (impure substances)
1.	
2.	
3.	
4.	

The soil under our feet contains different kinds of mixtures that are either solids, liquids or gasses. The air that soil organisms breathe in are a mixture of gasses, impurities in water that is soaked in the soil - is taken in by soil organisms, soil containing a mixture of decaying plant or animal matter forms compost - this helps plants to grow well, and such juicy plants serve as or providing food for soil organisms.

During photosynthesis, plants use
..... to make food (such as carbohydrates, e.g. glucose or sugar). Use the space below to write a word sum of all the substances that are combined to produce glucose or sugar (food) in plants during photosynthesis. Then check to see if photosynthesis produces a mixture or a compound.

Extension:

In the space below, design a model of compost heap that you intend to make in order to promote a good habitat for the survival or conservation of one or different soil meso-organism(s). You may use recyclable material found in or around your home or school. Label the different parts of your model, and write a brief description of the model to explain to some who is interested in your model.

Design and diagram of the model of a Compost Heap:

See pages 20
for instructions
on composting

Explanation of the model:

Trees and Soil

Find a tree or clump of trees in the veld.
Pick up a handful of soil from under the trees.
Rub it between your fingers and study it carefully.

You are holding something very special in your hands

Can you see any of the following in this soil? Tick (✓).

- | | | | |
|---------------------|-----|-------------------|-------|
| a) bits of leaf | () | f) pebbles | () |
| b) bits of root | () | g) living animals | () |
| c) bits of bark | () | h) living plants | () |
| d) animal droppings | () | i) other | _____ |
| e) sand | () | | |

How do you think leaves get down into the soil?

OUR FRIENDS THE EARTHWORMS

Earthworms pull fallen leaves down into the soil. Soil is full of things which are good for plants. Dead leaves and tiny creatures rot away to make good plant food.

① Make a wormery or compost heap or compost column.

1. Collect worms (look in good moist soil or near water.
2. Cut the top off a two-litre clear plastic soda bottle.
3. Fill the wormery with layers of different soils eg. a layer of washed sand, mud from a stream, garden soil and soil from higher ground.
4. Place a good layer of leaves in top - use dead and green leaves.
5. Wrap dark paper around the wormery so that the worms will come to the sides.
6. Remember to keep the wormery dark and moist.
7. Remove dark paper every few days to see what the worms are up to - look for changes in the soil.

You will need:

- 3 plastic cold drink bottles
- A knife / scissors
- Some broad adhesive tape
- Some compost

Cut up the bottles to make a column like the one shown in the diagram.

Cut the bottom off one bottle.
Cut the top off another bottle.
Cut the top and bottom off the third bottle.

Fill the column with a mixture of organic matter and compost that is rich in soil organisms. Keep the compost column moist by recycling the water that gets trapped in the moisture trap.

Check once a week to find out what is happening and what is living.

② BUILDING A COMPOST HEAP

Remember that compost can be made in many different ways, and these are only general guidelines. In fact, nature does it without any help from people!

A good size for the compost heap or trench dug into the ground is 2 m by 2 m, depending on the amount of compost you want to make.

- Mix the organic material well and chop up any big pieces - do not add layers of only one material, such as grass cuttings or leaves to the compost heap.
- Start by putting down about 200 mm of mixed organic material.
- If you would like to speed up the process of decomposition, add a 'starter'. This might be a bucketful of mature compost, animal manure, or bone meal. Commercial starters are available at nurseries and garden shops.
- You can also add soil to the growing heap as the many organisms that it contains will multiply and help the rotting process. Earthworms in particular are valuable members of the compost heap community. They eat plant material and produce worm castings that are very rich in nutrients. They also help to mix the compost ingredients and put air into the heap thereby speeding up the process of decay.
- Continue building the heap in layers of about 200 mm. The last layer should be soil, dry grass, leaves, or sawdust, as this will keep smells in and not attract flies.

Assessment Activity:

□ NS SO2 APPLYING KNOWLEDGE IN MATTER & MATERIALS

Instructions

- This is an individual activity

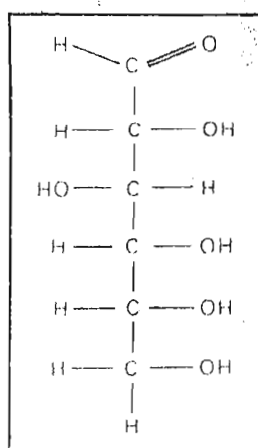
Different letters of the alphabet are used to write the symbols and formulae of the different elements and compounds.

a) Copy and complete the following table.

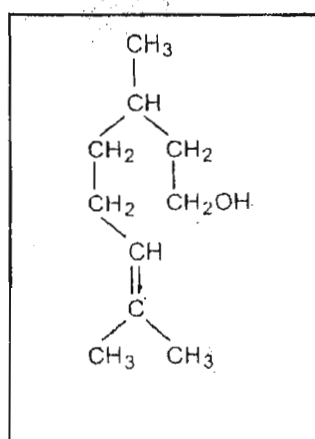
Symbol of Element	Name of Element
C	
O	
	Hydrogen

Citronellol is an alcohol found in citronella, a popular mosquito repellent. Glucose is a sugar found in blood.

Examine the chemical structure of Citronellol and Glucose and answer the questions that follow.



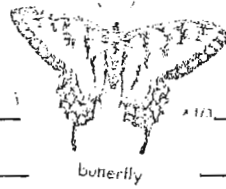
Glucose molecule



Citronellol molecule

b) Calculate the number of: C, H and O atoms in the Citronellol molecule.

c) How many hydrogen atoms are contained in 20 glucose molecules?



butterfly

- Focus question: What are the diversely different assortment of soil meso-organisms that are found in the soil? What do they each look like, eat, or are eaten by?
- Purpose: To provide opportunities for learners to explore the diversity of soil meso-organisms and of animal life in and on the soil surface.



Activity 1: Individual enquiry or investigation:

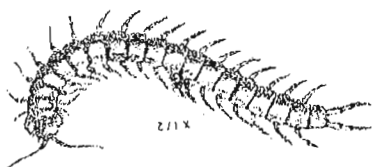
Soil sample study (compost or moist leaf litter). In class the learners plan for a few minutes, on identifying a suitable spot on the school grounds, where a soil study can be conducted to locate soil organisms. *(Alternatively, each learner or two members of the group are informed the day before, to bring in a closed punctured container with some moist leaf soil to class).* The class embark on a mini excursion on the school grounds, to locate a suitable spot where soil meso-organisms could be found. the learners either return to class with a soil sample for further analysis, or sketch the identified organism in their natural habitat, and to identify each later, back in class.

Steps to follow:

- 1.1. Find some useful tool to dig or scoop soil with, and a container with a lid such as a plastic tupperware or ice-cream container to collect your soil sample.
- 1.2. Find some compost or moist leaf litter or loamy soil in a suitable place at home or school, and collect this in the container.
- 1.3. Use the bug viewer or hand lense and draw the organisms you see in the soil sample.
- 1.4. Use the identification sheet on page to name the organism(s) you find. Write the name below each organism drawn, use the space below to draw your organism(s).
- (1.5. on the next page)



© 2000



mayfly

1.5. Draw a picture of bio-diversity interactions in compost or soil sample within a soil habitat. Use 1 or 2 or all of the organisms drawn above, and a few relevant ones in the identification sheet on page ~~23~~ to draw the bio-diversity interactions among the different organisms. Use the picture of a food web on page ~~24~~ for an idea, and to show you how to draw the interactions. Begin the interactions with a plant, and use arrows to show the directions of the interactions.

Activity 2: My Animal. Individual activity on your chosen small animal that lives in or on the soil. This may be a 'pet' animal, favourite or just one that you see very often in or on the soil. Read and then complete the different sections of this activity. You may get information from a book, magazine, older person or library/internet.

Facts in brief: (on my animal)

- Length:
- Weight:
- Number of legs:
- Eyes or none:
- Backbone or none:
- Life span:
- Food:
- Population:
-

Place a great picture here!

Conservation. How is my animaldoing?

- Is its habitat OK?
- Is its food web balanced?
- Are there more, less, or the same number of compared to long ago?
- Is the animal threatened?
- How is it threatened?
-
- Is there anything or anyone that is making it unnaturally sick?
- Are there other animals that are crowding its habitat?
-
- What are the best ways to help this species last for a long time?
-
- What can a person do to help this species last long?
-

My animal in a Food Web.

Use the circles given to you below, and place name of your organism (animal), and the names of other animals your animal eats, and those that eat your animal. Some of the circles of the food web are already completed for you. A food web shows us what gets energy from what. The arrows show the direction of the flow of energy.

Guide brochure on your animal to help inform a visitor who wants to know what to look for when trying to spot your animal.

- Where your animal can be found:
-
- What it might be doing different times of the day:
-
- What your animal eats:
-
- The plants and animals that share its habitat:
-
- What eats your animal:
- How is it adapted, how does it look?
-
- How are males & females different?
-

Title: The name of your animal.

.....

Give us a short **caption** for the picture of your animal:

.....

.....

Interesting things I (you) figured out doing this unit or study:

.....

.....

.....

.....

APPENDIX: C3

ASSESSMENT RUBRIC

Secondary School

Learning Area: Natural Science

Grade 8

Context of Learning: Biodiversity amongst soil meso-organisms (Environment - Conservation) Name:..... Date:

Sub-context: Matter and Materials.

Assessment rubric:

The final product, namely the portfolio-board will be assessed using the criteria below. Use the criteria as a guide while doing or preparing your boards.

Criteria	Developing 1	Developed 2	Well developed 3	Score
1. Title : Focus question is clearly stated and relating to the topic	Unclear or no focus question	Vaguely focus question relating to the topic	Clear driving focus question that relates to the topic	
2. Focus question does not assist in plans for problem solving	Not appropriate	Appropriate	Enhances task	
3. Gathered sufficient information and support materials for your position	Insufficient and lack details	adequate information and detail	Sufficient information and support materials that support the topic	
4. You used examples and details to support your argument	Inadequate or few or none listed	Adequate examples listed to support own argument	Sufficient examples and details used to make a persuasive argument	
5. Portfolio-board has well laid out text and visual representations, diagrams or pictures	Few or no visual text used, with little attention to lay out.	Adequate visual material. lay out needs attention.	Well laid out written text accompanied by different visual representations such as graph or pictures or a table, etc.	
6. Content is relevant, correct, and is orderly and logically presented.	Adequate	Mostly relevant and correct, but lacks orderliness	Content is relevant, correct, logically and orderly presented.	
7. Your position or argument was clearly stated	Unclear	Adequate	Clear stated argument .	
			Total: 21	
COMMENTS:				