

**An Exploration of what Grade 7 Natural Science Teachers Know, Believe and Say About Biodiversity and the Teaching of Biodiversity**

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## ABSTRACT

In the context of the newly implemented Curriculum and Assessment Policy Statements (CAPS) for Natural Science, this study explores what Grade 7 Natural Science teachers know, believe and say about biodiversity and the teaching of biodiversity. Despite its significance to environmental sustainability, biodiversity loss is accelerating in South Africa and internationally, driven by unsustainable economic development models, population growth and associated problems of habitat loss and widespread pollution.

Against the backdrop of these challenges, this study shares insights into how teachers' biodiversity knowledge relates to the CAPS and to international agreements and policies on biodiversity. The study seeks to inform teacher education and support programmes and future curriculum implementation decisions, especially those associated with the Fundisa for Change programme.

The study is designed as a qualitative case study inquiry that has used classroom observation, semi-structured interviews and document (textbook) analysis to generate data. Theories of teacher cognition (after Shulman, 1987) were used to gain an understanding of teachers' biodiversity knowledge. Different environmental and biodiversity metaphors and narratives were reviewed to gain an understanding of how teachers represented biodiversity and Kronlid & Öhman's work on environmental ethics (2012) provided a framework for considering teachers' values and ethical responses to biodiversity.

The study found that the biodiversity knowledge of the teachers in these three case studies was mostly limited to what they access in the curriculum and textbooks. Secondly, there appears to be the assumption that if teachers teach from certain textbooks, they will meet the Specific Aims for Natural Science, as well as implement the process skills which are the 'new' knowledge according to the Senior Education Specialist. It was found that teachers' close adherence to activities prescribed in the textbook seems to limit the depth, scope and criticality of their biodiversity teaching. The study also revealed that all three teachers expressed a pragmatic view of the value of biodiversity.

The study recommends that the Natural Science CAPS as well as textbook authors should reflect a more systemic approach to biodiversity knowledge, recognising the interrelations and interdependence of the ecological systems that make up biodiversity – including relationships with humans – and convey a sense of the changeability of biodiversity. Natural Science teachers should be supported in broadening their understanding of biodiversity and biodiversity loss. They should be encouraged and supported to develop or adapt textbook material where necessary and develop learner activities that will encourage their learners to question, deliberate, look for cause and effect, and seek solutions. This may help to realise the final recommendation, that learners and teachers become citizen scientists who will access and contribute to the various biodiversity databases and so join scientists in generating biodiversity knowledge.

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## ACRONYMS

INTERSEN	Intermediate and Senior Phase
SES	Senior Education Specialist
C2005	Curriculum 2005
CAPS	Curriculum and Assessment Policy Statements
LSEN	Learners with Special Educational Needs
RNCS	Revised National Curriculum Statements
IUCN	International Union for the Conservation of Nature
ESD	Education for Sustainable Development
DBE	Department of Basic Education

## **CHAPTER 1 Introduction to the Study**

### **1.1 Introductory Overview**

This small, qualitative research project was conducted in 2014 with three Grade 7 Natural Science teachers with a view to understanding what they know, believe and say about biodiversity. This chapter describes the broad socio-ecological context of the three participating Grade 7 classrooms in the city of Port Elizabeth, South Africa, and provides a rationale for the study's focus on biodiversity teaching. The chapter introduces the study's research question and objectives, briefly introduces the three research sites and outlines the content of each of the chapters to follow.

### **1.2 Rationale of the study**

Biodiversity is a three and a half week teaching programme in the Grade 7 Natural Science Curriculum and Assessment Policy (CAPS), a national curriculum which the Grade 7 teachers implemented from January 2014. Biodiversity is an important topic in Natural Science environment-oriented learning which aims to address the socio-ecological crisis currently facing mankind, including biodiversity loss, human-induced climate change, ecological degradation, population growth, human consumption and waste.

Biodiversity is significant to the well-being of all people. Today species are going extinct at an unacceptably high rate because of environmental changes caused by human activities. Biodiversity is a complex term (Blanchard, 2014) which encompasses various concepts all of which are complex as well. Biodiversity includes all living things (Rouwenhorst, 2007). All living things are made up of cells, which obtain its energy from living organisms which convert solar energy into chemical energy (Cook, 1991). The genes that are found in a single species, as well as the variation of genes found within different populations of that species is known as genetic diversity (Gurr, Wratten Snyder & Read, 2012). All species are named using a phenetic approach, that is, the shared features that are observed (Gornal, 1997). Species are defined as having distinct common features, they are able to reproduce, and they interbreed only within their species (Cook, 1991). Species include viruses, bacteria, algae, lichens, fungi, nematodes, insects, mammals and plants. Groups of different species together and within their abiotic environment are referred to as an ecosystem (Jax, 2010). Ecosystem functioning has been studied in various ways: as a process in time, as a

whole system, for the roles played by the organisms it hosts, as well as its services to humans (Jax, 2010). Ecosystem integrity, ecosystem health and ecosystem resilience have all been defined by various researchers in different ways (Guthrie, 2007; Jax, 2010). Biodiversity also includes trophic levels which bring together food chains in the food webs of interactions between producers, herbivores, predators, decomposers and so on (Shurin, Markel & Matthews, 2010).

Numerous international policies and frameworks call for the strengthening of environmental education in national school curricula. For instance, The Earth Charter (UNESCO, 2000, p. 4) declares that the world community needs to: “Protect and restore the integrity of Earth’s ecological systems, with special concern for biological diversity and the natural processes that sustain life”, and this entails providing everyone, but especially children and youth, with “educational opportunities that empower them to contribute actively to sustainable development”. The Ahmedabad Declaration (UNESCO, 2007, p. 6) similarly emphasises the importance of education systems that “promote earth system literacy and systemic thinking skills in environmental education to understand the nature of interdependency within the human family, the biotic community and the planet’s life sustaining processes”.

These global imperatives have been reflected in South Africa’s post-apartheid curriculum reforms and are currently evident in the National Curriculum Statement Gr R-12 (DBE, 2011, p. 5) which states that the country’s curriculum aims, amongst other things, to produce learners that are able to “use science and technology effectively and critically, showing responsibility towards the environment and the health of others” and “demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation”. One of the principles guiding the National Curriculum Statement Grade R-12 is the principle of “human rights, inclusivity, environmental and social justice (DBE, 2011, p. 5). The policy further states that the main task of teaching in the Natural Sciences is to build a framework of knowledge for learners to help them make connections so that “school science can be relevant to everyday life” (DBE, 2011, p. 10).

However, despite its inclusion in the formal curriculum, biodiversity as a concept and a topic for classroom teaching is not well understood or taught by many teachers. Recent research

(Songqwaru, 2013) has identified that teachers have content gaps, and lack confidence in teaching environment and sustainability content knowledge. This will be discussed in Section 2.5.

I am an English First Additional Language teacher with an interest in environmental education. Having been an anti-apartheid activist in the 1980s, I still have a concern with transformation of our communities and practices towards the ideals of a democratic society. I value critical thinking and discussion that leads to solutions, and I endeavour to inculcate these skills with all my learners. The need to still be an active part of transformation attracted me to post-graduate studies and this research topic in particular. My interest is in gaining a better understanding of environmental learning within the school curriculum so as to support our learners to understand our socio-ecological crisis and behave in ways that will preserve what we have.

### **1.3 Aim of the study**

The aim of the study is to explore what teachers know, believe and say about biodiversity and the teaching of biodiversity. More specifically, the study explores in three case studies, teachers' knowledge of biodiversity, their beliefs and values of biodiversity as they experience it, and why they have chosen to teach biodiversity in the way that they do. The study's findings would be of interest to some curriculum developers, textbook authors and those involved with Natural Science teacher professional development.

My proposed study falls within the broad Fundisa for Change programme and, through the case studies' focus on teachers' knowledge and teaching of biodiversity; it aims to understand how teachers are responding to this body of "new" knowledge in the curriculum. The case studies of how Grade 7 Natural Science teachers are thinking and talking about the topic of biodiversity will be of interest to the national Fundisa for Change programme which develops resources and supports the continuing professional development of Natural Science and Life Science teachers.

Some of the aims of teaching Natural Science and therefore, biodiversity are: "to produce learners that are able to use science and technology effectively and critically showing responsibility towards the environment and the health of others" and "to demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation" (DBE, 2011, p. 5). "Natural Science at the Senior Phase level ...prepares learners for

active participation in a democratic society that values human rights and promotes responsibility towards the environment” (DBE, 2011, p. 9). Thus this study will attempt to understand how teachers are achieving these aims within biodiversity teaching.

#### **1.4 The Research Question**

The overarching question to which this study responds is: What do Grade 7 Natural Science teachers know, believe and say about biodiversity and the teaching of biodiversity?

The research sub-questions are:

1. What knowledge do teachers have of biodiversity?
2. How do the teachers represent biodiversity, for example, which biodiversity narratives and metaphors are evident in their discourses?
3. What beliefs and values of biodiversity do the teachers hold?
4. What accounts do the teachers give of why they teach biodiversity in the way that they do?
5. Which textbooks do the teachers choose to use and how do they use CAPS?

#### **1.5 Three research sites**

This study was conducted at three primary schools in Port Elizabeth, South Africa. One school is an Afrikaans medium school, that is, the learners’ home language is Afrikaans. This school is situated in the northern part of Port Elizabeth, with a primarily ‘Coloured’ population. Two schools are situated in the previously disadvantaged Xhosa-speaking townships, one in an informal settlement that sprang up in the 1990s and the other in the much older township of Motherwell. Two of the three teachers are experienced Natural Science teachers. The three schools fall under the Port Elizabeth Education District. All three schools have high learner enrolment of between 1 000 and 1 200 learners with a staff of between 30 and 33. One teacher has a Teachers’ Diploma in addition to a one year Maths and Science course that she obtained at a local University. The second teacher, in addition to a Teachers’ Diploma, has obtained a Further Diploma in Education, and a Certificate in remedial teaching, as well as an Honours degree in Education and a Post-Graduate Diploma. She is currently registered for a Masters’ Degree. The third teacher obtained a Bachelor of Education Degree in commercial subjects at a local university and holds an Honours

in Education Degree in Education Management. This teacher is an inexperienced Natural Science teacher.

## **1.6 Overview of the Study**

The following chapter (Chapter 2) firstly reviews literature relevant to this study's focus, giving an overview of biodiversity and how it has been approached in the school curriculum, nationally and internationally. Secondly, the chapter explores an environmental ethical framework, and biodiversity narratives and metaphors in order to describe teachers' values and beliefs of biodiversity and how this may influence the way they represent biodiversity. The chapter concludes by introducing theories of teacher cognition.

Chapter 3 describes the research methodology that guided this study. I explain my research orientation and the case study method that I used. I also explain how the data was generated and analysed. The chapter also describes the steps taken to ensure validity and trustworthiness throughout the study, as well as my efforts to ensure that the study was conducted in an ethical manner.

Chapter 4 presents the study's qualitative case study data. I provide a contextual profile of each school and each teacher in the three case studies. I then describe the teachers' knowledge and beliefs about biodiversity and the teaching of biodiversity; I describe how the teacher represents biodiversity as well as what values the teacher attributes to biodiversity. I conclude with what support the curriculum and the textbooks have provided the teachers.

Chapter 5 presents the data obtained through an interview with the Senior Education Specialist for the Natural Sciences. He relates on how the teachers were prepared by the Department of basic Education to teach Biodiversity, how the Department has supported and is currently supporting the teachers, and his views on environmental education in the Natural Science curriculum.

Chapter 6 analyses and discusses the data described in Chapter 4, and synthesises it against the study's theoretical and conceptual framework to establish what insights have been gained through this study in response to the research question.

In Chapter 7 I summarise the findings of this research work in terms of each research question and offer conclusions based on the findings. Recommendations are made for future research and some critical reflections on the study are shared.

## **CHAPTER 2      Literature Review**

### **2.1 Introduction**

In this chapter the contextual features of the study are outlined and discussed, drawing on relevant literature. I begin with a broad overview of biodiversity in a global and local context. This leads into educational responses to biodiversity and relevant policy and literature. Thereafter I examine policy and curriculum changes as they pertain to biodiversity in the Natural Science teaching. I also look at current support for teachers of environmental education. I then draw on research in the field of biodiversity narratives and metaphors as well as environmental values and ethics to examine what teachers say about and how they value biodiversity. Finally, I examine teacher cognition and teacher knowledge and beliefs about teaching biodiversity.

### **2.2 Biodiversity**

Balvanera, Siddique, Dee, Paquette, Isbell, Gonzalez, Byrnes, O'Connor, Hungate and Griffin (2013) define biodiversity as “the variability within and among species, as well as the variability at other levels of organisation, such as between ecosystems and landscapes” (Balvanera et al., 2013, p. 50). They would measure variability in terms of richness and the equitability or evenness of species and the differences in the function and forms of the species.

Several researchers refer to biodiversity as a complex term (Blanchard, 2014) with complicated components such as genetics, species richness and abundance (Fick, 2011) and ecosystem diversity (Egoh, Rouget, Reyers, Knight, Cowling, van Jaarsveldt, Wels & Cowling, 2007; Dumalisile, 2008). Gurr, Wratten, Snyder and Read (2012) describe biodiversity as “the complex web of life” (p. 4), which embraces the diversity of life on Earth at every level including genes, species and ecosystems.

According to Guthrie (2007), the biodiversity of a system includes the biotic and abiotic elements of that system. Biotic elements refer to species, populations and communities while the abiotic elements speak to the non-living properties such as water, soil and climate. Biodiversity also includes ecosystem processes and function. For Guthrie (2007), biodiversity largely consists of the

interactions of species and populations, and the services and functions that they bring about within ecosystems.

Both Govender (2007) and Rouwenhorst (2007) provide comprehensive definitions of biodiversity. Before the term 'biodiversity' emerged, biological diversity, an ecological term, referred to the number of species (Govender, 2007). Biodiversity has since come to refer to the broad range of variation of organisms within the living world. Biodiversity includes biological diversity. The word diversity has different meanings in different contexts and to different scientists. Systematics, for example, is the study of species and how they are connected to other species, and in what part of the world they live (Eldredge, 1992). A systematist defines diversity as the number of species within a monophyletic taxon. A taxon is a group of organisms that is given a formal taxonomic name. A monophyletic group of organisms, also called a clade, includes the ancestor of that group of organisms and all its descendants. To an ecologist, however, diversity means the number of species represented by local populations within an ecosystem (Eldredge, 1992).

Govender explains biodiversity as follows:

Biodiversity is used to describe the number, variety and variability of living organisms from all sources including terrestrial and aquatic ecosystems and the ecological complexes of which they are part. The ecological complexes are the intricate and the interdependent relationship that often occur among coexisting organisms, including diversity within and between species as well as the diversity of the ecosystem. Biodiversity is usually defined in terms of ecosystems, genes, species, landscapes and the ecological and evolutionary processes that allow elements of biodiversity to persist over time. (Govender, 2007, p. 2)

According to Rouwenhorst (2007), biodiversity includes animals, plants, fungi, ciliates and flagellates (microscopic organisms), ameboids, archaebacteria (a type of prokaryote, a unicellular organism without a cell nucleus) and bacteria. Biodiversity also includes all aspects of biological diversity, species richness, ecosystem complexity and genetic variation. Biodiversity involves all the evolutionary and ecological aspects and includes the intraspecific and interspecific patterns in the ecosystem. Biological diversity includes the entire range of species that can be found on earth

(Rouwenhorst, 2007). In order to better understand the complexity of the concept biodiversity I will need to tease out the various aspects that characterise it.

### **2.3 Biodiversity across the world, regionally, and locally**

Since humans form part of the planet's ecosystems, the current biodiversity crisis poses a risk to human health, environment and economies. According to WWF, population growth and human consumption are the main causes of biodiversity loss. Humans are currently using one quarter more natural resources than the Earth regenerates, and this, together with gigantic amounts of waste that humans produce, causes biodiversity loss (WWF, 2014). The following facts reported by the IUCN clearly illustrate that Earth's biodiversity is unable to bear the demands of current patterns of human production and consumption:

- Since 2000, six million hectares of primary forest have been lost annually;
- 70% of coral reefs are destroyed or threatened, yet they provide food, storm protection, and income to 50 million people worldwide;
- Of the world's 5494 mammal species, 78 are extinct, 191 critically endangered, 447 endangered and 496 vulnerable;
- 1910 of Earth's 6312 amphibians are in danger of extinction;
- The main threats to biodiversity are habitat loss and degradation which affects 86% of all threatened birds, 86% of threatened mammals and 88% of all threatened amphibians (IUCN, 2014).

The Eastern and Southern African region is home to seven of the world's biodiversity hotspots. From Ethiopia to the Cape, the region contains several centres where species of birds, mammals and plants are endemic, that is, restricted to one area and occurring nowhere else. Population growth and its accompanying economic demands as well as climate change threaten this endemism. For example, Namaqualand in southern Africa is home to ecologically sensitive ecosystems that are under threat from human development consumption trends. This is further emphasised by the World Conservation Congress (IUCN, 2012) which reports that the target for reducing biodiversity loss has not been met in any part of the world, while the drivers of biodiversity loss, namely the destruction and conversion of natural habitats, are intensifying. The

Congress also reports that biodiversity loss is increasing in all three spheres of biodiversity, that is in species, genetically and in ecosystems.

The local South African biodiversity situation is assessed every 5 to 7 years by the South African Biodiversity Institute (SANBI). In its 2011 National Biodiversity Assessment it reports the following:

- 48% of the country's wetland ecosystems are endangered. Wetlands are crucial for purifying water and regulating water flow;
- Only 18% of high water yield areas have some form of formal protection;
- 24% of coastal and in-shore ecosystems are critically endangered, 12% of off-shore are critically endangered, and only 4% of off-shore ecosystems are well protected;
- St Lucia, South Africa's flagship estuary and part of a World Heritage Site, is in a poor state and consequently unable to fulfil its role as the most important nursery for marine fish on the south-east African coast;
- Terrestrial ecosystems are threatened by loss of natural habitat. In Kwazulu-Natal, North-West Province and Gauteng, conversion of natural vegetation to other land uses will result in no natural habitat, outside of protected areas, left in these provinces by 2050;
- Of South Africa's over 2000 medicinal plant species, 656 are traded. Of those, 56 are threatened, of which 7 are critically endangered;
- Between 1990 and 2007, invasive alien plants doubled from 10 to 20 million (SANBI, 2011).

In the Port Elizabeth region of the Eastern Cape Province, where this study is centred, the effects of worldwide biodiversity loss is experienced as well. The Nelson Mandela Bay Municipality which includes Port Elizabeth, Uitenhage and Despatch, hosts five of South Africa's seven biomes, namely Fynbos, Subtropical Thicket, Nama Karoo, Forest and Grassland biomes. Nelson Mandela Bay also forms the south-eastern corner of the Cape Floristic Region, a globally recognised biodiversity hotspot well known for its plant and animal diversity and endemism. The natural habitats within the Nelson Mandela Bay Municipality are under serious threat from inappropriate urban planning and development, alien plant infestation, agricultural expansion and human activities. According to Dr Japie Buckle, Eastern Cape Coordinator of the conservation group Working for Wetlands, 80% of Port Elizabeth's freshwater wetlands have been destroyed by

developments that have drained large areas of wetland. There are now only three freshwater wetlands left, in the Rocklands and St Albans areas. Wetlands are natural sponges, retaining water and preventing floods. They also remove pollutants from the water (Rogers, 2014). The black wattle is the worst invasive species in the Eastern Cape. The upper Zungu River Valley, a key catchment for the Groendal Dam, in the Uitenhage area, is infested by black wattle. The Groendal Dam not only provides 66% of Uitenhage's domestic water, but it also hosts the critically endangered ghost frog and the Cape reedfin (Nelson Mandela Bay Bioregional Report, 2014).

The 23km long Baakens River that flows through fynbos habitats through the city of Port Elizabeth is polluted by the more than 40 storm water outlet pipes. The storm water not only pollutes, but has caused floods in the past years (Rogers, 2014; NMBM Bioregional Report, 2014). The Cape Recife Nature Reserve, on the Port Elizabeth coast, is known for its beautiful views, the variety of bird and plant life and its historic lighthouse. The South African Marine Rehabilitation Centre (SAMREC) is also situated within the reserve.

The coast of Port Elizabeth is known as Algoa Bay. The world's largest ocean current, the Agulhus, flows along the south-east coast of Port Elizabeth. The wave action along the Algoa Bay coast is largely as a result of this current. Algoa Bay also carries a large fishing industry. Approximately 21875 tons of fish are harvested each year in the Algoa Bay area. Algoa Bay is a nursery for marine fish (NMBM Bioregional Report, 2014). The bottlenose dolphin and the humpback dolphin also reside along the Algoa Bay coast.

The Swartkops River Estuary, one of 27 found along the South African coast, is the only estuary located in the middle of a metropolitan area. The estuary is not only a breeding ground to many fish and birds, but also sustains people through its bait collecting industry (NMBM Bioregional report, 2014). Bird Island, just off the Port Elizabeth coast, is the breeding ground for Cape gannets, and is one of only six breeding sites in the world (Butler, 2014). The greatest number of the near-threatened black oystercatcher in the country is found in the Maitlands Dunefield area (NMBM Bioregional report, 2014). About 50km outside Port Elizabeth, the large elephant population of the Addo National Park meets tourism needs, but affects biodiversity with regard to soil features, land patchiness, plant biomass and diversity. The elephant numbers impact on insect, bird and antelope abundance, and availability of browsing for rhinoceros is reduced. The Addo

National Park includes 5 of the 7 biomes found in South Africa (Kerley & Landman, 2006). Poor management of two of the largest herbivores, elephant and rhinoceros, could threaten the sub-tropical thicket with desertification. Outside of the National Park, uncontrolled goat browsing in the succulent thicket known as spekboom is threatening to turn it into open savannah (Mills & Cowling, 2006). Sub-tropical thicket supports blue duiker, kudu, bushbuck, buffalo, tortoise, Cape eland, grysbok and bushpig. Over-harvesting of the more than 77 medicinal plant species commonly harvested in the six urban areas of the Eastern Cape, of which Port Elizabeth is one, also poses a major threat to biodiversity (Dold & Cocks, 2002).

The above section illustrates how human well-being is inter-related with biodiversity well-being and that it is in the interest of present and future generations to protect our biodiversity. Biodiversity loss, as part of the broader socio-ecological crisis, has been taken up at various levels and across numerous sectors of society, with several responses being offered. Education is seen as one of the responses to our environmental crisis, as I will expound in the following section.

## **2.4 International educational responses to biodiversity**

Several countries have committed themselves to working towards promoting a sustainable environment through international initiatives like the Belgrade Charter (UNESCO, 1975), the Brundtland Report of the World Commission on Environment and Development, the 1992 Earth Summit that was held in Rio de Janeiro and the World Summit in 2002. The term ‘sustainability’ though, is a complex and changing term. When the Agenda 21 signed in 1992 at the Earth Summit committed countries to education as one means of dealing with our environmental problem, the relationship between the environment and development came into sharp focus. Many poor in developing countries depend on natural resources to fight starvation. Consequently, the term ‘sustainability’ developed to include social, political and economic causes of the environmental crisis. In 1991, some of the world’s strongest environmental organisations, in particular the International Union for the Conservation of Nature (IUCN), the United Nations Environmental Programme (UNEP) and the World Wildlife Fund (WWF), drew up a strategic plan called Caring for the Earth which projected this systemic, process view of sustainability. It is based on two interdependent principles: people’s responsibility to care for nature (ecological responsibility) and people’s responsibility to care for each other (social justice).

According to UNESCO (2009, p. 2), “mainstreaming biodiversity into education and learning processes requires that people begin to recognise the relationship between biodiversity and human well-being and reflect on how this is exemplified in everyday life”. UNESCO identified the drivers of biodiversity loss as habitat destruction, pollution, invasive alien vegetation, climate change and the over-exploitation of resources (2009, p. 3).

## SUMMARY OF KEY GLOBAL EDUCATIONAL RESPONSES TO BIODIVERSITY

Table 2.1 below summarises how international frameworks, guidelines and agreements have placed the concern for biodiversity loss and the immediate need for biodiversity conservation high on the international agenda.

Table 2.1 International Frameworks Guiding Education

International guiding framework	Date, Source, context and purpose of publication.	Key statements regarding biodiversity education
Sustaining Life on Earth: How the Convention on Biological Diversity promotes nature and human well-being	<p>April 2000</p> <p>Secretariat of the Convention on Biological Diversity</p> <p>The publication aims to provide an accessible, user-friendly guide to the 1992 Convention on Biological Diversity so as to promote better public engagement with biodiversity loss.</p>	<p><b>“An important step in addressing our overuse of the biosphere lies in educating people.</b> An education that empowers and enables people to seek collective ways to overcome current destructive trends is a critical component of any successful strategy for achieving a sustainable future” (p. ii).</p> <p>“The transition to sustainable development requires a shift in public attitudes as to what is an acceptable use of nature. This can only happen if <b>people have the right information, skills, and organizations for understanding and dealing with biodiversity issues.</b> Governments and the business community need to invest in staff and training, and they need to support organizations, including scientific bodies, that can deal with and advise on biodiversity issues. We also need a long-term process of public education to bring about changes in behaviour and lifestyles, and to prepare societies for the changes needed for sustainability. <b>Better biodiversity education would meet one of the goals set out in the Convention”</b> (Secretariat of the Convention on Biological Diversity, 2000, p. 18)</p>

Earth Charter	<p>2000</p> <p>The Earth Charter Commission, UNESCO, Paris</p> <p>The Earth Charter is a product of an open and participatory process which spanned 3 years in which hundreds of organisations and thousands of individuals participated.</p>	<p>The Earth Charter calls for a commitment to (amongst other things):</p> <p><b>“Protect and restore the integrity of Earth's ecological systems, with special concern for biological diversity and the natural processes that sustain life”</b> (p. 3)</p> <p>Integrate into formal education and life-long learning the knowledge, values, and skills needed for a sustainable way of life:</p> <ul style="list-style-type: none"> <li>a. Provide all, especially children and youth, with educational opportunities that empower them to contribute actively to sustainable development.</li> <li>b. Promote the contribution of the arts and humanities as well as the sciences in sustainability education.</li> <li>c. Enhance the role of the mass media in raising awareness of ecological and social challenges.</li> <li>d. Recognize the importance of moral and spiritual education for sustainable living (p. 5)</li> </ul>
Framework for the United Nations Decade of Education for Sustainable Development International Implementation Plan	2006	<p><b>“Natural resources (water, energy, agriculture, biodiversity):</b> Building on more than 30 years’ experience in environmental education, ESD must continue to highlight the importance of addressing these issues as part of the broader agenda of sustainable development. In particular, the links with societal and economy considerations will enable learners to adopt new behaviours in the protection of the world’s natural resources, which are essential for human development and indeed survival. Humanity is dependent on the goods and services provided by ecosystems. Thus, <b>the protection and restoration of the Earth’s ecosystems is an important challenge</b> [for Education for Sustainable Development]” (p. 19)</p>
Ahmedabad Declaration	<p>November 2007</p> <p>4<sup>th</sup> International Conference in Environmental Education, held in Ahmedabad, India.</p>	<p>“Urges everyone to learn from history, nature and natural systems to <b>develop understandings of how to respect and live within the limits of nature</b>, and to evolve social, production, technological and economic systems that are</p>

	<p>The declaration was the output of consultation with 1200 people from 78 countries represented at the conference.</p>	<p>creative, innovative, equitable and sustainable” (p. 5)</p> <p>“Promote earth system literacy and systemic thinking skills in environmental education to understand the nature of interdependency within the human family, the biotic community and the planet’s life-sustaining processes that explain the causes and solutions for the critical challenges we face” (p. 6).</p>
Bonn Declaration	<p>April 2009</p> <p>A statement and call for action from participants of the UNESCO World Conference on Education for Sustainable Development held in Bonn, Germany</p>	<p><b>“ESD helps societies to address different priorities and issues <i>inter alia</i> water, energy, climate change, disaster and risk reduction, loss of biodiversity, food crises, health risks, social vulnerability and insecurity”</b> (p. 2)</p> <p>“Support the incorporation of sustainable development issues using an integrated and systemic approach in formal education as well as in non-formal and informal education at all levels, in particular through the development of effective pedagogical approaches, teacher education, teaching practice, curricula, learning materials, and education leadership development...”(p. 4).</p>
The Power of ESD – Exploring evidence and promise	<p>October 2012</p> <p>This is not an agreed conference declaration but a report on the insights and experiences gained since ESD was introduced in 1992 through the Rio United Nations Conference on Environment and Development and the 2002 Johannesburg Earth Summit. It serves to offer guidance for the last two years of the UN Decade of education for Sustainable Development (2005-2014).</p>	<p>“2.1 ESD as part of the Convention on Biological Diversity (CBD): “Recently an important step to link ESD and CBD was taken with the signing of an MoU between the CBD Secretariat and the Centre for Environmental Education, India. To further strengthen this synergy it is recommended to <b>identify stakeholders working with different aspects of biodiversity and to collaborate with them in organising workshops and step-by-step strengthening of ESD as part of the efforts to ensure biodiversity for the coming generations</b>”(p. 5)</p> <p>“3. Use ESD to re-orientate education: education...should...be of a high quality allowing learners to become well-informed, reflexive and action competent citizens. “</p> <p>“ESD is quality education...it incorporates the important sustainability aspects of equity and human rights as well as the environment. With ESD, education becomes reoriented towards life skills education...rather than focusing on narrow employable skills.”</p> <p>Recommendations are:</p>

	<p>“3.2. Ministries of education and other authorities should use ESD to strengthen the quality of educational programs and strategies”</p> <p>“The challenge of integrating ESD into the existing curriculum can be met by developing context-specific ESD teaching materials and manuals, for use in teacher education and in other learning settings” (p. 7)</p>
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One way in which the international agreements address biodiversity loss is through education. These agreements call for the correct information and understanding of biodiversity (COB, 2000), that is, knowledge of biodiversity and a moral and spiritual education which empowers people to deal with biodiversity issues, protect and restore our ecosystems and live within the limits of nature. To meet this challenge, education would need to be of a high quality, integrated and systemic and draw on the expertise of scientific bodies to advise on biodiversity matters. In the following section I explore how these international agreements translate into the South African national curriculum, in particular Natural Science.

## **2.5 Biodiversity in the National Curriculum**

### **2.5.1 Biodiversity in the curriculum**

The global imperatives described above have been reflected in South Africa’s post-apartheid curriculum reforms. Some of the developments in environmental education are evident in the National Curriculum Statement. The National Curriculum Statement Grade R-12 is based on principles, one of which is that of “human rights, inclusivity, environmental and social justice”: infusing the principles and practices of social and environmental justice and human rights as defined in the Constitution of the Republic of South Africa (DBE, 2011, p. 5). This would imply that society – and this includes our grade seven learners – has the responsibility to protect and defend the environment; to put policies in place to regulate the use of our natural resources and to put legislation in place to punish offenders. Inequality in the use of resources between rich and poor should be addressed as well as the immense poverty in certain parts of the world, in the interest of the environment and our natural resources. The National Curriculum Statement Grade R-12 also aims, amongst other things, to produce learners who are able to “use science and

technology effectively and critically show responsibility towards the environment and the health of others” and “demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation” (DBE, 2011, p. 5). More specifically in the Intermediate Phase, Natural Science is presented as the subject in which learners develop knowledge and skills to “analyse problems”, evaluate solutions, “grasp scientific, technological and environmental knowledge and apply it to new contexts” (DBE, 2011, p. 10).

## **2.5.2 The ‘Biodiversity’ focus in Natural Science**

In this section, I review environmental content knowledge, particularly biodiversity knowledge, in the national curricula for Natural Science from the early 1990s to 2014. The section illustrates how biodiversity knowledge has changed slightly in the way it is represented in curriculum policy. The implications of the way in which biodiversity is understood and taught by Natural Science teachers are considered.

### **2.5.2.1 Education before 1994**

Under apartheid, each race group had its own Education Department which had to adapt the national curriculum to meet its cultural needs within the financial constraints and the confines of the apartheid laws (Fedderke, De Kadt & Luiz, 2000). Appendix A is an extract from a Standard 5 General Science textbook which reflects the content that was taught under one of the departments, the Department of Education and Culture at that time. The extract indicates that no mention was made of biodiversity or its components at this Standard 5 (now Grade 7) level. Within this Standard 5 curriculum, biodiversity knowledge covered knowledge of vertebrates, non-vertebrates; seeded and non-seeded plants; sorting and classification, and plant and animal life as our living resources. The learners’ activities included collecting and touching real specimens. Knowledge was presented as facts and predominantly given to learners in lecture form (R. Campbell, personal communication, June 26, 2014).

### **2.5.2.2 Biodiversity in Curriculum 2005**

Post-1994, South Africa’s first national curriculum under democracy was named Curriculum 2005 (RSA, 1997). C2005, an outcomes based curriculum, was characterised by specific outcomes,

assessment criteria, phase and programme organisers, range statements, performance indicators and expected levels of performance (Chisholm, 2005) all of which left many teachers mostly confused. The curriculum included ‘environment’ as a phase organiser, with biodiversity appearing in two of the six units. The Port Elizabeth District Office drew up a Work Schedule for Natural Science based on the C2005 policy document. Some participants in the process of developing C2005 felt strongly that learners had to make sense of their world, give voice to their indigenous knowledge and bring to the fore the different kinds of knowledge that had been suppressed in the past. This thinking may have led to the terminology of learners having to ‘discover’ for themselves the knowledge that the curriculum had identified (Chisholm, 2005). The biodiversity-related content knowledge which learners were expected to discover included:

- “ecosystems and the environment” (Appendix B: Work schedule, p. 64);
- “biodiversity, change and continuity” (Appendix B: Work schedule, p. 68 & 75), “biodiversity” (Appendix B: Work schedule, p. 72 & 73); and
- “ecosystems” (Appendix B: Work schedule, p. 70 & 77).

Within the Programme Organiser: Ecosystems (see Appendix B: Work schedule, p. 64) learners were expected to use magazines, old textbooks, reference guides and the internet to obtain knowledge through discovery learning. Given that biodiversity is a relatively new concept, learners would not have obtained precise information on biodiversity from magazines; neither would it have been explained in the older textbooks.

The Port Elizabeth District Department of Education’s Work Schedule for Natural Science for Grade 6 for C2005 had six units, In these units, the term ‘biodiversity’ appears in units 5 and 6, while the term ‘ecosystems’ appear in unit 5 (see Appendix B: Work schedule, p. 57 and 68). Learners were assessed on their investigative skills while the activity required learners to compile a questionnaire about the biodiversity of the Earth (p. 57). The knowledge component under the assessment of ‘biodiversity’ appears as the categorising of animals into mammals and reptiles and carnivores and herbivores (p. 75). The assessment of ‘ecosystems’ is the same as for ‘biodiversity’, that is, “categorising or defining mammals and reptiles, carnivores and herbivores” (p. 70 and 77). The knowledge of biodiversity and ecosystems provided in this curriculum appears to be

inadequate in the light of our discussion on biodiversity in section 2.2. The section under activities: “Learners do *fun* (my emphasis) activities about biodiversity, change and continuity” (Appendix B: Work schedule p. 75), shows that an opportunity has been created for learners to engage with biodiversity and biodiversity loss and the threat to the variety of species of both plant and animal life and the importance of ecosystems. However, some assessment of biodiversity learning is unrelated to the content knowledge that is taught, for example: “Food chains and food webs” are the knowledge that learners should acquire, but the assessment task is for learners to: “put in order pictures of the life cycle of fruit flies, when observing real fruit flies reproducing” (Appendix B: Work schedule p. 16). The knowledge component for biodiversity that is expected from this curriculum is despairingly inadequate to equip learners with an understanding of biodiversity.

### **2.5.2.3 Biodiversity in the Revised National Curriculum Statement**

The Revised National Curriculum Statement, the RNCS, (DoE, 2002) is built on the vision and values of Curriculum 2005. The C2005 was revised between 2000 and 2001. The Revised National Curriculum Statement was introduced in April 2002 and implemented in 2004 (Chisholm, 2005). The Revised National Curriculum Statement served to set clearer knowledge and skills guidelines for teachers. It streamlined and simplified the curriculum to eight learning areas with clearer content knowledge to be taught, and clearer assessment guidelines provided by learning outcomes and assessment standards. Natural Science in the Revised National Curriculum Statements (RNCS) comprised four strands: Life and Living, Energy and Change, Planet Earth and Beyond and Matter and Materials (DoE, 2002, p. 5 & 6). In the Senior Phase, which comprised Grades 7, 8 and 9, the topic of biodiversity falls under the Life and Living strand which states: “Life and Living focuses on life processes and healthy living, on understanding balance and change in environments, and on the importance of biodiversity” (DoE, 2002, p. 5).

The National Curriculum Statement had three learning outcomes which served to measure learners’ competencies. In terms of environmental learning, learners had to demonstrate their ability to investigate and solve problems, have knowledge about the environment and apply it, and demonstrate an understanding of the interrelationships of technology, science and society (DoE, 2002, p. 6).

The core knowledge and concepts about biodiversity for the Senior Phase which learners needed to grasp were: Biodiversity, Change and Continuity – variation in species; natural selection and extinction of species; human biological characteristics as a social construct; biodiversity in relation to ecosystems, and in sustaining life; classification of vertebrates and invertebrates; causes of biodiversity loss; mass extinctions of the past; cells and life processes (DoE, 2002, p. 65).

While the core knowledge was divided into Phases, assessment was Grade specific. Some of the Biodiversity, Change and Continuity skills and knowledge the Grade 7 learner was assessed on included: “distinguishes vertebrates from invertebrates” and “uses a simple classification system to group root types of familiar plants” (DoE, 2002, p. 52). However, other concepts, for example natural resources, were dealt with in other strands and links may not have been made by the teacher to biodiversity or biodiversity loss.

The knowledge of biodiversity that was offered to the grade seven learners through this curriculum is also very limited compared to the complexity of the concept of biodiversity and the intricate concepts it requires the learner to explore within the interdependent relationships of the biotic and abiotic elements.

#### **2.5.2.4 Curriculum and Assessment Policy Statements 2014**

The previous curriculum, the RNCS, was revised once again, and in 2012 the National Curriculum Statements for Grade R-12 came into being. This entailed a single Curriculum and Assessment Policy Statement (CAPS) for each subject. Like its predecessors, the 2012 NCS promotes high knowledge and skill, active and critical learning, and social transformation. The Natural Sciences Grade 7 CAPS has three Specific Aims. Specific Aim 2 foregrounds the importance of learners knowing their subject content and making connections between the ideas and concepts in their minds and their real life experiences. It specifies that the objective of Natural Science teaching is to: “build a framework of knowledge for learners and to help them make connections ...this is different to learners just knowing facts...connections must be made” (DBE, 2011, p. 10). Specific Aim 3 connects science to society so that “issues such as improving water quality, growing food without damaging the land and building energy-efficient houses” can be realised (DBE, 2011, p. 10).

In Grade 7 Natural Science biodiversity is presented as a concept to be explored through topics presented in the first term. Biodiversity is defined as: “plants, animals and micro-organisms, and their habitats [that] make up the total biodiversity of the Earth” (DBE, 2011, p. 17). This definition fails to highlight the interdependent relationship between all plants, animals and micro-organisms in its biotic community and the interdependent relationship between the biotic and abiotic elements. Biodiversity is allocated 3½ weeks of teaching in the first term, covering the following: biodiversity (the classification of all living things), the diversity of animals and the diversity of plants (DBE, 2011, p. 13). Biodiversity as a topic is preceded in Term One by learning about the biosphere, which includes the lithosphere, hydrosphere and atmosphere where all life exists, and for which one week of teaching is allocated. This curriculum presents the biodiversity knowledge concepts in a fragmented way with no links made by the curriculum for the teacher.

The curriculum requires learners to apply the following process skills: the grouping of objects, drawing comparative tables, sorting, listing, observing, identifying and describing. The Natural Science CAPS also recommends that resources be used such as textbooks, pictures, video clips, plant seeds, containers and soil, pictures of vertebrates and invertebrates and magnifying lenses. In this curriculum, clear guidelines have also been given as to what knowledge and skills should be assessed:

- ✓ Learners should sort plants and animals into groups based on observable similarities
- ✓ They should give the distinguishing characteristics of the five vertebrate classes
- ✓ They should give the distinguishing characteristics of the selected invertebrates
- ✓ Name, describe and provide the function and components of the flower
- ✓ They should distinguish between pollination and fertilization
- ✓ They should link the presence of the differences between living things of the same species to variation (DBE, 2011, p. 21).

As can be seen from the above discussion, there has been great changes in the curriculum, and an increased emphasis on knowledge and assessment. However, since biodiversity allows for the study of the entire range of species found on Earth, in terrestrial and aquatic ecosystems and includes the interdependent relationship between the biotic and abiotic elements, the knowledge and skills prescribed by the Curriculum and Assessment Policy Statements are greatly lacking.

One organisation that offers support to teachers to strengthen the teaching of environmental content in CAPS, such as biodiversity, is Fundisa for Change.

## **2.6 Fundisa for Change**

Fundisa for Change is a collaborative national programme formed to enhance environmental learning through teacher education. Fundisa for Change was initially established through a partnership between the Department of Environmental Affairs and Tourism, the SANBI / GreenMatter Programme and national teacher education institutions, to strengthen transformative environmental learning and teacher education within the CAPS (DBE, 2011). The teacher education programme was initiated in 2011 in response to findings from three national reports that the foundation of environmental learning in South Africa needed more attention. These reports were the South African Environmental Skills Plan, the SANBI/ Greenmatter Biodiversity Human Capital Development Strategy and the Global Change Grand Challenge National Research Plan Human Capital Development Strategy. Two issues were identified: firstly, the quality of teachers' knowledge and ability to teach environmental knowledge, and secondly, the curriculum content needed to build national capacity for biodiversity management, sustainable use of resources, resilience to climate change and the building of a green economy ([www.fundisaforchange.co.za](http://www.fundisaforchange.co.za)). The Fundisa for Change Programme (2013) reports that a fragmented approach to teaching concepts such as biodiversity, ecosystems and climate change prevents teachers and learners from "joining the dots" and developing coherent, holistic understandings of socio-ecological challenges (Fundisa for Change, 2013). The programme notes that, "there is little educational understanding of how these new environmental knowledge areas and related intentions for societal changes are influencing foundational knowledge and the skills, competence and values developed in schools" (Fundisa for Change, 2013, p. 4).

Despite its inclusion in the formal curriculum, biodiversity as a concept and a topic for classroom teaching is not well understood or taught by the majority of teachers. Songqwaru (2013), for example, found that, "teachers have content gaps in environment and sustainability knowledge" and that the teachers who participated in her study "lacked confidence in teaching environment and sustainability content knowledge" (Songqwaru, 2013, p. 141). This resulted in a reliance on

textbooks and, in some cases, on teachers having access to only one textbook due to financial constraints (Songqwaru, 2013, p. 138).

Fundisa for Change has found that although most teachers may be aware that human behaviour can lead to biodiversity loss, and that humans need to adapt and change their behaviour, they grappled with how to get learners to understand this and change their behaviour. Fundisa for Change suggests that teachers can and should demonstrate that together we can “build a better world” by using their problem solving skills to find solutions to problems. All South African citizens have the right to a healthy environment as enshrined in the Bill of Rights in the Constitution of South Africa. Fundisa for Change sees education as pivotal in ensuring that all South African learners are “exposed to the knowledge, skills and values that are necessary to build a just and sustainable society” that will be able to “[manage] and [protect] its natural resources for both present and future generations” (Fundisa for Change, 2013, p. 4). More specifically, the Fundisa for Change programme aims to support teachers to develop a coherent and integrated understanding of biodiversity topics. It suggests that teachers look at a range of topics such as climate change and biodiversity, as contained in the CAPS curriculum, through the lenses of the curriculum principles of social transformation, active and critical thinking, high knowledge and skill, progression, human rights, inclusivity, environmental and social justice, indigenous knowledge systems and credibility, quality and efficiency. These principles flow from the goals of the United Nations Decade on Education for Sustainable Development which deems important the integration of environment, society and economies for a better life for all (UNESCO, 2005).

Fundisa for Change also recognises that, for many teachers, biodiversity knowledge is new. As such, the programme proposes that Natural Science teachers be grounded in foundational knowledge, that is, in the core concepts and processes of their discipline. These include understanding the earth as a system, understanding the key life-supporting processes and how ecosystems function.

Importantly, however, in line with the broad goals of environmental education and Education for Sustainable Development, and in line with the National Curriculum Statement’s concern that teaching should involve more than just the transfer of knowledge but should help learners to make connections to their lives and to society in general, the biodiversity content knowledge of the

Natural Science CAPS needs to be imparted to learners in ways that encourage transformative learning. Wals (2010) understands “transformative” to mean a new way of being and seeing, and “social learning” as presenting one’s own ideas and perspectives to others. In his argument for social transformative learning towards sustainability, Wals (2010) argues for teaching that helps learners cope with the uncertainties and complexities of our environment as new knowledge emerges. In his study with university students, he reports how learners can analyse ordinary, everyday occurrences by looking at how they are linked to other events, and by examining their causes and consequences. This process enables many different perspectives to emerge as well as alternative responses to prevent or reduce unsustainable practices. Transformative learning encourages learners to ask questions, deliberate and find solutions to problems, and to develop different social practices towards a more sustainable society. Transformative learning therefore encourages reflexivity in learners and an awareness of their values and how these work in society.

## **2.7 Biodiversity teaching internationally**

This study of what teachers know, believe and say about biodiversity and the teaching of biodiversity has to be set against the backdrop of what biodiversity teaching is already taking place and what teachers have said and done in relation to the teaching of biodiversity. Since not much research has been done on biodiversity teaching, biodiversity teachers could draw lessons from education for sustainability or environmental education in general. However, the International Union for the Conservation of Nature (IUCN) as well as a report on The Power of ESD, describe educational activities which may affect social change that will promote biodiversity. The IUCN 2013 Conference was held in Switzerland, where the Commission on Education and Communication reported on three educational programmes.

In a study in the United Kingdom, Gayford (2010) found that although some teachers understood the complexity of biodiversity concerns, they did not make essential links between core concepts due to time constraints of the science curriculum. The study found that teachers emphasised not only the biological importance of biodiversity but its economic importance and its inter-relatedness to broader environmental issues like global climate change, and marine and air pollution. The study proposed that ‘good’ biodiversity education should allow learners to explore the social, political, economic, spiritual and cultural aspects of biodiversity (Gayford, 2010).

Studies conducted by Fien & Maclean (2014) and Yavets, Goldman & Pe'er (2014) found that there were challenges to teaching education for sustainability. Fien & Maclean (2014, p. 60) raise a concern about the 'gap' between theories of environmental education in terms of what *should* be taught as advised in important international documents such as the Tbilisi Declaration and government policies, and what is actually happening in classrooms. They raise concerns with the cognitive/knowledge and skills objectives that are easier to assess than action/ citizenship ones. In other words, traditional tests which assess knowledge are easier to conduct than assessments of changes in learners' skills, attitudes and values with regard to the environment. Similarly, Yavetz, Goldman & Pe'er (2014) found that the student-teachers in their study saw the environment as an object and not as an interrelated system which includes people. The study's respondents regarded the environment in terms of subject disciplines, hence lacking an integrated understanding that is necessary to deal with the complexity of environmental issues.

Hill & Brown (2014) conducted a study with 12 teachers in New Zealand into how outdoor learning activities could develop a connection to and care of the environment that could lead to a sustainable future. They found that outdoor learning activities helped the students' understanding of the nature-society system and how their actions impact on that system. This association of connection to and care of the environment has its roots in deep ecology and place-based pedagogy.

The aim of environment-oriented teaching as seen in this section is to encourage learners to see the world as an interrelated system and to recognise our responsibility towards our environment. The goals that teachers are able to achieve in practice are influenced by the way in which they convey biodiversity knowledge i.e. how they represent biodiversity as a concept and how they get learners to engage with it. Inevitably, teachers' own perceptions of biodiversity may shape their biodiversity teaching. The next section explores a range of biodiversity narratives including biodiversity metaphors, and considers how these might be taken up by teachers or reflected in the textbooks they use.

## **2.8 Biodiversity Narratives**

### **2.8.1 Introduction**

Biodiversity narratives are located within wider environmental discourses. In this section, I review a range of environmental discourses as described by Dryzek (2005), Välliverronen & Hellsten (2002) and Veldman (2012) to gain further insights into teachers' biodiversity narratives.

An environmental discourse is a common way of making sense of the world and is commonly presented as stories or accounts. A discourse is based on the views, judgements and differences of speakers and thus provides a platform for deliberation. Although interchange across discourse boundaries seldom occurs, it can happen (Dryzek, 2005). According to Dryzek (2005), there are several ways of trying to make sense of environmentalism on Earth. He mentions that one could, amongst others, investigate institutions which address environmental issues, or investigate the policies which drive environmental issues, as well as political philosophies which underpin environmental relationships. In this study I draw on Dryzek's (2005) analysis of environmental discourses to help me understand how the teachers in the three case studies represent biodiversity concepts such as ecosystems, food chains, habitats and biodiversity loss.

People make sense of their lives at the hand of narratives available to them (Bell, 2002). Narratives are teachers' living stories (Clandinin & Huber, 2014), powerful constructs which are shaped by personal and community narratives (Bell, 2002) which reflect the teachers' feelings, hopes and values. Investigating teachers' narratives of biodiversity and of teaching biodiversity allows me to examine the underlying insights and assumptions that their stories illustrate, of which they might be unaware, and gives insight into their beliefs and experiences (Bell, 2002).

### **2.8.2. Different Environmental and Biodiversity Narratives**

#### **2.8.2.1 Apocalyptic Discourse**

Since the 1960s, the concept of biodiversity has been represented in various ways within the scientific community and within the public domain. The way biodiversity is talked about is influenced by wider environmental discourses. For example, the apocalyptic or doomsday discourse (Välliverronen, 1998; Välliverronen & Hellsten, 2002) portrays nature as threatened by

human expansion and greed and is characterised by metaphors such as “population bomb” and “war against nature”. Within this discourse, biodiversity could be represented as all forms of nature (oceans, forests, grasslands and so on) trying hard to survive in the face of human destruction. The apocalyptic narrative, according to Veldman (2012), is one of many environmental discourses. Apocalyptic refers to environmental catastrophe due to the ignorance or the insatiability of humans and their desire to dominate or control the natural world. This has led to all forms of pollution, loss of biodiversity, overpopulation, deforestation, and climate change which the narrative portrays as culminating in an ecological crisis of apocalyptic proportions. This narrative can cause a sense of hopelessness. But it can also lead to action. Veldman (2012) found that many people who were environmental activists were driven by their desire to prevent the destruction of life on Earth. Those who think that the environmental problems pose a severe threat, usually practice some form of activism. Some examples of activism are lobbying and engaging in campaigns to shift legislature priorities. Veldman (2012) found that people who practice pro-environmental behaviour such as composting and recycling are often influenced by a narrative of environmental apocalypse. The main advantage of the apocalyptic narrative is that it seems to be a powerful trigger for people to protect the environment. One of its disadvantages is that people may be left feeling hopeless and fearful and paralysed to act.

### **2.8.2.2 Sustainable Development Discourse**

Alternatively, the discourse of sustainable development (Dryzek, 2005) which builds connections between the environment and the economy and uses metaphors such as ‘we are all in the same boat’ and ‘spaceship earth’, may reflect biodiversity as a vital resource for human survival and development. An illustration of this can be seen, for example, in the way the Millennium Ecosystem Assessment (MEA, 2002) emphasises the importance of ecosystems in providing regulatory, supporting, cultural and spiritual “services”. Ecosystems provide people with food, fresh water, fuel wood, fibre, biochemical and genetic resources. It regulates our climate and disease and regulates and purifies our water. The cultural benefits we enjoy from ecosystems are recreation and eco-tourism, spiritualism, inspiration, a sense of place and cultural heritage.

### **2.8.2.3 Survivalism Discourse**

According to Dryzek (2005), the discourse of Survivalism is based on the understanding that the resources on Earth are limited. The discourse of survivalism acknowledges the importance of economic growth but it is concerned about the limits of natural resources and their exploitation. It describes the carrying capacity of Earth as the maximum population that an ecosystem can carry without being destroyed. The main proponents of the Survivalist discourse are experts in economics and politics and the sciences, scientists who would prefer a hierarchical, authoritarian government and administration to ensure that Earth's resources are used responsibly. The metaphor of the space ship is used by the Survivalists to illustrate that should the resources on the spaceship be used up, those on board will die. Garrett Hardin, in his "Tragedy of the Commons" in 1968 describes the world and its resources as a commons. He argues that with all decisions we make regarding the use of resources or even the amount of children we bring forth, though we may benefit from them personally, the commons bears the consequences. "The Limits to Growth", published in 1972, was a study based on computer modelling which used the aggregates of resources, pollution, food supply and population and ran global predictions into the future of how these aggregates interrelated and interacted. The results showed that unrestrained use of the Earth's resources will lead to the collapse of its natural systems. Ecological Economics emerged as a sub-field of Economics in the mid-1990s, foregrounding the understanding that economic systems function *within* ecosystems, that ecosystems are finite and therefore that there is a limit to the economic actions they can sustain.

### **2.8.2.4 Promethean Discourse**

The Promethean discourse takes its name from Greek mythology where Prometheus stole fire from the God Zeus and this gave him the power to control the world. In contrast to the Survivalism discourse, those who subscribe to the Promethean discourse believe in people's ability – together with technology – to solve any problem. They believe in a cornucopia, that is, an overabundant supply of resources on Earth. They believe in economic growth and see the natural environment as brute matter, there to serve the economy.

The Promethean argument was first articulated by Harold Barnett and Chandler Morse in 1963. They argued that the lower the price, the greater the abundance of that commodity. This follows

on from the economic principal that the greater the demand, the scarcer the product and the higher its price. Prometheans could prove that the prices of natural products had declined in the past years, proving not scarcity, but abundance.

Promethean discourse does not value ecosystems in the way that the Survivalism discourse does. Where Survivalists recognise economic activity to be embedded in – and hence dependent on – ecosystems, Prometheans uphold as most important, people and their ability to use technology to make resources; if one resource gets depleted, people will make a substitute. Thus people, markets, prices, energy and technology are the key entities in this discourse. Relationships with nature are based on human dominion as well as competition because, through competing, people come up with solutions. The agents who can bring about change are everyone, but especially economic actors motivated by self-interest. The metaphor associated with this discourse is the machine; machines are used to solve our problems.

Prometheans have one purpose – economic growth, driven by one purpose – that economic growth is good. The political and economic system is designed to this end, and generates policy and whatever is required to sustain economic growth. Promethean governments favour the economy and economic growth of the environment. According to Dryzek (2005), the Promethean discourse is attractive to not only capitalist entrepreneurs but also Christian conservatives in the United States. Promethean discourse assumes that nature has an overabundant supply of resources that nature is always giving and creating, despite how badly people treat nature.

### **2.8.3 Biodiversity metaphors**

Metaphor has come a long way from being understood as a mere linguistic phenomenon based on similarity between objects, for example, ‘the moon is a balloon’. According to Kirby (1997, cited in Dălălălu, 2012), this comparative view is based on the characteristics that the two objects have in common, thereby treating metaphor on a lexical (word) level only. Dălălălu (2012), however, traces more complex understandings of metaphorical thinking and its role in society. For example, an interactionist approach focuses on the cognitive function of metaphors in which metaphor is understood to be a semantic phenomenon and the result of an interaction of thoughts. Here, Black (1962, cited in Dălălălu, 2012) describes metaphor as thoughts of two different things, with associations of one being transferred to another. On the other hand, Searle (1980, in Dălălălu, 2012)

viewed metaphor as a discourse phenomenon. He looked at metaphor as the meaning that the speaker intended, in other words, as contextually embedded utterances.

Bouwers (2012) draws attention to the power that metaphor holds. He believes that words as metaphors carry the insights and misconceptions of earlier thinkers; they communicate how relationships are understood and acted upon. Moral values are hence also embedded within these culturally prescribed attributes. Participants in ecological relationships learn these culturally prescribed attributes in institutional settings such as the classroom and the workplace and in social settings such as in conversations with others.

Metaphor means to see and understand one thing as another or in terms of another (Nerlich & Jaspal, 2012). Metaphor can also be seen as a “device to make something less familiar more familiar that impregnates the target with characteristics which originally pertain to the source” (Caillaud, Kalampalikis & Flick, 2012, p. 368). Examples of metaphor functioning in this way are evident in the work of Nerlich and Jaspal (2012) who found in their studies on climate change that the planet is seen as a body to be protected. Just as people use sunblock to protect themselves from sunburn, global warming needs to be curbed. They also found that the planet is seen as a patient who had over indulged, over-consumed in its addiction to carbon, as well as a machine which has a problem with its thermostat.

Larson (2011) draws attention to how scientific concepts (such as biodiversity) are commonly communicated through metaphor. He suggests that, depending on which metaphor forms part of our worldview, we will be influenced to frame our problems accordingly and act. Larson is concerned with the multiple meanings that are conveyed in the metaphors that scientists use. He believes that scientists should realize that scientific knowledge is only a part of understanding biodiversity. He believes that communication is part of understanding biodiversity as well as and how others may interpret metaphors within their context. His point, I believe, applies to metaphors teachers may use in the classroom as well. Larson (2011) suggests that the metaphor of competition, for example, can lead people to regard nature with a free market, capitalist mentality. He maintains that we need metaphors that emphasise interconnectedness rather than separation between nature and culture, and that metaphors conveying co-operative and harmonious relationships will encourage sustainability.

In biodiversity narratives, metaphors are often used to convey the concept of biodiversity and its importance. Välliverronen and Hellsten (2002) reviewed the most popular metaphors used in representations of biodiversity since the 1990s:

- One such narrative represents biodiversity as “the library of life” or “the book of life”, which implies that the natural world is a collection of knowledge and information with the ability to build links between scientific knowledge, political action or popular images.
- Biodiversity is also often spoken of in terms of “bioprospecting” or “biotic exploration” which evokes images of exploration, breaking new ground or exploring new frontiers and a sense of ‘there’s more out there that we don’t know’.
- Biodiversity is also referred to as a web or a network of relations between humans and non-humans. Biodiversity is thus seen as a system of relations of which humans are an integral part (Välliverronen & Hellsten, 2002).

As elaborated above, metaphors function as conceptual tools for conveying abstract ideas in concrete ways. They contribute to discourses and are used to help people make sense of the world (Nerlich, 2010). According to Välliverronen (1998), metaphors in environmental discourses are able to influence social conduct and perception and they perform important communicative and connective functions. Communicatively, metaphors help to create common ground between scientists, politicians and teachers for making sense of concepts such as biodiversity. In a connective role, metaphors connect different disciplines and institutions, making biodiversity knowledge common and shared.

Metaphors such as the ‘ozone hole’ and ‘the greenhouse effect’ make environmental issues more concrete and easier to understand, but they can also reflect tacit beliefs and values of which teachers and learners might be unaware. In this study, my interest is in identifying any metaphors of biodiversity that teachers use, either during their biodiversity lessons or when talking to me about their understandings and experiences of teaching biodiversity, as these metaphors may be indicators of the beliefs and values teachers hold about biodiversity.

## **2.9 Teachers' beliefs and values**

### **2.9.1 A Framework for considering a teacher's values and ethical responses to biodiversity**

This study focuses on the intersection of biodiversity knowledge, the practice of teaching biodiversity, and the values that teachers' hold about biodiversity – all within a changing socio-ecological context. It is necessary, therefore, to clarify and take up a position in terms of environmental ethics and the ways in which the natural world (in particular biodiversity) is valued.

Environmental ethics typologies commonly represent anthropocentrism (a human-centred position) and bio- or ecocentrism (a nature-centred position) as opposing ends on a continuum. According to research done by Hattingh (1999), the anthropocentrists on the one hand, argue that nature has value only in so far as it is useful to humans. They also view economic growth as progress, and believe that natural resources are superabundant. 1. The Wilderness Preservation, an anthropocentric position, believe that untouched or preserved spaces have value for humans. It could be that humans value them as natural sinks, for their indigenous plants that could be harvested for medicine, or for recreational, therapeutic or spiritual purposes. 2. Another anthropocentric position, Ethical extensionism emerged when critics of earlier environmental positions felt that not only humans are morally considerable. They argue that our moral concern should include particularly those animals that are sentient, that is, with the capacity to experience pleasure and suffer pain. On the other hand, some non-anthropocentric positions hold that intrinsic value is ascribed to nature by humans. Ecological sensibility theorists argue, from a non-anthropocentric position, that more than sentientism is needed as a criteria for what part of nature is morally considerable. They argue that all living things have an interest in its own survival and have a good of their own. For this reason all living things have intrinsic value. These theorists reject human superiority over nature. Hattingh (1999) concludes that most environmental ethical positions are characterised by ethical monism, based in most cases on a single principle. The limitation of ethical monism for this study, is that it may not address the complex values of the teachers in these case studies. On the other hand, environmental pragmatism seems more appropriate because it provides the researcher with a set of conceptual tools that can be used to explain a diversity of ethical positions.

Kronlid & Öhman (2012), educationists in Sweden, have developed an environmental ethics framework that is rooted in pertinent literature on environmental philosophy spanning more than 30 years. Although it was conducted in a Western European context, I believe it is applicable to this study because the South African teachers would be able to relate to these categories that describe various aspects of ethics.

According to Kronlid & Öhman (2012), the Intrinsic Value Discourse splits environmental ethics between two positions. On the one hand only humans have intrinsic value and are moral objects while on the other hand nature has instrumental value. Instrumental value means a value which is a means to what is perceived as good. However, the Intrinsic Value Discourse was challenged and accused of perpetuating materialism and exploitation and was partly blamed for the environmental crises.

In an effort to move away from the oppositional debates around anthropocentric and non-anthropocentric positions, Kronlid & Öhman (2012) propose a combination of value-oriented and relation-oriented environmental ethics, based on three moral considerations:

- a. identifying who or what is the moral object
- b. clarifying the human-nature relationships, and
- c. defining nature's value

Their intention was to enable a more pluralistic description of environmental ethics positions as opposed to linear and oppositionalising anthropocentric versus non-anthropocentric descriptions. In both anthropocentric and non-anthropocentric positions, humans are moral agents, held responsible for their actions. The moral object means being morally relevant, in other words, besides having instrumental value, the needs, well-being and health of both human and non-human living beings are considered.

Relation-oriented environmental ethics refers to rational, emotive and relevant relationships that people, as moral agents, enter into with other people and nature. Relational theories such as Deep Ecology, Social Ecology, Ecofemism, Post-modern Ethics and Pragmatic Environmental Ethics have the following features: firstly, they situate their problem in a relational space, that is, within experiences of crises within the environment. Secondly they attend to the practical implications of

environmental and developmental problems. Relation-oriented environmental ethics are interested in understanding how environmental values are created and maintained and also seek solutions to all aspects of how humans need to live together.

Kronlid & Öhman's (2012) approach of drawing on value-oriented and relation-oriented environmental ethics to analyse texts and conversations is of value to this study of what teachers believe, say and know about biodiversity in their teaching practice because it may reveal teachers' values and ethical positions regarding biodiversity which filter through to the learners through teachers' speech and behaviour regarding biodiversity.

The way in which teachers value biodiversity will influence what they say about biodiversity in the classroom. Learners acquire values through the process of socialisation inside and outside the classroom and teachers are part of this process.

### **2.9.2 Previous research on teacher's environmental beliefs and values**

Where Kronlid & Öhman's contribution is theoretical, other studies contribute empirical insights to the influence of environmental ethics in education. For example, Baurain (2012) found that the teachers in his study viewed aspects of their classroom practice in terms of their faith: "In teacher knowledge terms, their personal religious beliefs constitute part of how they know what they know and why they do what they do as teachers" (Baurain, 2012, p. 328). Similarly, Olvitt (2012) reports how novice environmental educators' decisions about what and how to teach were strongly influenced by their religious convictions, childhood and familial experiences, and their commitment to broad social values such as democracy, justice and dignity.

Yavetz, Goldman & Pe'er's (2014) research into pre-service teachers' perceptions of environment reported an anthropocentric-ecocentric, an opposing value, approach. However, they warn against seeing this divide in overly simplistic terms: an anthropocentric approach (the separation between human and nature) may reflect a view where nature is seen as pure, undisturbed and pristine silence, beauty and tranquillity (Yavetz et al., 2014, Cocks, Dold & Vetter, 2012) where people obtain aesthetic and spiritual enrichment. Similarly, Cocks, Dold & Vetter (2012) found that the thickets in the Eastern Cape were revered by the local Xhosa inhabitants as sites where their ancestors live. The respondents also believed that the ancestors will take care of the forests and

that “the forests will always recover from destruction should the ancestors intervene” (Cocks et al., 2012, p. 4).

Dannenberg, Hausman, Lawrence & Powell (2012), investigated the discourses American students used when they talked about behaviour that would sustain the environment. They found that students emphasised that knowledge about a sustainable environment was critical to being willing to practice sustainable behaviour. However, they found that knowledge did not ensure sustainable behaviour. For sustainable living to become a way of life, people needed to live sustainably without thinking about it. It should be effortless, not require planning or be inconvenient. Dannenberg et al. (2012) also found that the respondents experienced guilt when they know what environmental/sustainable action they should carry out but cannot because of constraints such as, it is too dangerous to walk or cycle so I’ll rather drive a car. They found that guilt led to environmental inaction because they did not know how to behave sustainably and ended up acting in the usual non-sustainable way. Biodiversity teaching should then not only concentrate on knowledge, but include problem solving, solution-seeking activities as well - as is prescribed in the CAPS for Natural Science Grade 7 where learners should be able to “make connections between ideas and concepts”, “solve problems” and realize that “science can be relevant to everyday life” (DOE, 2011, p. 10). Teachers may also have deep-rooted opinions about the teaching methods that they use, about the curriculum they have to teach and about the learners’ abilities and needs.

Baurain (2012) found the beliefs defined in teacher knowledge literature to be about technique, methodology, curriculum, learner motivation and moral beliefs. However, he feels that spiritual beliefs should be part of teacher knowledge.

Tarman (2012) has found that teacher beliefs have a powerful impact on their willingness to adopt new teaching strategies. According to Tarman (2012) there are many different but connected definitions of beliefs. Beliefs refer to personal convictions, philosophies or opinions about teaching and learning.

### **2.9.3 Conclusion**

In this section I have drawn on Kronlid & Öhman's framing of value-oriented and relation-oriented environmental ethics which offer a nuanced and pluralistic environmental framework rather than reinforce an anthropocentric versus non-anthropocentric binary. I have also looked at studies which shed light on how environmental ethics influence education. Now, in the final section of this chapter, I consider theoretical perspectives on what teachers believe and how and why they teach in the way that they do. This leads me to theories of teacher cognition.

### **2.10 Teacher Cognition**

Research in education over the last 20 years has generated a significant body of research from which it has emerged that teachers are active decision-makers who draw on their knowledge, beliefs, theories, assumptions and attitudes to decide on their teaching practice (Borg, 1999).

#### **2.10.1 Key features of teacher cognition and relevance to the study**

Simon Borg defines teacher cognition as “a set of personally-defined, practically-oriented understandings of teaching and learning which exerts a significant influence on instructional decisions” (Borg, 1999, p. 22). This definition allows for the Natural Science teachers in this study to define how they understand biodiversity, how they experience biodiversity teaching and how their understanding shapes their practice. Teacher cognition is a theory of education that is well-suited to guide the analysis of the data generated in this study and to provide a language of description.

This study into what teachers say, know and believe about biodiversity and the teaching of biodiversity is designed around some of the key features of teacher cognition, as will be outlined in this section. The study focuses on “teachers' self-reflections, beliefs and knowledge about teaching, their students, the content and an awareness of problem-solving strategies” (Kagan, 1990, as cited in Adams & Krockover, 1997, p. 365). The study also focuses on “the network of beliefs, knowledge and thoughts which teachers hold about all aspects of their profession and draw on in their work” (Sanchez & Borg, 2014).

### **2.10.2 Brief history of teacher cognition**

According to Freeman (1996) research into teacher cognition was preceded by process-product research. In the process-product approach, which falls within Behaviourism, the educational product or the outcome that was produced was important. However, the role of the teacher was not considered (Freeman, 1996). A paradigm shift occurred when the process-product model was challenged at a United States Conference in 1975. Here, teacher decision-making and thought processes were introduced as a new research aim and conceptual framework (Freeman, 1996).

Consequently, research into teacher cognition in the 1980s focused on teachers' thinking, in particular teachers' planning, teachers' interactive thoughts and decisions, and teachers' beliefs and theories (Borg, 2005). However, critiques of the decision-making approach highlighted that this perspective did not reflect the complete process of teaching and teacher cognition, but could rather account for only a part of the teacher's mental activity in the classroom. This led to a shift in emphasis as teacher knowledge began to replace teacher thinking as the dominant concept in teacher cognition (Borg, 2005).

According to Borg (2003, p. 81), teacher cognition is "the unobservable cognitive dimension of teaching". Key areas which may shape teacher cognition are:

- *Schooling experiences*, which shaped the teachers' knowledge and initial perceptions of learning processes. For example, a teacher is likely to teach about biodiversity in the way that s/he was taught about the topic at school. However, in the case of many South African teachers, biodiversity was not taught when they were at school and they therefore have limited models of past schooling experiences to draw on when planning their own teaching.
- *Professional course work*, which may affect existing conditions by introducing new knowledge, perspectives on a topic and so on. For example, were teachers adequately oriented and supported to teach biodiversity during their initial teacher qualification? Or have they had any professional development opportunities that would develop their teaching practice in relation to biodiversity (or any related environmental content)?

- *Classroom practice*, which influences teachers' cognition as they reflect on past practices and plan future practices. For example, teachers may draw on learners' prior knowledge or draw on teaching aids to help learning where prior knowledge is lacking.
- *Contextual factors*, which have an impact on classroom practice, may result in teachers having to adapt their practices, or continue to experience dissonance as a result of contextual factors (Borg, 2003). Classroom size, for example, may have an impact on how teachers plan and present their biodiversity lessons.

### **2.10.3 Knowledge as one of the main components of Teacher Cognition**

Theories of the nature and role of knowledge in the education field is changing and expanding. In this section I engage with perspectives on teachers' knowledge which pose questions around what informs teachers' knowledge, where teacher knowledge may be obtained, and how it may be supported. I also consider what knowledge may be required for the teaching of biodiversity.

As far back as 1986, Lee Shulman, an American educationist specialising in teacher education and cognitive psychology of instruction, argued that the knowledge base of education is growing, that knowledge is a vital part of teacher education, and that it should be available for teacher practice (Shulman, 1987). Shulman (1986) asks: "What are the important ideas and skills in this domain [of education]?" and, "How are new ideas added and deficient ones dropped by those who produce knowledge in this area [of education]?" Shulman elaborates further "...the teacher must have not only depth of understanding...but also a broad liberal education that serves as a framework for old learning and a facilitator of new understanding" (Shulman, 1987, p. 9). Shulman's concerns are pertinent to this study which looks at how biodiversity knowledge has been introduced to, and taken up and re-presented by, the teachers in these three case studies.

Shulman (1987) identifies four main sources for a teacher's knowledge base. They are:

- a. *Content Knowledge in subject disciplines*. This refers to the knowledge, understanding and skills that a teacher has. This content knowledge is derived from accumulated literature on the content as well as historical and philosophical background to the content knowledge and alternative theories about it.

- b. *Learning and teaching support materials and the education system.* This includes textbooks and school resources, curricula, the structure of the school and its governance, the teaching profession and its rules, teacher unions and finance. Significant organisations like the school governing body, the staff and the unions' perception of biodiversity may determine to what extent the teacher will receive support for biodiversity teaching, especially in terms of purchasing resources like projectors and internet data to access biodiversity information. Teachers commonly acquire biodiversity content knowledge from the prescribed textbooks, whilst others might use multimedia resources to gain greater content knowledge.
- c. *Social and cultural phenomena.* This includes any developmental, social (including research), or cultural phenomena that may impact on teaching, teachers and education. Teachers who have access to developmental programmes such as Fundisa for Change will be exposed to biodiversity knowledge and effective teaching methods. Teachers may also participate in citizen science projects and access data bases such as the ICUN Red List of Threatened Species. Teachers in the Port Elizabeth area may take learners on biodiversity tours to places such as Cape Recife, Baakens River and Sacramento.
- d. *Wisdom of the teaching practice.* This includes teachers' personal maxims that guide their practice. Learners will be influenced by how teachers dispose of their waste at school, how they manage water, what living things they bring into the classroom, how they respond to fauna and flora that they encounter and what they grow and maintain around the classroom and in the school grounds.

The above knowledge sources offer a framework to examine teachers' knowledge sources of biodiversity in this study.

Shulman, together with Wilson & Richert (1985), American educational researchers, focussed more specifically on subject content knowledge. They defined teachers' content knowledge as teachers' understanding of the concepts of a discipline as well as teachers' understanding of the structures of that discipline. They found that teachers should have knowledge, firstly, of the substantive structures, in other words the facts and concepts of a discipline as well as the relationship among those facts and concepts. Secondly, teachers should have knowledge of the

syntactic structure of that discipline. This means that teachers should have knowledge of research, and how the discipline creates and assesses new knowledge. Leinhardt & Smith (1985), as cited in Shulman, Wilson & Richert (1985), found that an important component of subject content knowledge was being able to present it to the learners. This means being able to explain the subject content knowledge in different ways, for example using analogies, illustrations, and examples to help the learners' understanding. Hashweh (1985), as cited in Shulman, Wilson & Richert (1985), also found that teachers who had more subject content knowledge made connections for their learners by using representations that linked a specific topic to other topics within the discipline. They were also able to notice their learners' misconceptions in the subject content knowledge and correct it. Teachers who had less subject content knowledge were less likely to make such links for their learners nor notice learners' misconceptions.

In their review of curriculum environmental learning at tertiary level, Schudel, Le Roux, Lotz-Sisitka, Loubser, O'Donoghue & Shallcross (2008) considered the interface of content knowledge of biodiversity and pedagogy within a changing socio-ecological context. They found that for environmental education to be effective, learners need to learn to apply environmental education knowledge to their personal lives and changing socio-ecological contexts in order to be prepared to act appropriately. They suggest that, "when applied to the development of environmental education courses, these ideas imply that there should be an open-endedness in course design where students are introduced to contextually informed propositional ideas and case studies which they use as foundations to explore their own contexts and appropriate responses through situated learning processes" (Schudel et al. 2008, p. 544). Situated learning simply means that people cooperate in real community settings and in so doing, construct knowledge. The relevance to this study is how biodiversity knowledge could be used so that learners explore their own socio-ecological contexts and formulate responses. Sanchez & Borg (2014, p. 52) speak of "teacher's constructed context" which is a context filtered through the teacher's cognition, causing each teacher to interpret and thus respond to his/her context in a different way. Teachers' constructed context will shape how teachers' view their learners, which teaching strategies they decide on and so on.

## 2.11 Textbooks

Richards (1998) found that there was an assumption within the educational establishment that textbooks which are based on theory and research findings are able to improve the quality of education. He found that there may be the assumption that teachers may not teach well. The textbook is therefore designed to provide the prescribed content and tasks to compensate for the inadequacies of teachers. Textbooks are good in the sense that they save teachers time developing their own materials. Hutchinson & Torres (1994) as cited in Richards (1998) found that textbooks helped learners to see the learning programme as a whole, enabling them to understand what and how much will be covered. Richards (1998) found that textbooks may also help inexperienced teachers to develop skills and guide their teaching. However, textbooks may lead to teachers not taking responsibility for decisions on what to teach and how to teach it. Richards (1998) warns against reification and deskilling. Reification means that textbooks are seen as excellent and as having authority. Reification may result in teachers not looking at textbooks critically. Deskilling means that teachers lose their skills through lack of use. Apple & Jungck (1990), American curriculum researchers, identified two processes which they borrowed from the labour process and applied to education. The first, “separation of conception from execution” (Apple & Jungck, 1990, p. 230) refers to when the teacher doing the work in the classroom has lost control over the planning of the teaching process. All the teacher is expected to do is execute what others have decided. They also found that teachers taught factual and low-level process knowledge where there was external control over subject content and evaluation. The second process is deskilling, where teachers, as they lose control over the teaching process, lose their skills such as pedagogical reasoning skills and developing activities and tasks for teachers. On the other hand, Studolsky (1989) as cited in Richards (1998) argues that teachers may exercise control over which textbooks they use and how they use them. They may choose particular textbooks for their topics or content, or for their tasks and exercises. Richards (1998) still argues that textbooks are not perfect and teachers should therefore consider adapting and building on materials in the textbooks particularly to suit their contexts. Richards (1998) argues that these activities form the core of teaching.

## 2.12 Conclusion

This chapter started with a discussion about biodiversity, defining it as all life on earth, including human, that is interrelated and under threat. Global and national responses to biodiversity loss, in particular policy frameworks and sustainable development agendas, were reviewed before turning to education as a response to biodiversity loss. In line with the study's focus, biodiversity in school curricula was discussed in some detail, ranging from broad international guidelines such as the Earth Charter and the United Nations Decade on Education for Sustainable Development, to the details of the South African National Curriculum Policy Statements. Insights from international and national experiences (such as those of the Fundisa for Change programme in South Africa) were reviewed, drawing attention to the importance of a holistic, systems approach to biodiversity teaching, the role of problem solving and discursive skills, and the importance of teachers' own knowledge, beliefs and values in relation to the teaching of biodiversity.

The chapter then examined the nature of biodiversity narratives as they occur within more general environmental discourses, and the ways in which they can influence teaching and learning processes. Teachers' beliefs and values were likewise explored using an environmental ethics framework that allows for the nuances and complexities of teachers' values to be explored and described.

Finally, the chapter introduced the theory of teacher cognition, focussing in particular on how teachers come to work with knowledge (in this case biodiversity knowledge).

Theories of teacher cognition are clearly wide-ranging and, for the scope and purposes of this study and its focus on what teachers think and say about biodiversity and the teaching of biodiversity, I have decided to focus on the following dimensions:

- Teachers' *knowledge about* biodiversity
- Teachers' *representations of* biodiversity
- Teachers' *beliefs about* biodiversity
- *Values* that teachers attribute to biodiversity and the teaching of biodiversity

- Teachers *decisions about and reflections on* the teaching of biodiversity

The influence of the theoretical work reviewed here becomes evident in the next chapter where I describe how I designed this case study research project, generated rich, qualitative data, and analysed it in order to understand what the three participating Natural Science teachers know, believe and say about biodiversity and the teaching of biodiversity.

## **CHAPTER 3      Methodology Research Design**

### **3.1 Introduction**

The purpose of the research was to explore what teachers say, know and believe about biodiversity and the teaching of biodiversity as this may inform teacher development programmes such as Fundisa for Change, and may contribute to the shaping of teacher support programmes in Environmental Education or the Natural Sciences. A case study with a qualitative, interpretive approach seemed best suited to my research questions.

In this chapter I present a discussion on the research design decisions and methodology used in this study in relation to the purpose of the research. I begin with an overview of the research orientation of the study before focussing on the case study design and the data generation methods I employed. The chapter also explains my role as researcher and my considerations of how research ethics and validity influenced the trustworthiness and research quality of the data generation and interpretation processes.

### **3.2 Research Methodology**

#### **3.2.1 Research Orientation**

Since my research interest was to discover what teachers know, believe and say about biodiversity I chose a qualitative interpretive perspective. Such a perspective understands reality to be constructed by the individual, and because reality is constructed, people can understand reality differently. Whatever happens or is uttered may have different meanings for each individual (Bassey, 1999; Thomas, 2011). Consequently, there are multiple realities. According to Bassey (1999), a British educational researcher, the purpose of interpretive research is to increase the body of knowledge by describing and interpreting human behaviour and phenomena.

A qualitative approach is appropriate for this study as it deals with the accounts that teachers give of their lives and experiences, of how they make sense of their knowledge and how their understandings influence their behaviour. These accounts form part of the teachers' reality which

I am trying to understand. This focus on meaning and understanding is essential to the interpretive approach (Maxwell, 1996).

Qualitative research allows me to identify unforeseen data and, in an iterative way, draw on theory to explain it. In this study, I try to understand the process whereby knowledge, specifically biodiversity knowledge, may have changed and how the teachers make sense of this. My interest is in developing a deeper understanding of the teachers' perspectives on biodiversity and in the meaning that teachers make of biodiversity.

A qualitative study allows for the study of a small number of people, and my study looks at the unique circumstances of three teachers. I look for rich, detailed information through observations and in-depth interviews of teachers in their natural teaching environment (Janse Van Rensburg, 2001). The three qualitative case studies are introduced in the following section.

### **3.2.2 The Case Study**

As a qualitative researcher, I will endeavour “to preserve the multiple realities, the different and even contradictory views of what is happening” as highlighted by Stake (1995), an American educationist. In qualitative inquiry, as a case study researcher, I will firstly search for the events that take place, and secondly, try to understand the intricate interrelationships between the events (Stake, 1995).

A case study is not a method, according to Bassey (1999). Yin (1993), on the other hand, argues that the case study is a research method because it covers the methods for empirical research, namely, design, collecting data, analysing the data and reporting the findings. Case study research focuses on one thing – the case, which Yin (1993) refers to as the unit of analysis. The case is “a specific, complex, functioning thing” (Stake, 1995, p. 2), an empirical inquiry into an activity in its natural context, which tries to “... elicit what different actors seem to be doing and think is happening” (Bassey, 1999, p. 44). A case study is “the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances” (Stake, 1995, p. xi).

The case study design allows my research to focus on the “complexities” and “subtleties” of the three cases and the “embeddedness” of conflicts and differences within it (Bassey, 1999, p. 23). The case study helps me to represent the events in such a way that others may come to understand the event, for example, in the form of a story (Stake, 1995, p. 40). According to Thomas, a British educationist, the “primary purpose of the case study is to generate in-depth understanding” (Thomas, 2011, p. 10) and helps me to understand what teachers know, believe and say about biodiversity and to see it “in its completeness” (Thomas, 2011, p. 23).

My role as case study researcher has been to observe, and then describe what happens in the case, to look for causal relationships and to report what I have seen (Yin, 1993). In addition, my role has been to ask in-depth questions and to analyse rigorously and systematically (Bassey, 1999). I have also tried to be empathetic, and to see how the teachers see things; when I have interpreted the events, I have tried to preserve the multiple realities of the case (Stake, 1995).

### **3.3 Data Generation Process**

According to Thomas (2011), before I can begin to generate data, I need to be clear on my subject, my purpose, my approach and my process. I have already outlined my approach in Section 3.2.1. My subject is three Natural Science teachers and how they understand and experience biodiversity.

This is a descriptive case study according to Yin (1993), and a theoretical inquiry according to Bassey (1999). It is also an intrinsic study, and not instrumental. It is intrinsic because I want to learn about this specific case (Stake, 1995). It is not instrumental because an instrumental case study is about something else, something other than understanding the case. A descriptive case study does not explain cause/effect relationships but uses theory to cover the scope and depth of the case. Yin (1993) notes that this theory should be made clear at the start of the research process, as I have done in Chapter 2, but should, however, be dynamic and subject to change (Yin, 1993). The process through which data was generated within the three case studies is outlined in the following section.

### **3.3.1 Sample and Site**

Sample, in case study, is not a small portion of the whole. Rather, it is a selection of one thing that I want to look at without the expectation of generalising it to a larger group, community or population (Thomas, 2011). Drawing on Yin (1993) and Stake (1995), I selected my three cases according to whether they could provide data with which I needed to answer my research questions, and were feasible in terms of access and proximity whilst achieving balance and variety (Yin, 1993; Stake, 1995). I preferred teachers from both Xhosa and English/Afrikaans medium schools that are fully dependent on the Department of Education for all their resources. Their learners also come from previously disadvantaged backgrounds and still experience socio-economic challenges. The three cases are three single cases, that is, in each case my focus was on the relationship of that particular teacher to biodiversity. This is therefore not a comparative study (Thomas, 2011).

Three Grade 7 Natural Science teachers (one male and two females) took part in the study. They are all based at no-fee schools in Port Elizabeth and were taught the CAPS for the first time in 2014. The respondents consisted of teachers. Two of the schools were situated in the Xhosa-speaking community of Port Elizabeth. One school was situated in the Afrikaans-speaking community in the northern area of Port Elizabeth.

### **3.3.2 Data Generation Methods**

In this section, I describe and justify my choice of three qualitative data generation methods used in this study: document analysis, observations and semi-structured interviews. Analysis of the CAPS Natural Science Grade 7 policy documents and relevant sections from the Natural Science textbooks used by the teachers established an important backdrop to each case study. Contact with each teacher included one classroom observation, one in-depth interview, and a second short, follow-up interview. I also interviewed an official from the Department of Basic Education who is responsible for Natural Science in the Port Elizabeth District.

**Table 3.1 Generation of Data**

Index Code	Explanation	Appendix
LO1	Classroom lesson observation with case number 1	M
LO 2	Classroom lesson observation with case number 2	R
LO 3	Classroom observation with case number 3	S
HIL	In-depth interview with case number 1	L
JIM	In-depth interview with case number 2	P
EIP	In-depth interview with case number 3	O
PIR	Pilot interview	
DOEI	Interview with Department of Education	T
	Curriculum and Assessment Policy Statements Natural Science Grade 7	
	Textbooks used by Case Study 1 (Lance)  F. Baxter, H. Collett & E. Snyman. (2013). <i>Oxford Suksesvolle Natuurwetenskappe Leerder's Boek Graad 7</i> . Oxford University Press, South Africa, Cape Town.  F. Baxter, H. Collett & E. Snyman. (2012). <i>Oxford Suksesvolle Natuurwetenskappe Graad 7 Onderwysgids</i> . Oxford University Press.	N
	Textbooks used by Case Study 2 (Pam)  J. De Beer, D. Gibbon, R. Jones, T. Kuneni, J. Patrick, J. Sampson, B. Subramani, E. Whitlock. (2013). <i>Via Afrika Natural Sciences Learner Book Grade 7</i> . Via Afrika Publishers, Cape Town. (Doc 3)  J. Avis, M. Bester, M. Bezuidenhout, A. Clacherty, S. Cohen, J. Cowan, S. Doubell, J. Erasmus, A. Joannides, G. Lombard, E. Nkosi, R. Sadie, L. Schreuder.(2013). <i>Platinum Natural Sciences Learner's Book Grade 7</i> . Maskew Miller Longman, Cape Town. (Doc 4)  J. Avis, M.Bezuidenhout, A. Clacherty, S. Cohen, S. Doubell, J. Erasmus, G. Lombard, E. Nkosi, R. Sadie, L. Schreuder. (2013). <i>Platinum Natural Sciences Grade 7 Teachers' Guide</i> . Maskew Miller Longman, Cape Town. (Doc 5)	S
Doc 4	Textbook used by Case study 3 (Mandy)	S
Doc 6	J. Avis, M. Bester, M. Bezuidenhout, A. Clacherty, S. Cohen, J. Cowan, S. Doubell, J. Erasmus, A. Joannides, G. Lombard, E. Nkosi, R. Sadie, L.	

	Schreuder.(2013). <i>Platinum Natural Sciences Learner’s Book Grade 7</i> . Maskew Miller Longman, Cape Town. (Doc 4)	
	R. Brooksbank, J. De Fontaine, L. Marchant, R. Marriot, C. Mayers, C. McLaren, H. Skinner. (2013). <i>Solutions for All Natural Sciences</i> . Macmillan, South Africa. (Doc 6)	
Doc 7	F. Baxter, H. Collett & E. Snyman. (2013). <i>Oxford Successful Natural Sciences Learner’s Book Grade 7</i> . Oxford University Press, South Africa, Cape Town. (Doc 7)	

### 3.3.2.1 Document analysis

The documents that I examined in this study are extracts, relevant to biodiversity, from the Natural Science textbooks used by each teacher, and extracts from the CAPS Natural Science policy document (see Appendix C: Analysis of Knowledge: Textbook – Pam [This was done for each teacher]). The combination of CAPS and the textbooks are potentially significant sources of data in this study because they guide and support what teachers know and say about biodiversity. The CAPS Natural Science policy document is relevant because it guides teachers with regard to the minimum that they are required to know about biodiversity in order to mediate it in their lessons. Textbooks support teachers’ content knowledge since they cover various aspects of biodiversity in different ways. This may allow teachers a certain amount of choice on which aspects they want to foreground in their biodiversity lessons. Textbooks may also be values-laden and thus may influence teachers’ perspectives on biodiversity.

Documents are “social facts” (Atkinson & Coffrey, 2011, p. 79, as cited in Silverman, 2011) or social constructs, which means that they are produced, shared and used in socially organised ways. I contextualised the study of the abovementioned documents by considering each in terms of how it influences the teaching-learning interactions, the knowledge it represents and when and how it should be taught (Prior, 2011). Appendix C illustrates how I reviewed and analysed the textbooks. I analysed the textbooks for each teacher guided by concepts and perspectives from the theoretical framework outlined in Chapter 2. I considered what biodiversity knowledge is evident in the textbook, how biodiversity may be presented, whether any values about biodiversity are implicit in the text and how the textbook writers may be encouraging the teaching of biodiversity.

Documents are seen as entities of data which are collected and analysed and interpreted in the same way as interview and observational data (Henning, 2004; Stake, 1995). Hodder (as cited in Flick, 2014) sees documents as ‘material culture’, while May (2001, as cited in Flick, 2014, p. 176) holds that documents “are sedimentations of social practices and have the potential to inform and structure the decisions which people make”.

### **3.3.2.2 Observation**

Observation is about observing actions and behaviours as they are carried out in concrete, real settings (Gobo, 2011) and is important because it fills the gaps left by interviews (Henning, 2004). Flick (2014) states that all the researcher’s senses are integrated during observation. A criticism of this method is that it can be subjective, in other words, if different researchers observed the same setting they might see different things. One way to prevent this is by having a clearly defined observation tool which should guide the researcher to collect the data as set out in the design (Gobo, 2011). Observation of the teacher’s direct experience with a biodiversity lesson is a valuable method because it captures the teacher’s experience rather than a report of their experience. My observation of the teachers’ lessons on biodiversity was improved in two of the three cases through a discussion with the teacher about the accuracy of the recorded observation and my interpretation of it (Hammond & Wellington, 2013).

I arranged with each teacher to observe a biodiversity lesson during the first term of 2014. The lesson was conducted during the Natural Science period as allocated on the timetable so that the study did not disrupt the school programme. I used a digital audio-recorder to record the lessons.

As a non-participant observer, I observed the teachers in their social setting, their classrooms, and recorded the contexts in which they teach. Figures 3.1 and 3.2 were taken during the lesson observations and capture some of the activities and classroom interactions that I was able to observe by being physically present and attentive during those lessons.



**Figure 3.1 Learners looking for examples of plants or animals**



**Figure 3.2 Learners classify pictures into plants and animals**

I kept a detailed record of events (Stake, 1995) in the form of transcripts of the audio-recordings (See Appendix D for a transcript of a lesson observation). The observations allowed me to identify classroom dynamics and processes that an interview could not have revealed.

A risk to the quality and validity of my observations were my expectations and preconceived ideas about the research (Silverman, 2013; Greenhalgh & Taylor, 1997). To minimise this influence, I audio-recorded and transcribed what the teachers said about biodiversity during their lessons so that I could review the data several times. As will be discussed in Section 3.4.2, my subsequent analysis was guided by concepts and perspectives from the theoretical framework outlined in Chapter 2. The observation schedule guided me to look for aspects such as teachers' knowledge, representations and beliefs about biodiversity, the values they hold about, and their decisions and reflections on, the teaching of biodiversity. In addition, I was open to listening to anything that would assist me to understand what the teachers know, say and feel about biodiversity.

### **3.3.2.3 In-depth, semi-structured interviews**

Information about the social world of teachers and knowledge of the social world beyond the interviewer-teacher relationship is achievable through in-depth interviewing (Miller & Glassner, 2011). Following the observations, I conducted in-depth, semi-structured interviews which involved “conducting intensive individual interviews with a small number of respondents to explore their perspectives” (Boyce & Neale, 2006, p. 3). In-depth interviews allowed me to “obtain material that has depth and detail and is nuanced and rich with vivid thematic material” (Rubin & Rubin, 2012, p.101) with the three participating teachers.

The quality of in-depth interviews may be influenced by the quality of social interactions between the interviewees and the researcher. For example, there may be social misunderstandings or distance, interviewees might not trust the researcher, or may not understand the questions asked during the interview. One teacher is from an English-Afrikaans speaking community while two of the teachers are from a Xhosa-English speaking community. In retrospect, I realise that I should have piloted the interview schedule with a teacher from a Xhosa-English speaking background. This would have altered the one question, about the abalone, with which one cultural group was not familiar. However, after clarifying what abalone was, the participating teachers could respond.

A strength of conducting in-depth interviews is their ability to encourage self-reflexivity in the respondents. According to Stake (1995, p. 64), “the interview is the main road to multiple

realities”. The teachers may reveal “feelings, beliefs and private doubts” and the researcher may “discover the anxiety, ambivalence and uncertainty that lie behind the respondent’s conformity” (Kleinman *et al.*, 1994 in Miller & Glassner, 2011, p. 137). Interviews also help to identify the teachers’ culturally embedded explanations of events and their behaviour in relation to environment and biodiversity. These explanations represent the way teachers view themselves, the learners and their social world (Miller & Glassner, 2011). Interviews may also provide insight into and evidence of the research topic, its context and the teachers’ cultural frames or perspectives that they use to make sense of their experiences of biodiversity (Miller & Glassner, 2011).

The in-depth semi-structured interviews were guided by an interview schedule comprising open-ended questions based on the research question and related concepts. The interview included four photo stimuli that illustrated biodiversity loss (see Appendix E). I selected pictures so that the teachers could respond to the same context. The semi-structured format enabled me to probe the teachers’ answers with follow-up questions that led to more depth, detail and illustration (Flick, 2014). I conducted the interviews after observing the teachers’ lessons. The material that I had obtained during the observation guided me as to which concepts and aspects of my research question to focus on during the interviews. The audio-recorded interview sessions were between 40 and 48 minutes long. A limitation of the in-depth interview is that it was time-consuming to conduct the interviews and transcribe them before analysis. The audio recordings as well as the transcripts were clearly labelled and safely and securely stored in both hard and soft copy. One of the transcripts is included under Appendix D.

I piloted the interview instrument with a Natural Science teacher before I interviewed the teachers in this study. I needed to determine if the questions were clear and unambiguous, if any questions could be combined, etc. I also needed to make sure that the interview questions generated the data that will answer the research questions so that the research goals are met (Maxwell, 1996). The interviews were conducted during the second term. I conducted an in-depth interview individually with each teacher (See Appendix E for a copy of the Interview Instrument). The first interview was conducted in a home. The second interview was conducted after school, at the school of the second teacher. The third teacher was interviewed at her school during an administration period. Each interview was digitally recorded.

The interviews with the teachers raised questions with regard to the Natural Science curriculum and this necessitated an interview with the Curriculum Unit of the Port Elizabeth District. This interview was conducted in the third term. The purpose of the interview with the Senior Education Specialist (SES) for Natural Science was to determine how the Department of Education supported teachers in the teaching of Biodiversity, and how it had trained teachers in CAPS implementation (See Appendix F for the Interview schedule). This data gave me additional insights into why teachers were teaching Biodiversity in the way that they were.

### **3.4 Data Management and Analysis**

#### **3.4.1 Data Management**

My data was generated, as already mentioned, through classroom observations, in-depth interviews and documents. I stored the data in hardcopy form in a box, and digitally on my computer and on a flash stick as back-up. I labelled each piece of data for reference purposes and to maintain an audit trail.

#### **3.4.2 Data Analysis: process and tools**

According to Rapley (2011, as cited in Silverman, 2011) data analysis is the laborious work that begins when we try to examine and explain what is “underlying” in our data and to extract the essence, the meanings, themes and patterns from it. Data analysis required a detailed reading of the data and the reviewing and refining of my categories. The data sources were the textual materials which in this study were interview transcripts, classroom observation transcripts, and the textbooks that the teachers used. As an interpretive researcher, I tried to make sense of the data by reflecting the different viewpoints or experiences of the teachers’ lived experiences of biodiversity, in order to understand its nuances (Schwartz-Shea & Yanow, 2012).

Document analysis concentrates on the relationship between the documents and how they are used by the teacher (Prior, 2011). It is recommended that the document content be screened and coded for representations, images and accounts in terms of the research categories. Document analysis methods focus beyond what is in the document text, for example, how was the document produced, who produced it, what is the social organisation around the document (Prior, 2011). The documents

that I analysed are the textbooks that the teachers used. The documents were coded and analysed using the same categories to code the data as for the interviews.

The categories I used in this case study are drawn from the dimensions of teacher cognition, environmental discourses and environmental ethics (as discussed in Chapter 2), which act as lenses to look at, describe and analyse the teachers' narratives. These are:

**Table 3.2 Categories and Sub-categories used for coding**

Analytical Categories	Sub-categories
Teachers' knowledge about biodiversity	
Teachers' representations of biodiversity	<ul style="list-style-type: none"> <li>• Biodiversity narratives</li> <li>• Metaphors</li> <li>• People-nature relationships</li> </ul>
Teachers' beliefs about, and values that teachers' attribute to, biodiversity and the teaching of biodiversity	
Teachers' decisions/reflections of biodiversity, what made teachers choose to teach biodiversity in that way	<ul style="list-style-type: none"> <li>• Teachers' classroom practice</li> <li>• Contextual factors</li> </ul>
The ways in which CAPS and textbooks influence teachers' decisions on how to teach biodiversity	

The data that I used came from the three interview transcripts, as well as two much shorter interview transcripts, the three transcripts of the lesson observations, and six textbooks that were used by the three teachers. I analysed each set of data individually according to the categories listed above in Table 3.2. These provided useful categories for the coding of the data. I developed a set of analytical tools which helped me to extract data into the various categories. Firstly, I coded for the categories of teachers' knowledge about biodiversity as is illustrated in Appendix G. Then for teachers' representations of biodiversity as is illustrated in Appendix H, as well as the values and beliefs teachers' attributed to biodiversity as is illustrated in Appendix I.

I continued to code for teachers' knowledge of biodiversity (Shulman, 1986, 1987; Kaiser & Fuhrer, 2003), teachers' biodiversity narratives and metaphors (Dryzek, 2005), teachers' values and ethics about biodiversity (Kronlid & Öhman, 2012), teachers' accounts of why they choose to

teach biodiversity in the way that they do (Shulman, 1986, 1987, Woods, 1996) and how the textbooks and CAPS influence teachers in the way that they teach (Shulman, 1987).

**Table 3.3 Categories for Data Coding**

Number	Categories for coding	Sub-categories
1.	Teachers' knowledge of biodiversity	<ul style="list-style-type: none"> <li>• Biosphere (litho-, hydro- and atmosphere)</li> <li>• Biodiversity (classification, diversity, variation of plant and animal life)</li> </ul>
2.	Representations of biodiversity	<ul style="list-style-type: none"> <li>• Biodiversity narratives</li> <li>• Biodiversity metaphors</li> <li>• People-nature relationships               <ul style="list-style-type: none"> <li>- moral object</li> <li>- Intrinsic / instrumental value</li> <li>- Anthropocentric / non-anthropocentric</li> </ul> </li> </ul>
3.	Beliefs and values	Beliefs and values
4.	Teachers' decisions / reflections on the teaching of biodiversity, what made teacher choose to teach biodiversity in this way.	<ul style="list-style-type: none"> <li>• Teachers' classroom practice (past, present and how it influences future ideas)</li> <li>• Contextual factors in classroom (constraining factors / challenges)</li> </ul>
5.	In what ways do CAPS and the textbook influence teachers' decisions on how to teach biodiversity.	

I worked systematically, analysing each category separately and completely before I moved to the next category. Firstly, I coded the data according to analytical categories derived from the literature noted above. Colour coding helped me to link the raw data to these theoretical categories and has allowed me to reduce the data into analytical memos that are focused on my research question. This process was followed for each category. This process allowed me to re-organise the data and think creatively about it in terms of the theoretical concepts and frameworks (Coffey & Atkinson, (1996). In addition to this, the rigorous and systematic data analysis process that coding demands allowed me to complete an auditable analytical process. This means that the processes I followed will be accessible to a critical reader. This rigorous and systematic process contributes to the reliability and trustworthiness of my data analysis (Thorne, 2000). The final stage of my data

analysis allowed me to write up a case study for each participant teacher based on the analytic memos which form the basis of chapter 4. I used direct quotations from the data to describe the categories and themes which emerge so that the analytical process can be rooted in the data (Richie, Spencer & O’Conner, 2003). As the analytic categories are drawn from the conceptual framework described in Chapter 2 and the research questions, I was able to answer my research questions through the findings that emerged from the analytic memo and the case studies. These findings are captured in Chapter 5.

### **3.5 Trustworthiness and Validity**

According to Bassey (1999), validity is the extent to which a research finding is what it is claimed to be. Validity requires identifying threats to the rigorous and trustworthy representation of the data, such as researcher bias and reactivity. Maxwell (2005) cautions that, as the researcher, I should be aware of my assumptions and values as well as my influence on the teachers so that I may be aware of how these affect the study and its conclusions. Staying focussed on the analytical categories and discussing the data in a theoretically-informed way, helped to minimise bias in this study. Furthermore, the consistency of the evidence contained in the different data sources as built into the research design, promotes validity of the findings (Schwartz-Shea & Yanow, 2012). This means that the evidence obtained through the observations, the interview and the documents is consistent.

Trustworthiness and respect for truth are important in case study research (Bassey, 1999). I have used the classroom observation, the in-depth interviews as well as documents to triangulate the findings. According to Yin (1993), using three data collection methods rather than one method only to collect data on the same unit of analysis would leave the researcher more confident of the findings. The same questions should be asked of the respondents, and the same theoretical categories should be applied to the different sources of data. Should the researcher get the same, or similar results, one can be confident that the data has been successfully triangulated (Yin, 1993, p. 69). In this study, I have also used respondent validation. I requested the teachers to read the transcribed audio-taped recordings of their lessons and interview transcripts as well as their stories, to minimise researcher misinterpretation (Maxwell, 2005).

### **3.6 Research Ethics**

The research relationship should be built on trust, empathy for the teachers' challenges and open communication (Riley & Hawe, 2005); as researcher, I needed to show respect for the experiences of the participants of this study. In this section, I outline measures that I took to ensure that the research was conducted in as ethical a way as possible.

During the stage of negotiating access to the research participants and research sites, I was granted access to the teachers' classrooms by the Eastern Cape Department of Basic Education (Appendix J), gained permission from the principals of the schools concerned (Appendix K), as well as approval to proceed with the research from my principal. I also obtained informed consent from the research participants. Each participant teacher received a written copy of a Permission and Consent to Participate form which we read together. In it the participant teachers were informed that their participation is voluntary, that they need to understand and be informed of the purpose of the research and that they have the right to withdraw at any time. They also have the right to remain anonymous. They were informed that their information remains confidential and will only be shared with my immediate supervisor and the research team. Each participant teacher signed this copy after we had read it and all questions were clarified. (See Appendix L for a copy of the consent form).

During the data generation stage of the study, I stored the data securely. I assured the participant teachers that their information will only be shared with the research team. Besides ensuring confidentiality, I created what Bassey (1999) calls an audit trail. The transcripts of recorded data as well as the case studies were shown to participants so that they could check if I had interpreted their data correctly, and if they may have additions or changes. I have kept a project archive of all information and so maintained an audit trail.

I am responsible for integrity in the production of knowledge by offering anonymity to the teachers and confidentiality. The teachers have used pseudonyms. I have shown respect for the teachers' experiences at all times (O'Leary, 2004; Clandinin & Huber, 2014). There is only one Senior Education Specialist (SES) for Natural Science in the Intermediate and Senior Phase (INTERSEN) for the 318 schools in Port Elizabeth. It would make no sense to grant the SES anonymity as he will be recognised by his senior position (Bassey, 1999).

### **3.7 Conclusion**

In this chapter, I have discussed the study's design and data generation tools and explained why they were suitable in this study. I also described how data was managed and analysed. I have also provided a brief discussion on how issues of trustworthiness and ethics have been dealt with. In the following chapter, I present the data that was generated through this process.

## **CHAPTER 4**

### **4.1 Introduction**

In this chapter I describe the data of the three participating teachers as three separate case studies. I obtained my data through one lesson observation, followed by one long and a second shorter interview per teacher. I also referred to extracts from the teachers' textbooks as a data source. I was granted an interview by the Senior Education Specialist for Natural Sciences in the Port Elizabeth area. He is responsible for the Natural Science subject in Grades Four to Nine in the 316 primary and high schools in Port Elizabeth.

### **4.2 Case Study 1: Lance at Seaview Primary School**

#### **4.2.1 Lance, the Grade 7 Natural Science teacher**

Lance grew up in the Northern Areas of Port Elizabeth. This is still a predominantly 'Coloured' community that was created under the Group Areas Act of the 1950s when the 'Coloured' community of South End and Fairview were forcibly removed to the newly created Northern Areas. Lance attended a local high school and completed a Bachelor of Commerce Education Degree at the then Vista University (Port Elizabeth) campus. He started teaching at a high school in Butterworth in 1997 where he taught Accounting, Economics and Business Economics. He was successful in obtaining a post at an East London school where he taught English, Economic Management Sciences and Social Sciences. During this time, Lance completed his Bachelor of Education Honours degree, specialising in Education Management part-time at the University of Fort Hare. At the time of this study, Lance had been teaching for 17 years. He took up the post at Seaview Primary in 2012 and has been teaching there for two years. He is now 40 years old. At Seaview Primary he taught Natural Science for the first time in his career although he is qualified to teach Commerce and not Natural Science. Lance was required to take on the responsibility of teaching Grades 6 and 7 Natural Science due to the shortage of science educators at the school and in the province generally. This trend was confirmed by the Senior Education Specialist for Natural Sciences, who in an interview (see Appendix M) expressed his concern that about 30% of the

Natural Science teachers in the Port Elizabeth area are new to the subject (DOEI, 14/ 415,416). At Seaview Primary, Lance is also responsible for soccer coaching and matches.

#### **4.2.2 Overview of Seaview Primary School**

The suburb of Seaview (not the real name) in which the school is situated is nestled between large residential suburbs, double-storied, ownership homes with lawns and trees in most yards. Yet Seaview is comprised of tiny two-roomed homes. The houses have been designed so that one block is split into 4 homes with two rooms each: a bedroom and a kitchen. The community is overcrowded, with several relatives living in one two-roomed house. The community is plagued by gangsterism which the youth perceive as a source of money.

The biodiversity that the learners are exposed to in the Seaview area is very limited. Every available piece of land has been built on. The only vacant land is areas in front of homes and pathways between homes. These areas were strewn with stones and litter. For the past three years, the local government has been upgrading the community infrastructure. It has tarred the main roads, laid lawns between homes and the pavements, and planted trees along the roads. The population of 30 000 people proves too much for the sewerage system which fails regularly, resulting in seepages into the street.

Above Seaview, sprawling up the mountainside, an informal settlement has developed. Homes are structures constructed from of metal sheets and wood. Large areas that once boasted natural vegetation have been cleared to make way for these homes, leaving the soil exposed, scattered with stones and no trees. Learners have been exposed to all sorts of violence and are in grave danger in this community. Learners have been physically assaulted, have seen their parents murdered, many have been raped, emotionally neglected, abandoned, and murdered. Most teenage girls have babies. Unemployment is high and most rely on the government social grant, disability grants, old age pension and orphan grants to survive.<sup>1</sup>

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<sup>1</sup> South African families whose combined income is less than R3 000 a month are eligible for a child grant of R320.00 a month for each child under the age of 14; disabled people get a grant of R1 350 per month; pensioners (men and women who are 60 years or older) get a grant of R1350 per month; children who had been left orphaned through HIV/AIDS get a grant of R740 a month.

Seaview Primary is an Afrikaans-medium primary school situated in the notorious ganglands of the Northern Areas of Port Elizabeth. The school is 51 years old, with an enrolment of 1 200 learners and a fluctuating staff of between 30 and 35, depending on whether the School Governing Body is able to pay for teachers. The previously stable staff is slowly changing as staff members leave due to retirement and ill-health. At the time of this study, two teachers were on indefinite incapacity leave, one teacher was boarded due to ill health, one had retired and one had resigned from teaching. These posts have yet to be filled by the Department of Basic Education. The School Governing Body (SGB) pays substitute teachers a small stipend to teach the full allocation of these vacant posts.

The school is fenced, with two police reservists manning the gate daily from 8am to 3pm. This is to protect learners and teachers from crime and gangsters. All classrooms have security gates which teachers may keep locked during tuition time. All the windows have burglar proofing. Burglars still gain entry though, by forcing small children between the window and the burglar proofing. The entire school building is monitored by a security company. Due to excellent management over the 50 years of the existence of the school, the infrastructure is in a good condition. However, the school fence has been stolen intermittently, and there are frequent burglaries. Teacher absenteeism due to illness is prevalent and, as a temporary measure, parents are paid a small stipend to supervise classes where there are no teachers. The school has an active SGB that assists with discipline. The ACVV [Assosiasie van Christelike Vroue Vereenigings], the Association of Christian Women Unions, a non-governmental organisation, deploys a social worker at the school on a weekly basis which helps greatly with the extreme cases of social need that teachers are unable to deal with.

Due to an increased budget from the Department of Basic Education, many more resources were purchased to aid teaching and learning. Additionally, through the national School Nutrition Programme, learners receive a cooked meal once a day, and although absolutely necessary for learners' nutrition, it does affect the time allocated for tuition. The school offers mainstream sport such as soccer, rugby, cricket, hockey, netball, chess and athletics as an extra-mural activity.

### **4.2.3 Lance's perspectives on biodiversity**

#### **4.2.3.1 Early influences**

In an interview with Lance, I asked him to reflect on his experiences of biodiversity and any other things that may have influenced the way he understands the topic and approaches teaching it (see Interview transcript HIL in Appendix N). Lance explained that, as a child, he went camping at Hogan Park, a seaside resort, with his family. This was at a time when it was still open to the public to swim to Bird Island. They also camped at Willows and at Joorst Park, both seaside resorts. Joorst Park has been closed down as a result of the development of the Port of Coega. Lance visited the circus twice as a child and, with his family, visited the Cango Caves in Oudtshoorn and a crocodile farm in the Southern Cape. While teaching in New Zealand for three months, Lance also visited the zoo in Auckland.

Lance is of the opinion that the teachers who taught him Biology at school did a good job. They used textbooks a lot. They used many pictures and there was a lot of teacher-talk. His science teachers used the investigative method of teaching and the learners would investigate topics and draw conclusions. They also used lots of equipment like microscopes. He feels limited at his present school because the school does not have microscopes (HIL 8/225-236).

#### **4.2.3.2 Lance's current understandings of and attitudes towards biodiversity**

Lance believes that science is the most important subject because "science refers to your body. Without your body there is no life. And also the oxygen you breathe in is science. So without oxygen and without your body, there is no you" (HIL 8/244-254). He also believes that learners must be exposed to many examples to get them interested in science (HIL 8/241,242).

Lance explained his understanding of biodiversity as "life in general, that's now really where you touch on all the different forms of life on the planet" (HIL, 2/48, 49). Lance believes that he has been socialised to have respect for animals and for life in general through his teachers, his parents, his church and Animal Planet, a DSTV channel (HIL, 14/434-441). For Lance, biodiversity has inherent worth (Kronlid & Öhman, 2012) (HIL 4/101-104) as well as systemic or emergent value "because the tortoise and the leopard [the large prominent and the small insignificant] I would like

to see both of them on the Earth forever if that is possible, because we need both of them, they both play a role in the food cycle” (HIL 4/118-121). Biodiversity also has need value for Lance, because it meets humans’ needs: “It’s difficult, like I said, it’s heart sore to see it [referring to the picture of the forest cleared for agriculture] but I understand from my economic history...people’s needs have to be satisfied and needs, food, is a basic need. We all must eat. So it’s just the balance. Some of the area can be cleared for agriculture, we understand that, but not all of it. Most of it needs to be nurtured and kept in its natural form, because like I say, it will affect the animal life and the plant life (HIL 3/94-99).

For Lance, the present and future generations are constituted as Moral Objects: “We know the people are killing [the rhino] and selling their horns so we would like to see more of them [rhino] in our part of the big five, in our zoos and for our future generation” (HIL, 12/381-382) as well as “we must preserve [wild animals or animals] because if one of the species should become extinct our future generation will not be able to enjoy them or see them (HIL,13/406-409). In his view, humans and biodiversity share geographical space when he speaks of algae at the Port Elizabeth beachfront area (LLO/98-100), “fungi...breadmould” (LLO/104-109) and “bacteria in the air...enters your body...a virus as well...enters your body through your nose and grows in your body” (LLO/147-153).

Lance believes that “Humans usually pollute [wetlands]. If there are no humans then normally we’ll have a natural water source there, for animals and for humans and insects; all types of life will benefit but usually the humans pollute”. He holds an anthropocentric view because he implies that nature is important to humans only in so far as it is good for humans.

Lance believes that there should be an effective administration that acknowledges the suffering of both humans and non-humans “It will help a lot ...where government come in to say this area is reserved for this...because politicians make these hard choices or decisions and not us teachers” (HIL 5/147-150). He wants environmental justice when he says the law makers should decide what is legal and illegal with regard to perlemoen (HIL 12/377-379) and, “If government should ban the killing of animals it means we will have more animals you know biodiversity would be richer” (HIL, 13/390-392). It seems as though Lance leans strongly to a political space where government institutions should make decisions “that would then help a lot...actually where your spheres of

government will come in, your local government with your national government...” (HIL, 5/147-150).

Lance’s discourse reveals that nature is threatened by humans “Humans pollute...if humans could stay away from the wetlands if possible” (HIL 5/145). He is concerned with “where are we going to place those animals, insects, plants” as human domination eats away at natural vegetation (HIL 4/103-104). However, he remains optimistic about exploration that still lies ahead for Earth as “the Earth is still busy proving itself...each day [scientists] discover new species and they are just becoming more and more as time goes by”(LLO/35-37). His positive view of the environment is further illustrated by his description of biodiversity as “bright, life and continuity” (HIL 2/52) and “biodiversity is like jelly tots [multi-coloured sweets], different colours, different flavours, it’s just like species of animals” (HIL 2/98-101). He believes, though, that our environment requires an effective administration: “Government ...to say this area is reserved for this or for that” (HIL 5/147-150).

#### **4.2.3.3 Lance’s engagement with biodiversity through CAPS**

Lance does not always have a lesson plan. He feels it is more important to teach and cover the work to the best of his ability (HIL 16/485,486). He reports feeling confused when “our EDO (Education Development Officer, who oversees a subject) told us we mustn’t worry about lesson plans...but our deputy told us...we must have lesson plans” (HIL 15/481-483).

Lance explained that he started the lesson by showing the learners “different types of pictures...the sea world...birds...animals in the air...animals in the water...to show them the different species we have of those” (HIL 5/155-163) because his learners relate very well to what they see (HIL 6/168-173). He believes that it would be difficult to teach biodiversity and for the learners to understand the concept without the pictures (HIL 6/184-190). From the pictures he actually builds the new knowledge.

Lance feels that the two days training that he had received the previous year (2013) to prepare him to teach the CAPS curriculum was not enough (HIL 9/273-275). He says they were advised by the Department of Basic Education to stick to the curriculum and also to teach as much as they can:

They told us we got five years to implement CAPS. I don't know how long we will... they will stay with CAPS. The one EDO told us we don't need actually to prepare the lessons... So they want to make it easier for you. He told us there...always remember, he said, you must just go and teach. (HIL 14, 15/448-456)

Lance says that before he teaches, he consults the CAPS document to see what CAPS requires and then he looks at the textbook to see what it has about that specific topic (HIL, 15/473-475). The school does not have enough resources and this affects his teaching because he feels limited in what he can do (HIL, 9/285-289). This concern of Lance is also a concern of the Senior Education Specialist for Natural Science who said: "If we want 100% CAPS implementation we mustn't shy away from this...teachers need to get these resources [pointing to the 4th column: Equipment and resources]" (DOE, 25/761), and later "... that is sorely lacking from the Department" (DOE, 25/755-757). He suggested that "these resources should be coming from the people that devise this [the CAPS document]" (DOE, 26/773).

#### **4.2.4 Lance's Grade 7 Biodiversity lesson**

##### **Introducing the lesson**

In March 2014, I observed Lance teaching a lesson on biodiversity to one of his three Grade 7 classes (see transcript LLO in Appendix 4.1). There were 39 learners present in the class. The period was 45 minutes long and was conducted in Afrikaans. Lance requested two boys to hold up two large posters, with pictures depicting a range of birds, marine life and animals. Lance told the learners that the charts showed them pictures of birds and fish. He did not identify the birds or fish by name (LLO, 2-5).



**Figure 4.1 Lance uses charts to teach biodiversity**

He then asked them to name some birds that are not on the charts. The learners raised their hands as per his instruction. The learners answered with ease. One learner answered [an eagle] “*n arend*” (LLO, 9). He then asked the learners to name fish that were not on the chart. One learner answered [an octopus] “*n oktopus*” (LLO, 12) and [a dolphin] “*n dolfyn*”. Lance accepted these answers although these are technically not fish. The charts served as an introduction to his lesson, which he concluded by saying that [there are lots of different animals...different birds and different fish even though all are not shown here on the charts] “*daar is baie soort diere...baie soort voels en baie soort visse al word almal nie hier vir ons gewys nie*”. [There are still many different birds and many different fish, but we can’t do them all, can we?] “*Daar is nog baie soort voels en baie soort visse maar ons kan nie almal doen nie, ne?*” (LLO, 16-19).

## **Introducing biodiversity**

Lance then proceeded to define the word 'biodiversity'. He wrote the term on the board in five syllables: bio/di/ver/si/teit. Lance gave a definition of biodiversity: "biodiversity refers to different sorts of living organisms. It includes all the living organisms on Earth, okay? Whether it is in the air, or on the Earth or under the Earth, or part of the lithosphere, the atmosphere or the hydrosphere. It includes all the spheres" [*"Dit verwys na alle soorte lewende organismes, ne? Dit sluit al die lewende organismes op die aarde, okay? Of dit nou in die lug is, of op die aarde is of onder die aarde, die lithosfeer, die atmosfeer en die hydrosfeer. Dit sluit al die sferes in"*] (LLO, 19-23). Lance did not use a textbook but spoke from memory. He then proceeded to question the learners on how many plants, animals and birds they think there are on Earth. One learner responded: [millions] "*Miljoene*" (LLO, 29). Lance responded:

...Scientists have already identified 1,5 million living organisms...scientists reckon that there are more than 1,5 million ...they claim that there are between 30 to 50 million living organisms. But if you look at 1,5 and 30 then we still have a way to go, isn't it? The Earth is still busy proving itself...each day new species are discovered and they are just increasing as time goes by. [*"... Wetenskaplikes het al so ver geidentifiseer 1,5 miljoen van hierdie lewende organismes...wetenskaplikes skat dat daar nog meer lewende organismes is as 1,5 miljoen. ...Hulle se maklik is daar tussen 30 to 50 miljoen lewende organismes. Maar as jy kyk na 1,5 en 30 is dit nog 'n ver pad om te gaan, ne? Die Aarde is nog besig om homself te bewys ...elke dag ontdek hulle nuwe spesies en hulle raak net meer en meer soos die tyd aangaan"*]. (LLO, 32-38)

Lance gave only one illustration to represent the biodiversity concepts. For example, he explained that on Port Elizabeth's beachfront, in the pools of water, one will find greenish slime, which he says is algae (LLO, 97-100). He also explains that the dark decay that is found on the bread in our homes is fungi (LLO, 104-105).

The only connection in the lesson that Lance makes for the learners is when he says that algae almost looks like bacteria, and that algae and bacteria have a lot in common (LLO, 96-97). However, he does not explain how fungi and bacteria are similar.

## Classification

Lance introduced the concept of classification by using racial classification as an analogy:

Now we must remember that scientists also group, organise or classify living organisms according to characteristics which they have in common. For example, now you also like to classify things. People who have fair skins and smooth hair we call whites, don't we? People who have our hair we say they are Coloureds, don't we? Then we get Black people and Indians and so on. That is a classification system. It is the same with scientists...classification systems...how they group things according to characteristics and features. For example, when we think of animals, animals have certain things in common, don't they? [*Nou, ons moet ook onthou dat wetenskaplikes groepeer ook, organiseer of klassifiseer lewende organismes volgens dinge wat hulle in gemeen het, volgens hulle kenmerke. Byvoorbeeld, nou julle hou ook daarvan om dinge te klassifiseer. Mense wat almal ligte vel het en gladde hare se ons hulle is blankes, ne? Mense wat onse hare het dan se ons hulle is bruin mense, ne? Dan kry ons ook swart mense en Indiers en so aan. Dis 'n klassifikasie stelsel. Nou dieselfde met wetenskaplikes...klasifikasie stelsels...hoe hulle dinge groepeer volgens kenmerke en eienskappe. Byvoorbeeld as ons dink aan diere, diere het sekere dinge in gemeen, ne?*]. (LLO, 39-47).

He proceeded to question the learners on the distinguishing characteristics of animals. Through persistent questioning, Lance got the learners to identify the shared characteristics of animals which are, according to the learners, "reproduction" ["voortplanting"] (LLO, 52); "carbon dioxide" ["koolstofdiksied"] (LO, 58); "oxygen" ["suurstof"] (LLO, 60). Lance left it at that, in other words that the life processes are eating, reproducing and breathing. He then proceeded to introduce the five Kingdoms. He named one of the kingdoms, as if to lead them on. He said "Diere" ["Animals"] (LLO, 64). After this, the learners responded with: Plants (LLO, 65), Bacteria (LLO, 66). Lance wrote this on the board. The learners carried on classifying, while Lance wrote on the board. Through persistent questioning he enabled the learners to participate by giving examples in each Kingdom. He handed out a colour copy to each learner of the five Kingdoms, which gives a definition of each kingdom, examples, a colour picture and the seven life processes. Since the school does not have a microscope, he describes a microscope to them. He explains that if they were to look at bacteria under a microscope, they would see something similar to that in the picture

(LO, 90-93). He helps the learners to understand in real terms each of the kingdoms: he uses the example of slime in pools of standing water on the beachfront to help the learners understand “*Protis*” and “*algie*” (LLO, 98-101). He describes bread mould as an example of fungi (LLO, 104-109). Lance continues: “People can sometimes get fungi. Sometimes fungi grow on people’s backs. For example, you may notice a brown patch on their skin. That is fungus.” [“*Partykeer kan ons mense ook swamme het. Partykeer groei ons swamme op ons rug. Byvoorbeeld, as mense hulle uittrek, sien mens bruin gedeelte op ons vel. Dis swam.*”] (LLO, 110-111). He then skimmed over plants and their life processes before he paused at animals (LLO, 114-116). Lance then asked the learners to recall the five classes of vertebrates which the learners recalled these effortlessly (LLO, 120-130).

### **Application**

Lance then gave the class an individual activity on identifying the life processes of the five Kingdoms.

#### **4.2.5 The textbook used to support Lance’s biodiversity lesson**

Lance uses only one text book because “when I look at the text book and I look at CAPS...it’s actually the same. Also the examples of test and exams...lots of definitions of concepts...lots of pictures because our children like pictures (HIL 16/499-509).

In the textbook that Lance used, knowledge of ecological systems is not evident in Unit 1 [*Eenheid 1*] where it says learners will learn 1) biodiversity 2) why and how organisms are classified 3) the 5 kingdoms 4) the difference between plants and animals and 6) the classification of living things (Baxter, Collett & Snyman, 2013) in Appendix P, Doc 1/21. The textbook defines biodiversity as: all living things on the Earth, all the plants, animals and micro-organisms and their habitat together forms biodiversity on Earth. [*Wetenskaplikes gebruik die word biodiversiteit om al die verskillende lewende dinge op Aarde te beskryf. Al die plante, diere en mikroorganismes en hulle habitat vorm saam die Totaale biodiversiteit op Aarde.*] (Baxter, Collett & Snyman, 2013) in Appendix P, Doc 1/21. This is the definition that Lance used in his lesson (LLO, 20-22).

The pictures of the animals in the unit on biodiversity resemble Identity Document photos, that is, a snapshot of the animal only. They do not reveal the animals' relationship to other animals, humans, vegetation or the climate (Baxter, Collett & Snyman, 2013) in Appendix P, Doc 1/21& 26. Lance too only speaks of animals and plants in isolation and not in relation to each other.

The knowledge of biodiversity in this unit continues with the knowledge of the classification system in which all living things that make up biodiversity is classified: Kingdom, Phyla (Divisions), Classes, Families, Orders, Genera and Species [Ryk, Phylum, Klas, Orde, Familie, Genus, Spesie] (Baxter, Collett & Snyman, 2013) in Appendix P, Doc 1/24. Lance's lesson followed this order as well.

The following on-line resources are included in the textbook:

- a) A blog inviting comments or question. The knowledge in the textbook is presented in the blog in the form of charts and flow charts.
- b) A five minute video which shows the viewers a large variety of vertebrates.
- c) Charts, and a You Tube video on the Kingdom of Vertebrates.

The on-line support reinforces the knowledge in the textbook – which is mostly in prose - but introduces no new or different knowledge (Baxter, Collett & Snyman, 2012) in Doc 2/38, 40. In other words, the same knowledge is simply presented in a different form. Lance did not refer to these online resources.

Unit 2 deals with diversity. The Teacher's Guide (Baxter, Collett & Snyman, 2013) in Appendix P Doc 2/40 states: "This unit develops the concept of biodiversity further by studying the diversity of animals" [*"Hierdie eenheid ontwikkel die begrip van biodiversiteit verder deur na die diversiteit van diere te kyk"*] (Doc 2/40). A definition of diversity is not provided, in either Unit 1 or 2. Diversity is restricted to classification: "the first, of importance is to classify animals" [*"die eerste, belangrikste is om diere te klassifiseer"*] illustrates that classification of animals into vertebrates and invertebrates etc. is presented as the extent of diversity. Four pictures on page 24 ((Baxter, Collett & Snyman, 2013) in Appendix P, Doc 1, [4 ID photos of three individual animals and one plant] has the caption: The diversity of South African plants and animals. [*Die diversiteit van Suid-*

*Afrikaanse plante en diere*]. The knowledge that is contained under diversity is the difference between vertebrates and invertebrates, the arthropods and the molluscs [*die verskil tussen gewerwelde en ongewerwelde diere, die onderskeidende eienskappe van die vyf klasse gewerwelde diere, geleedpotiges en weekdiere*]. Lance very faithfully followed and implemented this classification of animals with his learners.

Knowledge of the process skills of classification and sorting and grouping is dealt with in the activity on page 22. Learners formed different groups (Baxter, Collett & Snyman, 2013) in Appendix P, Doc 1/22 and then labelled each group based on the similarities they have in common. Lance asked the learners to apply the process skills and to compare plants and animals according to their movement, feeding and reproduction (Baxter, Collett & Snyman, 2013) in Doc 1/24.

#### **4.2.6 Conclusion**

Lance, a teacher with seventeen years of teaching experience as an Economics teacher has only two years' experience as a Natural Science teacher. The school is situated in a very poor socio-economic area. As a child, Lance camped at seaside resorts and visited circuses and crocodile farms. In his opinion he had good Biology teachers at school. He had been socialised to respect animals and all living things. As a result, biodiversity has inherent worth for him. He also acknowledged the systemic and emergent value of biodiversity and that it meets human needs. He believes our biodiversity should be preserved for future generations. However, he feels that humans threaten biodiversity with pollution and that government should appoint an effective administration to protect biodiversity. He remains optimistic about the variety of biodiversity on Earth. Lance believes that his learners' understanding must be supported with visual images. In his opinion, the training that he received to prepare him for biodiversity was inadequate. In his lesson, Lance illustrates biodiversity concepts for his learners through at least one example. Other than that, biodiversity concepts were illustrated through the pictures in the textbook. He consulted his CAPS document to see what he had to teach and then used one textbook to support his lesson. He stated that he needs additional resources to teach. In his lesson, the learners identified different animals, birds and fish. After he gave a definition of biodiversity, Lance taught classification and the distinguishing characteristics of animals and the five Kingdoms. He asked the learners to identify the life processes of the five Kingdoms, as depicted in the textbook.

### **4.3 Case Study 2: Pam at Palm Plains Primary School**

#### **4.3.1 Pam, the Grade 7 Natural Science teacher**

Pam, 47 years old, was born in Pedi, a rural town in the Eastern Cape. She attended Emfundweni High School in Peddie. Pam came to Port Elizabeth in 1989 where she trained as a teacher at the Algoa College of Education. She later completed a Further Diploma in Education (FDE) through the University of Pretoria, specialising in Education Management. She pursued further studies through the then University of Port Elizabeth (UPE) where she completed a Bachelor of Education Honours Degree in Education Management. She was deeply disappointed when the Nelson Mandela Metropolitan University did not confer a Masters Degree but instead converted her studies to a Post-graduate Diploma. Her most recent qualification was in Augmentative and Alternative Communication through the University of Pretoria. This qualification would help her with learners who have little or no speech. She is currently registered as a Masters student.

Pam started teaching in 1992 as a Grade one teacher in Port Alfred. At that time the school only had Foundation Phase. The school later upgraded to a Primary school. She then started teaching Grade 5 Natural Science in 1997, the following year she taught Grade 6 and thereafter Grade 7. Pam started teaching at Palm Plains Primary in 2008 when she was successfully cross-transferred.

#### **4.3.2 Overview of Palm Plains Primary School**

The main road leading to the suburb in which Palm Plains Primary is situated, is lined with palm trees and green lawn. In the suburb, most of the land is occupied by homes. There is no visible vacant land. The suburb on the way to Palm Plains Primary comprises ownership homes. The houses are neat with boundary walls. Some homes have beautiful lawns and gardens. Not far from the school is a centre comprising a clinic, a community hall, a petrol station, a large chain store and smaller shops. Goats and cows forage on grassy patches around the centre. The subsidiary road through the suburbs is in a good condition. However, the road to the school is full of potholes. There is a high school situated on the next block, a street away from Palm Plains Primary. The gate to Palm Plains Primary stands open. There is no security guard at the gate. The Administration block has a solid metal roll-up security gate to seal its entrance during the night. The Administration Block only is monitored by ADT, a security company. The small tarred car park is

surrounded by several huge trees in the school yard. The area between the car park and the Administration Block and the first row of classrooms has short lawn. I had to speak to the Secretary through a security gate. The classroom walls are empty due to the burglaries that occur every weekend. Palm Plains Primary is classified a full-service school which means it admits learners with learning disabilities as well. The school was supposed to have received human and physical resources to meet the requirements of the learners with special educational needs (LSEN), but the school is still waiting for these. About 45% of each class comprises learners with special needs. The Department of Basic Education wanted to deploy six of their teachers, but the School Management lobbied the Provincial Task Team in Bhisho to keep their teachers.

Palm Plains Primary needs more classrooms to alleviate the learner-teacher ratio. They also need burglar proofing to secure the classrooms. Another challenge is the lack of managers. Pam said that “there’s no one to lead”, so she has to head the Intermediate Phase with all its subjects ((EIP, 6, 7/175-178). The school is also regularly vandalised which hinders effective teaching. There is no security and no caretaker. However, they have become a Section 21 school, which means that they receive a cash allocation to manage the school and have to submit audited financial statements to the Department of Basic Education.

### **4.3.3 Pam’s Perspectives on biodiversity**

#### **4.3.3.1 Early influences**

In an interview (see Transcript EIP in Appendix Q) I asked Pam to describe her experiences with biodiversity and anything else that may have shaped her understanding and her teaching of it. She explained that she lived near a river as a child, and she used to catch crabs and insects which she stored in bottles and took to her teacher at school. Her understanding of biodiversity was further shaped by their goats, cattle and sheep, which she grew up with. She did not have specific training in biodiversity.

Pam reflected that as she had completed her schooling in the rural Eastern Cape, it was easy for her to go the river to catch crabs, but it is difficult for her learners to do the same because there are no rivers near their homes (EIP, 19/533-544). Pam feels that her professional training as a teacher prepared her “a lot...we used to do practical teaching...at the township school” (EIP, 21/601-602).

Pam says when she was a teacher in Port Alfred, she used only the textbook. But when she came to Port Elizabeth, she was workshopped and orientated to use the CAPS Policy Document (EIP, 6/157-162).

#### **4.3.3.2 Pam's current understanding of and attitudes towards biodiversity**

Pam explains that “biodiversity is about plants and animals...the nature...the pictures of natural resources...the different types of animals” (EIP, 10/282,283). Pam seems to have obtained her knowledge of biodiversity primarily from the textbooks that she has used, as will be explained in Section 4.3.5.

Pam says that she uses the known to the unknown approach (EIP, 17/486,487). She asks the learners to bring or identify any animals or plants that they know. She then gives them a chance to brainstorm. She also writes everything on the board, especially all the new concepts. She believes when her learners see the spelling on the board, it stays longer in their minds (EIP.18/489-511).

Pam's narrative suggests a perspective that natural resources occur in abundance. For example, she notes that: “many animals have been killed for their skins (EIP, 16/448-459). Pam says that “animals are useful because they can make floor mats” (EIP, 16/458). Pam believes that people won't stop using animals because in addition to what animals provide people with, animals are also used in rituals (EIP, 16/ 460). Pam sounds confident that “the animals won't decrease in number...the animals will always be there...because reproduction is still there” (EIP, 17/ 466-472). Although Pam does not identify a problem with biodiversity, she would like an effective administration to protect biodiversity like perlemoen (EIP, 28/786). She believes that human beings individually are responsible for our biodiversity because, “God ordered that you are responsible for all I [God] have created” (EIP, 29/816-820).

There was a time when Pam did not value animal life. She recalls how she killed a cat, because it had eaten all the Kentucky Fried Chicken she had bought for her mother on one of her holidays to Peddie (EIP, 29/805). She admits that through education she had learned to value all life, and she now teaches that to her learners. Pam sees biodiversity as having inherent worth (Kronlid & Öhman, 2012) - “forests cannot be cleared just for agriculture...the farmers must find another place to do crop farming because this is a habitat for other animals (EIP, 13/357-365). She also

attributes demand value to biodiversity, where biodiversity provides satisfaction for humans' felt preferences, for example, the Zionist Christian Church baptise their members in the wetlands (EIP,16/433-444), floor mats are made from animal skins and animals are used in rituals (EIP, 17/459). Pam also attributes transformative value to biodiversity where in the past she may not have valued the life of an animal (EIP, 29/805-809), "now we know, since we have studied the value of animals...we have to take our animals to the vet" (EIP, 29/829-831). Pam sees social non-human animals as Moral Objects, as objects worthy of moral consideration. Her mother had about three tortoises that she kept as pets for many years. Pam feels that the lives of animals are very important (EIP, 13-15, 371-414). Pam also believes that the future generation should be considered when she says "this is unfair [referring to the picture I showed her of the clearing of natural vegetation for agriculture] because here the plants have been abused...they could be useful in the future" (EIP, 12/341-342). This reflects a utilitarian, or instrumentalist value of nature which seems stronger than her sense of intrinsic value.

#### **4.3.3.3 Pam's engagement with biodiversity through CAPS**

Pam spent much of her teaching time completing the documentation to have the learners with special needs placed at special schools. She is the Co-ordinator of the ILST (Institutional-based Learner Support Team). The Institutional-based Learner Support Team at all government schools is managed by the Department of Basic Education Psycho-Social Support Services Unit which serves to support learners with special educational needs in mainstream schools. The Institutional-based Learner Support Team at Palm Plains Primary also has to support the class or subject teacher to help the learners with educational needs. They help teachers with charts, sentence strips, counters, etc. Pam is left confused by conflicting requests from the Curriculum Unit which monitors the implementation of CAPS, and the Psycho-Social Unit which says that their learners with special educational needs should be given support so that they can be treated like other learners. The dilemma Pam faced was that more than 40% of the learners with special educational needs could not cope with the biodiversity knowledge required in CAPS (EIP, 33/938; 34/945) this while the mainstream learners lose valuable tuition time (EIP, 10/ 260,270). Pam is also the Head of Department (HOD) of InterSen (Intermediate and Senior Phase) at Palm Plains Primary.

Pam believes that the new textbook is in line with CAPS, "They are CAPS oriented from page to page" (EIP, 31, 32/866-908). She compares the textbook to the policy document. She uses all the

textbooks. She feels that the curriculum does not take the learners with special educational needs into consideration - “this week you must be finished...while other learners are not at the same level...you have to leave learners behind” (EIP 32, 33/ 913-944).

Pam believes that the Life and Living strand of the previous Revised National Curriculum is the same as Biology, and that the outcomes-based education (OBE) that has been phased out is the same as CAPS. She believes that the content is the same as that taught by her own Biology teacher when she was a learner at school. When Pam teaches, she still recalls how her primary school teacher taught her and tries to emulate that approach (EIP, 20/566-569).

#### **4.3.4 Pam’s Grade 7 Biodiversity lesson**

##### **Introduction to the lesson**

Pam presented a lesson to one of the three Grade 7 classes (see Transcript PLO in Appendix 4.2). There were 26 learners in the class. They were seated in groups. The period was 50 minutes long. She had a lesson plan in front of her with notes. The medium of instruction was English. Pam explained to the learners that these two kingdoms have been chosen for them to study, “because they are the biggest that can be seen with our naked eyes and we know that all the world is occupied...mostly occupied by plants and animals” (PLO, 16-18). Pam then told the learners that they will go on to biodiversity which Pam considered as classification: “if we classify...if we go into biodiversity. We are going to classify...” (PLO, 20). Pam reminded the class that they had already classified the living things into five groups and that they will now look at two of those groups, the biggest groups, the plant kingdom and the animal kingdom (PLO3/21-22). She adds that the animal kingdom has the largest number of species in the world, followed by the plant kingdom (PLO, 22, 23). Pam continues to inform the learners that “those [animal and plant kingdoms] are the two important kingdoms that we deal with in biodiversity” (PLO, 31, 32). She makes sure that they understand that the lesson was going to be on the animal kingdom.



**Figure 4.2 Teacher starts her lesson**

	Locomotion	Body covering	old/warm blooded	Habitat	Reproduction
Fish	(fins) swimming	scales	cold	water	external fertilization
Mammals	(legs) walking	fur	warm	land	Internal ✓
Amphibians	hopping	no body covering	cold	land water	external
Reptiles	sliding	scales	cold	land	external
Birds	wings flying	feathers	warm	air land	internal ✓

**Figure 4.3 Teacher at the end of her lesson**

### **Vertebrates and their distinguishing characteristics**

Pam asked questions about the two classes of the animal kingdom and wrote the learners' answers on the board. The learners answered "vertebrates" and "invertebrates". Pam gave the learners a definition of vertebrates. The learners repeated the definition (PLO, 47, 48). She did the same for

invertebrates. She told them that they will leave the invertebrates and continue with the vertebrates (PLO, 55, 56). Pam then continued to explain that scientists look for similar characteristics in order to group species (PLO, 58-60). Pam covered the characteristics of “what they eat”, “warm or cold blooded”, “gaseous exchange” and reproduction (PLO, 61-70) as well as “locomotion”. She explained that on the basis of these characteristics, animals are grouped into five classes. She asked the learners to name the five classes. They answered correctly and effortlessly. She then asked them to give her an example of each class. She asked for an example of a fish. One learner answered: Shark. Pam said “shark is an example of a mammal” but she does not explain why. This is one example of incorrect information that was allowed to go through in the lesson. Pam continued to write their answers on the board. She then asked the learners to describe the locomotion of each class (PLO, 123-148). She then asked them for the body covering of each class and she wrote their answers on the board (PLO, 149-162). The learners answered effortlessly. Pam then defined cold-blooded animals “whereby it feels cold and when it is cold we say it hibernates...in summer we see the snakes and lizards...when it is a cold-blooded animal it feels cold” (PLO, 162-167). The learners then answered cold- or warm-blooded for each class. Pam then asked the learners for the habitat of each class. She wrote their answers on the board (PLO, 177-198). Pam then defined fertilization as “the combination of the sperm cell and the female egg...” she defined both internal and external fertilization (PLO, 199-208) and then asked the learners to say which fertilization occurs in each class.

Pam continued to explain that only two classes of vertebrates practice parental care “only the mammals and the birds have parental care” (PLO, 218). She explains that fish and reptiles and amphibians produce young without caring for them and that these young develop on their own (PLO, 229-231). As this is not technically true in all cases, Pam had allowed a misconception of biodiversity knowledge to slip through. She then introduces metamorphosis, and explains that it occurs only in the class of amphibians.

### **The learners classify**

Pam then proceeded to give the learners magazines from which to find pictures of vertebrates. Each group received a blank chart. They were instructed to classify the pictures of vertebrates into

the five classes. Before the end of the lesson, Pam reminded the class to bring more magazines the next day as they will be doing the second class of animals, invertebrates (PLO/324,325).

#### **4.3.5 The textbook used to support Pam's biodiversity lesson**

Pam used three textbooks to support her Natural Science teaching, which I refer to as J. De Beer, D. Gibbon, R. Jones, T. Kuneni, J. Patrick, J. Sampson, B. Subramani, E. Whitlock. (2013). Textbook 3 (Document 3), J. Avis, M. Bester, M. Bezuidenhout, A. Clacherty, S. Cohen, J. Cowan, S. Doubell, J. Erasmus, A. Joannides, G. Lombard, E. Nkosi, R. Sadie, L. Schreuder. (2013). Textbook 4 (Document 4) and Textbook 6 (Document 6).

In her lesson, Pam did not define diversity, but started with the division of animals into vertebrates and invertebrates. In the textbook that Pam used, Textbook 3 (Doc 3/22), Diversity of animals appears in Topic 2. This textbook provides no definition of diversity. The Unit starts with the division of animals into vertebrates and invertebrates. Here the animals are depicted in isolation, with no ecological context (Doc 3/22, 23).

In her lesson, Pam explains to the learners that scientists classify animals into groups (PLO, 58-60). In one of the textbooks, Textbook 6 (Doc 6), biodiversity is defined as: "biologists classify all living things into groups to make sense of the variety of living organisms on Earth" (Doc 6/23). A definition of biodiversity is given as the variety of all living organisms and habitats on Earth (Doc 6/26), while "habitat" is defined as a "forest, desert, wetland or ocean" (Doc 6/27). This textbook comes the closest to giving all life on Earth a context. However, this context is not developed further in the textbook, since this definition is followed by classification on pages 27 and 28.

The picture on page 29 of the Five Kingdoms shows plants and animals in isolation with no ecological context. This textbook, however, explains each concept in the finest detail and is an asset to a novice teacher. Page 28 explains each concept within each kingdom e.g. single cells, many cells, complex plants and complex animals. The language used is simple English. When Pam asked the learners to identify movement and reproduction, for example, the learners could answer confidently. On page 30, the concepts of movement, nutrition, reproduction, growth and responses

to the environment are explained in simple detail. Under the topic: Diversity of animals in Unit 2, though, the classification of the Animal Kingdom only is dealt with (Doc 6/34).

In Textbook 4 (Doc 4), the definition of biodiversity is given as: “the variety of living organisms in a particular area is called its biodiversity. An environment with many different types of plants and animals has a high biodiversity. If there are only a few plants and animals in an environment, it has a low biodiversity” (Doc4/9). [The consequences of low or high biodiversity is not explained in the textbook].

Diversity of animals is described in Unit 2 on page 14, as the classification of animals into vertebrates and invertebrates, which is exactly what Pam taught in her lesson. The five classes of vertebrates are introduced with one picture for each class and the facts arranged around the picture. The picture has no ecological context (Doc 4/14-16). The pictures on page 16 show the habitat. Similarly, the invertebrates are introduced (Doc 4/17, 18). On page 21 the pictures do not show the animals in relation to other animals or in the context of their surroundings (Doc 4/21).

In Textbook 3 (Doc 3), the biodiversity unit in Topic 2 (Doc 3) starts off with a definition: “the term biodiversity refers to all living organisms and their habitats on planet Earth. This includes all plants, animals and micro-organisms” (Doc 3/1). It illustrates this knowledge in a pie charts which shows all the kingdoms. The pie chart is labelled “Planet Earth’s rich biodiversity”. The pictures in the pie chart show individual plants, animals and organisms, unrelated to each other. This definition is immediately followed by why organisms should be classified. This may explain why Pam goes immediately into classification. The knowledge provided about biodiversity is more than just an ID snapshot (Doc 3/20). The visual diagram is supported by rich knowledge, for example:

- a) The role that bacteria plays in relation to humans is listed: useful in the production of food such as cheese and yogurt, decomposes dead organic matter but can also cause disease such as tuberculosis.
- b) Algae includes the ‘plants’ that wash out on the beach, and certain parasites, for example, the parasite that causes malaria.
- c) Fungi includes mushrooms, mould on bread, as well as the parasite that causes athlete’s foot in humans.

d) Plants, by trapping the sun's energy, change light energy into food energy, and so provide food for animals.

e) Animals feed on plants and other animals.

Pam, in her lesson, follows this faithfully: the biodiversity knowledge is immediately followed by classification. Biodiversity knowledge then reverts back to classification into Kingdoms, Phyla, Classes, Families, Orders Genera and Species.

#### **4.3.6 Conclusion**

The foundation of Pam's understandings and perspectives of biodiversity were laid during her early childhood in the rural Eastern Cape where she lived near a river with goats, sheep and cows. She also feels that she has had good training as a teacher. The school where Pam teaches is situated in a middle class suburb, but is plagued by burglaries. Though a mainstream school, it has enrolled about 45% learners with special educational needs which places a strain on the tuition. Pam obtained her biodiversity knowledge primarily from the textbooks. She uses the known to the unknown approach with her learners. Her attitude towards biodiversity is that there is an overabundance of resources and she believes animals will always be there. However, she would still like government to appoint an effective administration to protect biodiversity. Through education, she has learnt to value all life. She recognises that biodiversity has inherent worth and provides for human demand. For this reason biodiversity should be preserved for future generations. She has drawn on three textbooks in teaching biodiversity which she believes are well aligned with CAPS. She also believes that biodiversity is the old Biology. In her lesson, she went into classification immediately. Her lesson focussed on the Animal Kingdom, specifically vertebrates. Before she asked the learners to classify the pictures of animals into the five classes, she taught the characteristics of the five classes of vertebrates. Some misconceptions on biodiversity knowledge slipped through during Pam's lesson. One textbook supported Pam in the explanation of the concepts, a second textbook supported Pam in her lesson in the classification of animals into vertebrates and invertebrates and the five classes of vertebrates. The third textbook also followed its biodiversity knowledge with classification, which is the order that Pam followed.

#### **4.4 Case Study 3: Mandy at Omega Primary**

##### **4.4.1. Mandy, the Grade 7 Natural Science teacher**

Mandy, who is in her 40s, has been teaching Natural Science for 25 years. She completed a Teachers' Diploma at a teachers training college in the then Transkei. She continued with a two year part-time qualification in Maths and Science at the then University of Port Elizabeth (UPE).

##### **4.4.2 Overview of Omega Primary School**

The community in which Omega Primary is situated is a sprawling RDP housing area with neat rows of houses as far as the eye can see to the horizon in whatever direction one looks. This community was an informal housing settlement where the government, through its Reconstruction and Development Project (RDP) built a home in the place of each informal dwelling. The community lies off the R75, a four lane subsidiary road linking Port Elizabeth to Uitenhage and Despatch. The building of the RDP homes was completed in early 2000. The snaking tarred roads twist neatly between red roofs. On the way to Omega Primary, vacant land here and there stands barren, with the soil exposed and washed away when it rains. A rivulet boasts the only green patch of grass and some spekboom as it struggles to trickle through the heap of polluted waste dumped in its path. Opposite the school, on the opposite side of the R75, lies a spekboom thicket. The thicket looks well preserved and free from pollution. The menfolk would visit this thicket on two occasions during the year, the winter and summer vacations when the young men go to this bush for initiation, a young man's rite of passage to manhood.

The face-brick school has had to obtain several pre-fabricated classrooms to cope with the growing number of learners. The school has about 1 200 learners and a staff of 31. The school is fenced with a single long roller gate. There is no security guard at the gate. Newly planted young trees in the school car park are fenced for protection from livestock. An organogram depicting the colour photo of each teacher and their names adorn one wall in the Administration Block. The secretary's office has a 'trellidor' security gate on the counter window.

### **4.4.3 Mandy's perspectives on biodiversity**

#### **4.4.3.1 Early influences**

In an interview (see Transcript JSI in Appendix R), Mandy reflected on her experiences with biodiversity. She completed a Teachers' Diploma at a teachers training college in the then Transkei. Under the apartheid government the Transkei was reserved for and governed by Blacks. She continued with a two year part-time qualification in Maths and Science at the then University of Port Elizabeth (UPE). Mandy recalls her own schooling. "My primary school...the way we were taught science is totally different from what we are teaching our learners now" (JSI, 10/295). In fact maybe I was in a totally disadvantaged school then (JSI, 10/297), there were no chemicals and we were just learning from our textbooks (JSI, 10/299,301). I happened to go to a good teachers training college. What I learnt from the training college that's where it was clear how to teach, even with our workshops we are clearly [shown] how to teach" (JSI,11/308-316).

#### **4.4.3.2 Mandy's current understandings of and attitudes towards biodiversity**

Mandy defines biodiversity as "the variety of living organisms in a particular area" (MLO 2/10). As Mandy reviews the first term, she feels that the biodiversity topic is not difficult but is too long: "We started this year to do biodiversity, so it was new to me...so I've learned some of my mistakes" (JSI 13/379-386). "Next year I must make sure that everything is well prepared; if you are well prepared it becomes easy for you to teach a particular topic. If I've got enough time to explain [the terms, concepts] ...I'll have enough of these flashcards..." (JSI, 15 /405,409,414-427). As regards her teaching approach, Mandy explains: "We are encouraged not to tell learners everything. You must first find [out] what they know (JSI9/254, 5) and encourage them to think for themselves (JSI, 9/257). There are so many terms here...I have to make flashcards, spread on the wall so with the definition" (JSI, 10 /287-290). Since biodiversity was new to Mandy, she obtained her knowledge of biodiversity from the textbooks that she used. These will be discussed in Section 4.4.5.

Mandy tends to lean towards favouring an authoritarian government that takes responsibility for environmental management (Dryzek, 2005): "Our government can help us to put laws that would

be very strict for people not to kill the [lion and zebras]” (JSI, 18 /222,224) as well as a government that can ensure economic growth. Mandy prefers an “Environment that is economically stable...like having enough food because we get food from plants...sell some of these, export some of the food” (JSI, 4/92-95). Human domination is evident in the assumption that [humans] water the plants to grow (LO2/197). Mandy sees biodiversity as a “good picture...all about plants and animals” (JSI, 13/76). She would like “the forest to be kept like that...untouched [and not cleared for agriculture]” (JSI, 6/172).

Mandy attributes demand value to biodiversity, in other words, biodiversity provides for humans’ felt preferences (Kronlid & Öhman, 2012) when she says “ we need [animal skins] to make leather jackets,...to make us warm” (JSI,17/191,192). She also attributes need value to biodiversity, in other words, biodiversity meets human needs.

Mandy sees non-human animals with the ability to experience pain and suffering as worthy of moral consideration. She says: “Some of the animals that live in this habitat the [dirty] wetland...they can die of that air pollution” (JSI, 5/125,125). While looking at the picture of the forest being cleared for agriculture, she says: “I’m thinking, what they thinking about the animals, which is their home” (JSI, 6/156). “The home is for the animals... is like when your home is burnt like this, how can you feel?” (JSI, 6/176).

#### **4.4.3.3 Mandy’s engagement with biodiversity through CAPS**

Mandy feels that on the one hand, the Department of Basic Education has helped teachers a lot (JSI, 12 /356). On the other hand, she feels that the Department has not prepared her sufficiently to teach biodiversity. “No the honest truth is that maybe they were busy with the workshop since we started this new programme this year, but preparing for biodiversity in fact I didn’t know that there’s something that is new which is so long ...in our topic until we got the textbooks in February or March...It was late by then, that’s why... we didn’t prepare thoroughly” (JSI, 15 /430-439). The Senior Education Specialist explained how he supported the Natural Science teachers during the training in 2013. He said that biodiversity is on page 17 of the Senior Phase CAPS document (DOEI, 2/40, 41). He explained that the first column on page 17 informs the teacher of how many

weeks to spend on biodiversity. He continued to explain that the second column is the topic while the third column is about the classification of living things (DOEI, 2/43-49). He continued: “Then in the next column, **now this is the new thing** whereby they say grouping, drawing and sorting. Those are the skills in the Resource column they give you this, you must use drawings and pictures and magnifying lenses...” (DOEI, 2/ 52-55). He explained the support that the department gave: “Now that is the level at which we gave the support of biodiversity, so that everyone was doing the same thing now ... this brings about uniformity...it brings about standardisation” (DOEI, 3/69-83). Mandy feels that the text book and the curriculum go well together. “The textbook goes hand in hand with the policy document” (JSI, 17/514).

#### **4.4.4 Mandy’s Grade 7 biodiversity lesson**

##### **Introduction to the lesson**

Mandy had 37 learners in her Grade 7 class. The medium of instruction was English. The period was 50 minutes long. The learners sat in groups. Mandy began the lesson with a definition of the concept of biodiversity (see Transcript MLO in Appendix 4.3). She pasted a sentence strip with the definition on the board. She made the learners repeat the definition a few times. She corrected their pronunciation. Using the question and answer method, she extracted from them some examples of living organisms. The learners answered “plants” and “animals”. Mandy defined variety as “we are talking about different plants and animals” (MLO, 27).

##### **Learners identify and classify**

Mandy told the learners to imagine that they were walking in a forest which is where they would find different plants and animals (MLO, 33, 35). Mandy said that she had given them pictures of plants and animals that they can find in the forest (MLO, 37, 38). Throughout her lesson, Mandy used pictures of plants and animals to illustrate biodiversity concepts. Mandy had placed sets of pictures with each group of learners. She asked them to open these, and identify each plant or animal. They had to write its name on the page/picture. She made sure that the learners had the correct labels by questioning the learners and checking the labels against the pictures.



**Figure 4.4 Learners identify plants and animals**

The learners identified the dragonfly, the Woodspecker... Mandy then asked the learners to divide their page in half. They were now required to sort the pictures of the plants and animals and paste it under plants or animals. They pasted grass, trees, elephant, frogs, Woodspecker, dragonfly and a bug. She explained to them that they were classifying.

#### **The differences between plants and animals**

She then proceeded to the difference between plants and animals. This knowledge she extracted from them using the question method. The learners responded: “plants make their own food”; “animals eat plants and other animals”. One learner said that plants cannot move because they don’t have legs to which Mandy responded that they grow towards light (MLO, 185). One learner said that animals drink water while another learner said that “we water the plants to grow” with which Mandy agreed (MLO, 197, 198). Mandy did not notice or correct the learner’s misconception that humans water plants to grow. Mandy concludes this part of the lesson by pinning her chart of the difference between plants and animals on the board. She briefly summarises it for the learners, as can be seen in Figure 4.5.

DIFFERENCES BETWEEN	
PLANTS	ANIMALS
Plants do not move	Animals move
Plants have roots and absorb water from the soil.	Gets water by drinking it
Can make their own food by a process called photosynthesis	Get food by eating plants and other animals.
Reproduce by producing seeds	Reproduce by giving birth

Figure 4.5 Mandy's summary of the differences between plants and animals

### The Kingdoms and Classes

She then introduced them to the concept of kingdoms and the two kingdoms in particular, the Plant and the Animal kingdoms, and told them that they would now look at the Animal kingdom (PLO 2/223-228). She wrote on the board the names of the two groups into which the Animal kingdom is divided. She defined vertebrates as animals with a vertebrate and invertebrates as those without (MLO, 233-250). She then proceeded to focus on the vertebrates. She wrote on the board the five groups - the five classes - of vertebrates. She then did the distinguishing characteristics of each class. She allowed them to return to their activity where they had to write down the classes and provide examples for each class. As she ended the lesson, she explained that they will continue with vertebrates in the next lesson, and then proceed to invertebrates.

#### **4.4.5 The textbook used to support Mandy's biodiversity lesson**

Mandy feels that the textbook and the curriculum go well together. "The textbook goes hand in hand with the policy document" (JSI, 17/514). Mandy used two textbooks, Textbook 4 (Document 4) and Textbook 6 (Document 6). Pam also used Textbook 4. Lance used the Afrikaans version of Textbook 6.

The text book, Document 4, states: "the variety of living organisms in a particular area is called its biodiversity. An environment with many different types of plants and animals has a high biodiversity. If there are only a few plants and animals in an environment, it has a low biodiversity" (Doc 4/9). [The consequences of low or high biodiversity was not explained]. Mandy appears to have drawn from the activity on page 9 which places learners in a forest. Learners have to write down all plants and animals, and then classify them; this is what Mandy asked the learners to do.

Diversity of animals is dealt with in Unit 2 on page 14. Diversity of animals seems to be described as the classification of animals into vertebrates or invertebrates. The five classes of vertebrates are introduced with one picture for each class and the facts arranged around the picture. The picture has no ecological context (Doc 4/14-16). Mandy proceeded to introduce the two kingdoms and then specifically the Animal kingdom where she continued to teach about the vertebrates. In line with this textbook, Mandy taught the five classes of vertebrates and some facts for each class. The pictures on page 16 show the habitat. The invertebrates are introduced in the same way (Doc 4/17, 18). The pictures on page 21 do not show the animals in relation to other animals or in the context of their surroundings (Doc 4/21).

The second text book that Mandy used defines biodiversity as "...all the living things on Earth. All the plants, animals and micro-organisms, and their habitats, make up the total biodiversity of the earth" (Doc 7/21). Knowledge of ecological systems is not evident in Unit 1 where it states that learners will learn 1) biodiversity 2) why and how organisms are classified 3) the 5 kingdoms 4) the difference between plants and animals and 5) the classification of living things (Doc 7/21). Mandy followed these steps in her lesson; from this textbook she drew on the five kingdoms, the differences between plants and animals and the classification of living things. The pictures of the

animals in the unit on biodiversity resemble ID photos, that is, a snapshot of the animal only. It does not reveal the animal's relationship to other animals, humans, vegetation or the climate (Doc 7/21 & 26). The knowledge of biodiversity in this unit continues with the knowledge of the classification system in which all living things that make up biodiversity are classified: Kingdom, Phyla (Divisions), Classes, Families, Orders, Genera and Species (Doc 7/24).

#### **4.4.6 Conclusion**

Mandy, a science teacher with 25 years of teaching experience, currently teaches at a school situated within a former informal settlement. Mandy completed her schooling and teacher training in the rural Eastern Cape. Mandy prefers an authoritarian government that could protect biodiversity while simultaneously ensuring economic growth. Mandy acknowledges that biodiversity provides for human needs and human demands. Mandy feels that although the biodiversity topic was not difficult, it was too long with many new concepts for the learners to grasp. Mandy obtained her biodiversity knowledge from the textbooks. She feels that the textbooks align very well with the CAPS. She feels that she had not been sufficiently prepared by the Department of Basic Education to teach biodiversity. In her lesson, Mandy used sentence strips to help learners understand the definition of biodiversity. After that, she had the learners classify the plants and animals. She then taught the difference between plants and animals, she introduced the Plant and Animal kingdoms and then, within the Animal kingdom, defined vertebrates and invertebrates. She taught the five classes of vertebrates before giving the learners an activity where they had to identify vertebrates in the five classes. Mandy used two textbooks extensively for biodiversity knowledge and activities.

### **4.5. Insights of a Senior Education Specialist: Port Elizabeth Education District**

#### **4.5.1 Supporting teachers to teach biodiversity**

After the teacher interviews and lesson observations, I interviewed Mr Sampson, the Senior Education Specialist for Natural Science in the Port Elizabeth Education District, to gain more insight into how the Department of Basic Education supported teachers in the teaching of biodiversity (Appendix F). Mr Sampson was concerned that about a third of Natural Science teachers in the district have no qualification or training in Natural Science. Many of them have been taken from their previous posts of, for instance, Economic Management Sciences or Physical

Training and told to teach Natural Science (DOEI, 14). Mr Sampson supported these teachers by providing them with worked out lesson plans. He said that he has prepared “everything every lesson for every topic for every week for the entire year for grades four and [he] got as far as grade seven”. This is available when teachers “... come to [him] and say they have nothing” and “there’s at least three different activities per topic like for biodiversity... So to save the teachers planning time [he has] given them the plan...everything worked out for them” (DOEI, 15/ 450-462).

The SES was also concerned that there are new or young teachers who “want to know the content, but they are not equipped in didactics and pedagogy...they struggle...” with how to teach (DOEI, 17/509-511). Consequently, the SES says that he has “tried to take them from the base line towards the expected”; he wants to save teachers time by giving them the file with complete lessons, “but many of them still need training in especially Matter and Materials and Energy and Change. They skim over that...they [are] comfortable with Biology...” (DOEI, 17/513-525).

Mr Sampson spoke highly of teachers who freely share their successes with struggling teachers, describing them as his support base. He said that he would not be able to cope with so many schools were it not for these teachers who share their ideas and their materials (DOEI, 18/543-554).

In line with my observations and interview data, Mr Sampson explained that teachers rely heavily on the textbook when implementing CAPS. He explained that when the teacher opens the CAPS document on page 17, they see what they have to do in three and a half weeks. The activities are all given “...but how will they teach it?”... “they must list the distinguishing characteristics, but how [will they] jazz it up?” in other words, how will teachers make it accessible and interesting for the learners? (DOEI, 20/589-601). The SES feels the answer to this lies in the choice of textbook and expressed his excitement and support for two very good textbooks in which the authors “looked at the requirements and came up with very beautiful colourful ways of teaching the various topics” (DOEI, 20). He added:

Finally, finally, there are textbooks that have worked this out for you...because...when I was a teacher...when we were taught at school there was a textbook and the textbook was in line with the policy. Now for the first time last year [2013]...the teachers can go to this book, forget about specific aims and process skills, because its worked in here...you’re just

going to teach it like this...so by just teaching this, they are complying with policy, with specific aims and the process skills (DOEI,21,22/628-650).

In his view, a good textbook is like a didactical book. “It’s like a college in the book, because if I was a novice and I never taught the subject before, I can see that’s my requirement and here’s my book” (DOEI, 23/705-711). He continues: “So this textbook now becomes the SES in *absentia* so then I can say that book is excellent...at the moment there are only two [textbooks] that are very strong” (DOEI, 24/713-716).

Another challenge to teaching biodiversity that the SES identified is teachers’ access to resources. He referred to “Thunderbolt books” which were handed out to teachers during the previous year [2013] which direct teachers to websites containing videos on, for example, diversity of plants. Most of the township and northern areas schools in Port Elizabeth had received laptops with unlimited internet access which Mr Sampson regarded as sufficient to equip teachers to implement the CAPS curriculum effectively (DOEI, 25).

#### **4.5.2 Environmental learning in Natural Science**

When asked about the extent to which the CAPS Natural Science documents enable teachers to bring out environmental learning, Mr Sampson explained that learners receive a holistic education as provided by the four strands of the Natural Science curriculum: Life and Living, Matter and Material, Energy and Change and Planet Earth and Beyond (DOEI, 28/839-841). However, in his view, neither the CAPS nor the textbooks offer much regarding people’s relationships with biodiversity, nor with the importance of caring for it. In the biodiversity section, he said, he only sees facts but believes the facts should be supported by a footnote to help learners realise their role in the home and school environment and to respect the “space that we co-habitate” (DOEI, 30).

Mr Sampson illustrated this point by noting that in grade six, the learners study a short section about the importance of wetlands. Although Port Elizabeth is surrounded by wetlands, learners might wonder how wetlands are relevant or important to them because “animals and diversity and ...wetlands are not explicitly explained” in the curriculum. He notes: “During a drought, a wetland can become very important in your life, because a wetland purifies water.....water that we also need to drink. Eventually that water goes into the ground. There’s a water cycle, but the teachers

are not told to teach it that way. It might take some environmentalist as a teacher to hammer it home” (DOEI, 32/999-1011). “On behalf of the Department, I plead guilty, because it’s not as explicit here...here in grade seven they do not go to the extent of making people aware ...How can we expect the child to be a responsible citizen, but we [are] not teaching them how to be responsible citizen[s]...we [are] just teaching them content and we divorce the social consciousness from the content” (DOEI, 33/1013-1028).

## **CHAPTER 5**

### **5.1 Introduction**

Chapter 4 provided a description of the data drawn from extracts of the raw data in the form of three case studies. In this chapter, I discuss and analyse that data, and synthesise it in the light of the study's theoretical and conceptual framework. In doing this, I address the research question directly, which is: What do Grade 7 Natural Science teachers know, believe and say about biodiversity and the teaching of biodiversity? The following sub-questions guided the study:

1. What knowledge do teachers have of biodiversity?
2. How do the teachers represent biodiversity, for example, which biodiversity narratives and metaphors are evident in their discourses?
3. What beliefs and values of biodiversity do the teachers hold?
4. What accounts do the teachers give of why they teach biodiversity in the way that they do?
5. Which textbooks do the teachers choose to use and how do they use CAPS?

These questions were used to identify issues that needed to be considered in order to understand the scope of biodiversity and the teaching thereof. As presented in Chapter 2, the study has also considered the scope of biodiversity, the international policies and agreements affecting it and the national curriculum with regards to the teaching of biodiversity. To facilitate the discussion in this chapter, I represent the data through a sequence of analytical statements which form the basis of the study's findings. The analytical statements are drawn from the data as recorded in Chapter 4 as well as the theoretical discussion presented in Chapter 2.

Education is seen as one of the solutions to our environmental crisis and, in this study in particular, biodiversity loss. Therefore, teachers' knowledge of biodiversity and biodiversity loss is crucial. Below, I discuss the findings related to the research sub-question: What do teachers in these three case studies know and believe about biodiversity and the teaching of biodiversity?

**5.2 Finding 1: The biodiversity knowledge of the teachers in these three case studies is mostly limited to what they access in the curriculum document and textbooks.**

Shulman (1987) describes subject content knowledge as teachers' depth of understanding and skill based on the accumulated literature on the content knowledge as well as its alternative theories and its historical and philosophical background. But understanding of concepts and facts of the discipline is not sufficient. According to Wilson, Shulman and Richert (1985), teachers should be able to make connections between the facts and concepts within the discipline, for the learners.

In this study, one of the teachers came across the word "biodiversity" for the first time in 2014, with the CAPS (JSI, 18/533,537) while the second teacher heard about biodiversity for the first time during the CAPS training in September/ October 2013 (LI2/10,11). The third teacher heard about biodiversity for the first time "at the arrival of the new curriculum [CAPS]" (PI2/32). This implies that, as the three teachers in these case studies have had no significant preparation to teach biodiversity, their biodiversity content knowledge was not well-developed when they started to teach biodiversity for the first time in 2014.

The teachers report that they were prepared for biodiversity teaching by the Department of Basic Education. The two day teacher training session that was held in 2013 was run by the Senior Education Specialist (SES) for Natural Science InterSen. He was supported by a small team of Natural Science teachers. According to the SES: "This [CAPS biodiversity] content is now very prescriptive"... [and] it's actually the way the textbook also wants it" (DOEI, 2/55-63). The Senior Education Specialist suggests that there is a standardisation, a uniformity and the following of prescription in Natural Science teaching. "The standard" is in the test, exams, assessment and content (DOEI, 11/319). The activities that teachers are required to do based on the biodiversity content knowledge is "suggested" in the CAPS, but "it's the way the textbook also wants it" and this leads to "uniformity" and "standardisation" (DOEI, 3/73-83). In the light of the complexity of what biodiversity encompasses, it is clear that some teachers may need more than two days to be introduced to the complicated and interlinked terms within biodiversity.

One teacher, who has many years of experience as a Natural Science teacher, believes that biodiversity is the old Biology, it is not new. This sense of biodiversity being the same as in previous Natural Science curricula is conveyed by the SES as well, when he says, "There's your

content. It's the same" (DOEI, 7/190-202). However, there seems to be a sense of needing to keep the teachers happy and not getting them disgruntled. There seems to be an anxiety, "to get the buy-in from the educators by saying, look here, there's your content. It's the same" (DOEI, 17/190-202). According to the Senior Education Specialist, "the new thing" in biodiversity is the process skills of grouping, sorting and classifying (DOEI, 2/52-55). This point is further discussed in Section 6.5. It would also seem as if teacher happiness is considered more important than including a body of vitally important knowledge. One has to wonder if the Department of Basic Education is so occupied with teacher concerns that they neglect to focus on sourcing and including the new knowledge that is being generated in research communities.

The teachers' biodiversity knowledge seems limited to facts about plants and animals. An important aspect of teachers' subject content knowledge is the teachers' ability to represent the subject content matter to their learners (Wilson, Shulman & Richert, 1985). In other words, teachers should be able to explain the subject matter in different ways using analogies, examples, and illustrations to enable their learners' understanding of the subject content concepts. This study found that biodiversity content knowledge was poorly illustrated by the teachers' own illustrations or examples, possibly due to the teachers' own limited knowledge of biodiversity. The teachers relied heavily on the pictures in the textbooks to illustrate biodiversity knowledge for their learners. The danger of relying on the textbook as the only source of knowledge is that textbook knowledge may be limited, as has been revealed in this study

Wilson, Shulman and Richert (1985) also recommended that teachers should have knowledge of the relationship between the facts and concepts in their discipline, and in the specific topic. The teachers should be able to make links between concepts for the learners. In the three case studies, only one teacher made some connections for his learners. The only connection Lance made for his learners was when he said that algae looked like bacteria and algae and bacteria have a lot in common (See Section 4.2.4). In most cases, the biodiversity concepts and facts in the textbooks were presented as isolated facts. Pam, for example, introduced vertebrates and invertebrates, taught the characteristics of vertebrates, the five classes of vertebrates and the characteristics of each class, she defined warm and cold-blooded animals and internal and external fertilization, all of which contain a large amount of facts (See Section 4.3.4). Lance and Mandy taught in much the same way, as was presented in Chapter 4. The Department of Basic Education through its

curriculum, as well as the textbook writers who had followed the curriculum, had failed to capture the essence of biodiversity. The curriculum and textbooks currently focus on biotic and abiotic elements of an ecosystem. It should however also include the processes and functioning of ecosystems and its link to the 'web of life'. This means that there needs to be a focus on how human interference can influence the health, stability and resilience of ecosystems as well as human's role as a predator on the trophic levels. Learners also need to understand the top-down-bottom-up production processes that drive the food chain which links all living organisms, while focus on above-ground-below ground interactions would help learners to understand the role of some micro-organisms.

Hashweh (1985), as cited in Wilson, Shulman and Richert (1985), found that teachers who had a greater command of subject content knowledge were able to notice when their learners' had misconceptions or incorrect understandings of the content. They were then able to correct the learners' misconceptions. The teachers in these case studies did not notice or correct their learners' misconceptions. The incorrect knowledge was allowed to slip through. For example, one learner proposed that one difference between plants and animals is that "we water the plants to grow" which Mandy agreed with (MLO, 197, 198). Mandy did not notice or correct the learner's misconception that plants are dependent on humans watering them in order to grow.

As noted above, the teachers' biodiversity knowledge seems limited to minimal facts about plants and animals. This was reflected, for example, in Lance's comment that, "biodiversity is all about seeing the different creatures that's on the Earth" (HIL, 10/322-325). This view of biodiversity is in line with CAPS. The teachers are doing all that is required of them in the section on biodiversity on pages 17 and 18 of the Grade 7 CAPS document. It would appear that CAPS did not sufficiently develop its aim for Natural Science "to understand the world as a set of related systems" (DBE, 2011, p. 9) and for learners to "make connections – not just to know facts". These aims have not been carried through into the biodiversity teaching plan section in CAPS on pages 17 and 18, and has not been "connected" (DBE, 2011, p. 9) for the teachers (section 2.4.1).

While Fien and McClean (2014) found a gap between what ought to be taught and what is actually taught in the classroom, this is not the case in these three case studies. The three teachers are in effect doing what the CAPS biodiversity section states ought to be done. It thus appears that the

limited scope of the curriculum limits biodiversity knowledge to facts about a selection of individual plants and animal species, its diversity, rather than as an interrelated, ecologically significant system which includes people (Yavtez, Goldman & Pe'er, 2014). This limited representation of biodiversity may prevent learners from exploring the social, political, economic, spiritual and cultural aspects of biodiversity which Gayford (2010) argues is fundamental to environmental education.

The teachers' pedagogical content knowledge (PCK) (Shulman, 1986), evidenced in this study through the use of flashcards with the concepts, drills with definitions and pictures of biodiversity, was sufficiently effective to convey the factual knowledge as required by CAPS on pages 17 and 18. However, this factual knowledge is unlikely to lead to transformative learning which, according to Wals (2010), requires learners to ask questions, to deliberate, to find solutions to problems and to look at cause and effect.

**5.3 Finding 2: There appears to be the assumption that if teachers teach from certain textbooks, they will meet the Specific Aims for Natural Science, in terms of biodiversity. They will also be implementing the process skills, which is the 'new knowledge' according to the SES.**

It is interesting to note that the teachers taught their Grade 7 biodiversity lessons in a similar fashion even though they come from different backgrounds and have never met one another. They defined the biodiversity concepts, drilled and consolidated the knowledge using flashcards and pictures, and then allowed the learners to classify, sort and group. They taught the same knowledge followed by the same kind of activities. There may be three explanations for this. The first explanation lies in the design of the curriculum and the biodiversity content knowledge which teachers are required to teach. I have addressed this in Finding 1 above. The second explanation lies in the two-day training that the teachers received through the Eastern Cape Department of Basic Education, and the third explanation lies in the design of the textbooks which the three teachers used.

The biodiversity content knowledge of the teachers, their pedagogical approaches as well as the activities the three teachers chose to allow learners to engage with biodiversity knowledge may possibly be explained by the way the teachers used the textbooks.

Two of the teachers used the same textbook [Textbook 1 (Doc 1) which is in English, and Textbook 6 (Doc 6) which is in Afrikaans]. The textbook writers convey the rich abundance of biodiversity of Earth, the continual discoveries of new species and a sense that much more is yet to be explored (see Document 1 and 4, Chapter 4). While this may be true, it is significant that biodiversity loss is not acknowledged in this textbook. One consequence of this is that two of the three teachers appear not to have considered biodiversity loss at all in their teaching.

A second aspect that is absent from the section on biodiversity in this textbook is context. As described in Chapter 4, the shared context of biodiversity and humans is not conveyed in any of the textbooks. The authors define biodiversity as “all living things on the Earth, all the plants, animals and micro-organisms and their habitat together forms biodiversity on Earth” (Doc 1 & 6/21). “Habitat” is the only word that refers to the context, but it does not convey the sense of changeability, or the interrelation or interdependence of the ecological systems that make up biodiversity (see Section 2.2.1). This lack of context is further evident in the pictures in the textbook. The pictures of the animals resemble identity document photographs; a snapshot of the animal only. The pictures do not reveal the animal’s relationship to other animals, humans, vegetation or climate (Doc 1/21, 26; See Appendix S). One teacher uses the teacher’s guide of this textbook. The teacher’s guide provides online resources which include a blog, a 5 minute video clip, charts and a You-tube video clip. The online support reinforces the knowledge in the textbook but does not introduce new or different biodiversity knowledge. The online material presents the same knowledge in a different form, for example, as flow charts, and charts, and live images as is described in Sections 4.1.7.1 and 4.3.7.1. These features reflect what Schudel et al. (2008) describe as the limitations of (biodiversity) content knowledge interfacing with pedagogy within a changing social-ecological context (see Section 2.9.3).

The textbook activities that learners are required to do include the process skills of classification, sorting and grouping. According to the Senior Education Specialist, this is the new addition to CAPS which makes biodiversity knowledge in CAPS different to biodiversity knowledge in the RNCS, the previous curriculum. The activities include the process skills as listed in CAPS (p. 18) where learners are required to classify and list objects (Doc 1 & 6/22), complete a table (Doc 176/24), identify, list (Doc 1 & 6/27), observe, describe and make a drawing (Doc 1 & 6/30) (See Appendix S).

In a second textbook used by two teachers (Doc 4), biodiversity is defined as "...the variety of living organisms in a particular area and is called its biodiversity. An environment with many different plants and animals has a high biodiversity. If there are only a few plants and animals in an environment, it has a low biodiversity" (Doc 4/9). However, the textbook writers do not explain this very crucial point of high and low biodiversity and what causes it to be high or low. (For example, it could have been appropriate, at this point, to introduce peoples' overexploitation of natural resources and high levels of waste generation as immediate threats to habitats and biodiversity, as well as human-induced climate change (See Section 2.2.2).

In a third textbook (Doc 3) used by one teacher, the biodiversity knowledge that is provided is more than just an Identity Document snapshot as is the case in Textbooks 1 and 6. In Document 3 (page 20) the textbook writers depict the role that some bacteria, algae, fungi and plants and animals play. However, the biodiversity knowledge is not extended to the role that humans play in biodiversity.

A fourth textbook (Doc 5) is used by one teacher. Of the 5 textbooks used by the teachers in this case study, this textbook comes the closest to giving all life on Earth a context, where "habitat" is defined as a "forest, desert, wetland or ocean" (Doc 5/27). However, this context is not developed further, since, as is the case with the other textbooks, it is followed by classification. One advantage of this textbook is that it explains each concept in detail and would therefore be an asset to the 30% of Natural Science teachers who are new to the subject (DOEI, 14/415, 416). The amount of time spent on knowledge concepts far outweighs that spent on the knowledge of process skills. This is not so with the other 4 textbooks (Docs 1, 3, 4, and 6).

The Senior Education Specialist seems to endow some of the textbooks with great power. According to the SES, there are "two very good [textbooks]" (DOEI, 21/628, 629). The specific aims of Natural Science and biodiversity and the process skills "have been worked out for you" in the textbooks (DOEI, 22/648-650). Consequently, "because it's worked in the [textbook] you just go to teach it like this" (DOEI, 22/666, 667). The textbook holds so much power that by teaching "it like this, they are complying with policy, specific aims and the process skills" (DOEI, 22/671, 672). The SES believes in the power that the textbook has to ensure effective teaching because the textbook is "like a didactical book" (DOEI, 24/731) and has become "the SES *in absentia*" (DOEI,

24/736). The Senior Education Specialist adds that he finds only “two [textbooks] that are very strong” (DOEI, 24/738).

According to Richards, a British educationist (1998), in studies in the USA and Britain, there may be a perception that teachers do not teach well. Textbooks are therefore designed to provide the prescribed content and prescribed tasks to compensate for teachers’ inadequacies. Richards (1998) also found that within the educational fraternity there is the thinking that textbooks that are based on research findings and theory are able to improve the quality of education. Richards (1998), however, warns against reification. Reification means that textbooks are seen as excellent and as having authority. The danger is that reification results in teachers not looking at textbooks critically. Textbooks, no matter how good, are not perfect and therefore teachers should feel free to adapt and build on materials in the textbooks as they feel their learners need it. Adaptation and supplementing of teaching and learning materials form the core of teaching (Richards, 1998). None of the teachers in this study indicated that they have changed or built on materials in the textbooks. The SES did well to empower the teachers on his training course to evaluate textbooks and so select the ones most suitable to the CAPS content. However, textbooks may not be perfectly suited to the context of the learners (Richards, 1998), and teachers need to know how to adapt textbook materials.

Textbooks may help inexperienced Natural Science teachers like Lance to develop skills and guide his teaching (Richards, 1998). However, textbooks may lead to teachers not taking responsibility for decisions on what to teach and how to teach it. For example, one teacher in this study does not always prepare lesson plans but teaches directly from the textbook.

Hutchinson and Torres (1994, as cited in Richards, 1998) found that textbooks help learners to see the learning programme as a whole, enabling them to understand what and how much will be covered. It is interesting that this is what the textbook did for Mandy when she received the textbooks and realized how much content she had to teach (JSI, 15/430-434). However, this reliance on the textbook to be informed of which content to teach, indicates that the teachers in these case studies had no prior knowledge of what the biodiversity unit in the learning programme entailed and how they could teach it.

There seemed to be the assumption that if teachers taught from the textbooks they would meet the Specific Aims of Natural Science as well as implement the process skills. The textbooks depict biodiversity abundance but not its loss. The pictures of biodiversity in the textbooks lack an ecological context, while the textbook overall is silent on the role of humans in biodiversity.

**5.4 Finding 3: Teachers' close adherence to activities prescribed in the textbook seems to limit the depth, scope and criticality of their biodiversity teaching.**

This section discusses data that relates to the research sub-question: What accounts do teachers' give of their choices to teach biodiversity in the way that they do?

The teachers' pedagogic approaches and the learners' activities are limited to having the learners sort, classify, list, describe and draw about the biodiversity knowledge provided them. The teachers appear to do this because the learners' activities are clearly prescribed in the CAPS and in the textbooks.

A broad range of literature in environmental education and biodiversity teaching in particular suggests that learners, even at the primary level, should be able to do more than just sort, classify, list and describe. Learner activities should provide opportunities for situated learning (Schudel et al., 2008) where learners co-operate in their own socio-ecological contexts which will enable them to construct knowledge and formulate real responses to problems such as biodiversity loss.

Biodiversity is represented in the textbooks as knowledge. The textbooks all seem to lean towards this, since the textbooks concentrate in all the units on facts about the classification and diversity of plants and animals. Two textbooks emphasise that scientists are the experts and the holders of knowledge (Dryzek, 2005). Each sentence in the biodiversity unit starts with "Scientist". "Scientists use...", "Scientists have identified...", "They [the scientists] think that..." (Doc 6/21). "Scientists group...", "They [the scientists] look for...", "Scientists name...", "Scientists have grouped..." (Doc 6/22). One textbook (Doc 1 and 6) foregrounds the great abundance of life on Earth: "scientists think that there are between 30 and 50 million different kinds of living organisms on Earth" (Doc 7/21). This impression of abundance is not balanced by noting the challenges and implications of biodiversity loss.

The three teachers in this study restricted themselves to the activities in the textbooks. However, by doing only the activities in the textbooks, the quality of biodiversity teaching and learning is compromised. Smith (2013) describes place-based education as an approach where learners' places of living and playing become additional contexts for learning. The activities which the teachers followed in the textbooks prevent learners from participating in inquiry activities where they consider alternatives and apply the scientific research process to real world problems. According to Smith (2013), this inquiry will allow learners to see the relationship between, in this case, biodiversity knowledge and skill and their real world. Smith (2013) further argues that when learners are allowed to read up and interview people to obtain information, they become knowledge producers and not simply consumers of knowledge in the textbooks. Smith (2013) also found that learners who participated in efforts to care for and improve their environment not only developed ecologically sustainable behaviour but also achieved academically.

A pragmatic approach would also offer the biodiversity programme greater depth of understanding and critical thinking. A pragmatic approach, according to Rennie (2011), applied to biodiversity teaching in this case, would allow learners to participate in solving biodiversity problems in their communities which may help them understand that science in the real world is complex and changing. It would allow them to participate in dialogue and debate that would consider differing social, cultural, economic and political views that may shape biodiversity in their communities. Rennie (2011) found that learners develop reasoning skills as they engage scientific knowledge in real life contexts, and this may be the case for biodiversity knowledge as well.

Transformative learning, as described by Wals (2010), will benefit biodiversity teaching and learning as learners will come to understand and learn to cope with the uncertainties and complexities of our biodiversity. For example, learners could look at how real life events are linked to other events, and examine their causes and consequences. In transformative learning learners are encouraged to ask questions, deliberate and find solutions to problems and to explore different social practices towards a more sustainable society.

It is evident that much potential exists to explore approaches to biodiversity teaching that may lead to practices that would indeed reduce, or even prevent, biodiversity loss.

#### **5.5 Finding 4: All three teachers expressed a pragmatic view of the value of biodiversity.**

A diversity of ethical positions is held simultaneously by the teachers. The teachers experience tensions because they hold both anthropocentric as well as non-anthropocentric views of biodiversity. Biodiversity has intrinsic value for the teachers, in other words, biodiversity has inherent value and worth. Lance attributes inherent worth to biodiversity. The value creates conflict within him because he accepts the fact that people must eat and therefore need to clear areas of natural vegetation to plant crops, but he is concerned with where the displaced animals and plants shall go (HIL, 4/101-104). Pam, too, attributes inherent worth to biodiversity. She is also left hurt, and experiences personal conflict, and would prefer farmers to select areas for farming that do not infringe on the habitat of animals (EIP, 13/357-365). Lance values both the large and prominent animals as well as the small and insignificant species for their systemic value (Kronlid & Öhman, 2012), for the role that they play in the food cycle.

But while Lance holds the view that biodiversity has intrinsic value, and that all living things should be allowed to live because that has a good of its own, a position that philosophically rejects human superiority over nature (Hattingh, 1999), he resigns himself to the fact that humans dominate (Dryzek, 2005). He is concerned with “those animals, insects, plants” that are displaced by human domination of the land, asking: “Where are they going?” (HIL, 4/103-104). During the biodiversity lesson, Mandy left uncontested a discussion about the differences between animals and plants when one learner said that animals drink water and another learner added that: “We water the plants to grow”. This reflects a view on the part of the learner that the only way that plants grow is when humans water them, thereby implying that humans control the growth process of plants (JSO/197).

In order to curb human domination, Lance advocates for an effective administration (Dryzek, 2005) to help manage our biodiversity. He believes that “government ... [should] say this area is reserved for this or for that” (HIL, 5/147-150). Pam, too, would want the government to consider protecting species, like abalone, that are under threat of human exploitation (EIP, 28/786).

The teachers also hold an anthropocentric view which sees economic growth as progress and preserves nature for human use (Hattingh, 1999). Mandy, on the other hand, prefers a government “that would be very strict” in order to preserve our diversity of animals (JSI, 18/222, 224) and that

would ensure an “environment which is economically stable ...and sell and export some of the food” (JSI, 4/92-95). Lance understands that some of the forest needs to be cleared for agriculture because people’s needs have to be met. However, he would like to see a balance, that some land should be used for agriculture but that the rest “be nurtured and kept in its natural form” (HIL, 3/94-99). Two teachers considered their present and future generations as worthy of consideration. Lance considers leaving our biodiversity, in particular the “big five”, for our future generations (HIL, 12/381, 382,) as well as preserving all the species (HIL, 13/406-409). Pam, too, feels that our plants should be preserved for the future (EIP, 12/341, 342). While Lance’s description of biodiversity as “continuous” conveys his desire to preserve our diversity of plant and animal life “for future generations” (HIL, 13/406-409), Mandy describes biodiversity as “the beauty of the environment (JSI, 3/86) ...an environment which is economically stable” (JSI, 4/92).

Whilst the teachers attribute inherent value to biodiversity, they also attribute instrumental value to it. Biodiversity has instrumental value to all three teachers, in other words, biodiversity is useful to humans and is the means to what is perceived as good. Biodiversity has *demand* value (Kronlid & Öhman, 2012) for both Pam and Mandy. Biodiversity has demand value for Pam in that it satisfies human preferences in her experiences. The wetland is used to baptise the members of a large and prominent church (EIP, 16/433-444). Animals have demand value because people can find many uses for their skins including floor mats. Animals are also needed for rituals (EIP, 17/459). Mandy refers to the need for animal skins to make leather jackets (JSI, 7/191-192). Here, Nature is seen to have value because it meets basic human needs (Kronlid & Öhman, 2012). Biodiversity also has *need* value for Mandy, who prefers that the produce of plants be sold and exported (JSI, 4/92-95). Mandy also seems to make a distinction between domestic animals and “animals that are found in the forest” (JSI, 8/230,232). She is not concerned about domestic animals like “chickens or pigs [which] grow every time” (JSI, 8/216) but feels that government should protect “the animals in the forest” because they can become extinct.

Biodiversity also has *transformative* value. Pam’s encounters with knowledge about biodiversity have transformed her perception of the value of non-human life (Kronlid & Öhman, 2012). She relates how in former years she did not care about the life of animals – for example, she killed the cat that stole her mother’s Kentucky Fried Chicken (EIP, 28/298- 809) – but years of education

have transformed her views. She reports that she now values animals and takes them to the vet (EIP, 29/829-831).

While it is evident from Lance's discussions that he believes biodiversity to be threatened by human pollution (HIL, 5/145), he seems optimistic about unexplored biodiversity. He says "The Earth is still busy proving itself" as scientists discover new species each day (LLO/35-37). His optimism about the abundance of biodiversity is further conveyed by his metaphor of biodiversity being like jelly tots<sup>2</sup> "the different colours, the different flavours, it's just like species of animals" (LI2/98-101). Lance's view of an abundance of resources is echoed by Pam. Pam holds the view that the number of animals won't decrease in number because they will keep reproducing (EIP, 17/465-482) indicating that there is the assumption that the supply of resources is abundant. There is no fear of an end to supply (Dryzek, 2005). According to Pam, people are driven by self-interest and business and economic interests as: "animals have been killed ...for their skins...can make doormats..." and by religious interests: "animals can also be used for rituals" (EIP, 17/459). However, Pam believes that people should be responsible for taking care of biodiversity because "God ordered human beings to be responsible for His Creation" (EIP, 29/816-820).

According to Kronlid & Öhman (2012), when a non-human is constituted as a moral object, it implies that it is morally relevant, and that its needs and well-being are considered. In this study, two teachers considered biodiversity to be morally relevant. Mandy considers non-human animals with the *ability to experience pain and suffering* as being morally relevant. She considers the animals that live in the wetland that may suffer as a result of pollution (JSI, 5/124, 125). She is also concerned for the animals that once lived in natural vegetation that was cleared for agriculture (JSI, 6/156). Pam, on the other hand, considers non-human animals with whom humans have a *social connection* as being morally relevant. She considers tortoises very important because her mother kept them as pets. It upsets her to consider that tortoises can be eaten (EIP, 13, 371-15, 414).

Relational environmental ethics refer to the rational, emotive and relevant relationships that people as moral agents enter into with other people and with nature. Relation-oriented environmental ethics is also concerned with how environmental values are created and maintained, and seeks

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<sup>2</sup> 'Jelly tots' are small, multi-coloured sweets that are popular in South Africa.

solutions to how humans and nature should co-exist (Kronlid & Öhman, 2012). Lance sees humans and nature as sharing certain geographical space as with the algae found at the beachfront (LLO 98-100), fungi on our bread (LLO 104-109) and bacteria and viruses in the air around us (LLO 147-153). For Mandy, the animals are separate from people's daily lives as they are "in the forest" (JSI, 8/230). The forests also seem "untouched" for Mandy (JSI, 6/172). She views domestic animals such as chickens and pigs as different to "the animals in the forest".

The relationships that Lance understands people to have with other people and nature is one of human domination. The cause of the environmental crisis is human pollution (HIL, 5/136-139). His solution is for local and national government and its politicians to make the decisions to protect sections of natural vegetation and allow people to use the rest. The implication of this, however, is that should people abuse "the rest", the consequences will be carried by all, everywhere, and by nature as a whole according to the argument presented in Section 2.2.2. Human well-being is inter-related with the well-being of biodiversity which crucially links all organisms on Earth into an independent eco-system, the Web of Life, and provides life-giving resources and services to all life on Earth. Mandy's reference to "animals in the forest" (JSI, 8/230) as different from domestic animals like chickens and pigs (JSI, 8/216) may indicate her perception that animals in the "forest" are endangered, yet domestic animals will always be around (JSI, 8/234). This may also indicate a perception that "the animals in the forest" are subject to one kind of environment, or that an environmental crisis exists there, while domestic animals are subject to another, where there is no crisis. Pam, on the other hand, does not clearly suggest a cause for the environmental crisis – she does not lay the blame with people. She ventures to say that "animal cruelty" has caused many animals to be killed but is silent on the subject (EIP, 16/448). The solution to our biodiversity - not that Pam has clearly identified a problem with biodiversity or nature – is that all human beings are responsible for taking care of our biodiversity. For Mandy, the problem seems to be that "all of us eat meat" yet Mandy does not want animals to be extinct. The solution for Mandy is that animals "in the forest" must be protected through government and the law (JSI, 8/222).

## **5.6 Conclusion**

This study found that the three teachers' biodiversity knowledge is mostly limited to what they have accessed in the curriculum document and the textbooks. This study also found that the way

in which teachers represent biodiversity and the values that they hold, reflects a pragmatic view of biodiversity. Teachers adhered closely to the activities in the textbook which seemed to have limited the depth, scope and criticality of their teaching of biodiversity. It was also found that there may be the assumption that if teachers teach from certain textbooks, they will meet the Specific Aims, and the process skills which, according to the Senior Education Specialist, is the new knowledge.

In the next and final chapter, I reflect on these insights in terms of the study as a whole and make some recommendations for responding to these strengths and challenges, as well as some recommendations for further research in this important area.

## **CHAPTER 6      Conclusions and recommendations**

### **6.1 Introduction**

The overall aim of this research was to explore what three Grade 7 teachers know, believe and say about biodiversity and the teaching of biodiversity. In this concluding chapter, I present summative conclusions on each research objective, and make some recommendations for further research.

### **6.2 Concluding Insights**

The main conclusions that can be drawn from this study are that teachers do not have a sound knowledge base in terms of biodiversity, and that the content and manner in which they teach biodiversity is substantially influenced by the curriculum document and the textbooks they use.

All three teachers in the case studies learned about the concept of ‘biodiversity’ for the first time at the CAPS training and through reading the CAPS document. Although literature reviewed for this study advocates that biodiversity be taught as an integrated system that includes people, the case study data showed that the teachers taught facts about selected plants and animals. Similarly, international literature about biodiversity teaching emphasises that learners should have opportunities to ask questions, deliberate, find solutions to problems and examine cause and effect. However, as evidenced in these case studies, the three teachers focused almost exclusively on teaching vocabulary, definitions of the main biodiversity concepts, and classification of plants and animals. Yet the teachers were, in fact, doing what the curriculum demanded of them. The CAPS for Natural Science emphasises process skills of sorting, grouping and drawing; the textbooks align closely with the policy and thus focus on the development of these process skills in the section on biodiversity. There appears to be a uniformity, a prescribed, standardised way of teaching biodiversity across the curriculum documents and the textbooks, and the teachers align closely with both and follow the activities as prescribed in the textbook.

One teacher believes that biodiversity is the ‘old Biology’. This is echoed by the Senior Education Specialist for Natural Science who suggested that the biodiversity content is the same as the previous curriculum and that only the process skills of grouping, sorting and classifying were “new”. The study found that in all three cases, the biodiversity content knowledge was poorly

illustrated by the teachers to their learners. Two teachers made no connection for their learners regarding the relationship between the range of biodiversity facts and concepts and specific topics such as habitat through, for instance, using analogies, examples and illustrations. The three teachers in these case studies did not notice or correct their learners' misconceptions about biodiversity. In one case, the teacher implied that humans are responsible for the growth of plants. One teacher believes that humans are responsible for biodiversity, based on the Christian religion. These findings illustrate that teachers' biodiversity knowledge is limited in its scope and depth.

Regarding the teachers' values and beliefs about biodiversity, the study found that all three teachers view biodiversity as abundant and assume that the supply of natural resources will always be available. The metaphors that they used reflect their perception of biodiversity as continuous, good, beautiful and economically stable. All the teachers valued biodiversity but in different ways, for different reasons. Biodiversity is valued variously for its systemic, transformative and demand value and because it meets basic human needs.

All three teachers expressed the belief that humans dominate over other forms of life on Earth, although one expressed concern that such domination is not good for the environment, while another was of the opinion that, although people's self-interest, business, economic and religious interests do result in animals being killed, there is no need for concern since animals reproduce. All three teachers seemed to identify effective governance as what was needed to manage biodiversity and protect species and ensure an economically stable environment.

It is against this backdrop of the teachers' biodiversity knowledge, beliefs and values that this study found that all three teachers were heavily reliant on their selected Natural Science textbooks for structuring and resourcing their biodiversity lesson plans. The Natural Science textbook was perceived as very important, with the Senior Education Specialist himself referring to it as "the SES [senior education specialist] *in absentia*". Furthermore, it seems to be the view of the Department of Basic Education, through the Senior Education Specialist, that if teachers teach from certain textbooks, they will meet the Specific Aims for Natural Science, in terms of biodiversity. They will also be implementing the process skills which, according to the Senior Education Specialist, is the 'new knowledge'.

Closer examination of the textbooks used by the three teachers indicated that the textbooks generally foreground the development of concepts related to biodiversity but do little to situate learners' understandings of biodiversity in the global context or their local context. They were also found to present biodiversity as an information-rich topic that concentrates on facts about plants and animals. One textbook that was used by two of the teachers, presents scientists as the holders of biodiversity knowledge. As such, humans' connections to biodiversity, either as beneficiaries of biodiversity or as the source of threats to biodiversity, are not addressed.

### **6.3 Recommendations**

*Recommendation 1:* The Natural Science CAPS should reflect a more systemic approach to biodiversity knowledge, that is, one that recognises the interrelations and independence of the ecological systems that make up biodiversity (including relationships with humans) and conveys a sense of the changeability of biodiversity.

*Recommendation 2:* Natural Science teachers should be supported to develop their understanding of biodiversity. Opportunities to broaden teachers' understandings of biodiversity beyond the basic content specified in the CAPS and in the textbooks, should develop holistic, contextualised understandings of biodiversity and biodiversity loss. By understanding biodiversity as complex, inter-related and dynamic, teachers might be better equipped to discuss with their learners the responsibility that people have towards biodiversity. This, together with Recommendation 3 below, may enable teachers to develop lesson plans that are more situated in and responsive to their learners' social-ecological contexts.

*Recommendation 3:* Natural Science teachers should be encouraged and supported to develop learners' activities that include opportunities to ask questions, to deliberate, to find solutions to problems and to look at cause and effect. Associated with this is the recommendation that teachers be encouraged to adapt textbook materials where appropriate and perhaps even exceed their minimum content.

*Recommendation 4:* As teachers appear to rely heavily on Natural Science textbooks when teaching biodiversity, textbook authors should be encouraged to depict biodiversity more clearly in terms of interdependence, interrelation with each other including humans, and the changeability

of biodiversity. Learners cannot be expected to understand the world as a set of related systems when biodiversity is represented through decontextualized photos of apparently disconnected plants and animals, and through texts that emphasise abstract concepts and terminology.

*Recommendation 5:* In the three case studies, the teachers were silent on organisms, ecosystems and species with regard to values. Teachers do not value life forms that they are not aware of. Consequently, extending teachers' knowledge base of biodiversity to include the micro-organisms that make up our biodiversity, might place them in a better position to attribute value to it. Similarly, developing teachers' understandings of the interrelationship and interdependence of people within ecosystems may stimulate them to attribute moral relevance to ecosystems and species.

*Recommendation 6:* If teachers were to have broader, more holistic and contextually-linked understandings of biodiversity, and textbooks conveyed similar understandings, teachers would be in a position to respond to the final recommendation of this study: that learners and teachers may become citizen scientists who access and contribute to various biodiversity databases, by collecting and identifying samples and engaging in local citizen science projects. This may negate the view that biodiversity science and knowledge belong only to scientists.

#### **6.4 Concluding thoughts and openings for further research**

This study set out to investigate what Grade 7 teachers know, believe and say about biodiversity and the teaching of biodiversity and has found, firstly, that teachers' knowledge of biodiversity is mostly limited to facts about plants and animals and to what they access in the curriculum document and textbooks; secondly, by teachers' limiting themselves to the textbook, their biodiversity teaching was limited in depth, scope and criticality; and thirdly, teachers hold a diversity of ethical positions simultaneously. These findings have highlighted the importance of teachers' biodiversity content knowledge as well as their reliance on the curriculum document to guide classroom teaching and learning. The findings raise challenges for teacher training and in-service teacher training and support to shape a broader knowledge base for biodiversity. Biodiversity is an important area in the Senior Phase curriculum of Natural Science because education has been identified as a strategy to address biodiversity loss by developing citizens who will maintain and preserve our biodiversity. Further research is needed on how best to ensure that

the aims of Natural Science and international agreements to preserve biodiversity through shaping an understanding in our learners of biodiversity as interrelated, interdependent, changing and inclusive of all life, including human, can be carried through into lesson planning. To build on this study, I recommend that further studies investigate in-service teacher training and support for a broader biodiversity knowledge base which includes understanding biodiversity as dynamic, interrelated and interdependent. I also recommend that further studies examine how the aims of Natural Science as expressed in the CAPS inter-relate with teachers' pedagogical content knowledge, their preparedness to teach about biodiversity, and their overall orientation to biodiversity and its value.

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## APPENDICES

### Appendix A

#### Standard 5 1991 Syllabus

(extracted from Walters, Voster, Schreuder and Fox, 1990)

Biology	Vertebrates	Fish, amphibian, frog, reptiles, birds, mammals: Habitat, body parts, body covering, locomotion, breathing, reproduction.
	Non-vertebrates	anthrododia, insects, locust, crustacean crab, arachnida, spider, scorpion, centipede, diplopoda, chilopoda mollusc, snail: habitat, body division, skeleton, locomotion, breathing.  Activity: collect and study a live specimen.
	Plants with seed	Angiosperm the petunia, Gymnosperm, the pine,
	Plants without seed	Ferns, Algae, Fungi, bread mould
	Sorting and classification	Plant/Animals; Vertebrates/Invertebrates; Seeded plants/ seedless plants. Keys for classification.
	Our living resources	Plants: nature reserves, Botanical Gardens, Conservation Programmes, National Tree Planting Day  Animals: Reserves for wild animals, Zoos, Preserving Wild animal programme (black and white rhinoceros)

## **Appendix B**

**Curriculum 2005: The Department of Education Work Schedule for Grade 6  
Natural Science**

**Pages: 16, 57, 70, 72, 73,75.**

Act. No.	Learning Outcome	Assessment Standard	Integration	Time duration	Knowledge Skills Values	Activity	Resources	Assessment	Recording
12	6.2: Construction Science Knowledge: The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.	6.2.3: Interprets information: At the minimum, interprets information by using alternative forms of the same information. 6.2.3.1: Finds information in science texts by using glossaries, indexes and tables of contents. 6.2.3.2: Extracts information from bar graphs. 6.2.3.3: Puts in order pictures of the stages in the life cycle of fruit flies, when observing real fruit flies reproducing. 6.2.3.4: Identifies external parts of animals (e.g. noses, ears, tails, fur, gills, fins, scales, feathers), and tells as much as possible about their function in the animal's way of living.		30 min	Food chains and food webs Interpreting information Getting information from a bar diagram. Arranging of information Identifying different parts.	Compile food chain.	Magazines Old textbooks Reference guides Internet	Form Assignment Who Teacher What Knowledge Evidence Food chain Instrument Checklist	✓

Act. No.	Learning Outcome	Assessment Standard	Integration	Time duration	Knowledge Skills Values	Activity	Resources	Assessment	Recording
10	<p><b>6.1: Scientific investigations:</b> The learner will be able to act curiously on curiosity about natural phenomena and to investigate relationships and solve problems in scientific, technological and environmental contexts.</p>	<p><b>6.1.1:</b> Plans investigations: Helps to clarify focus questions for investigation and describes the kind of information, which would be needed to answer the question.</p> <p><b>6.1.1.1:</b> Expresses focus questions in own words.</p> <p><b>6.1.1.2:</b> Considers classmates' ideas about kinds of information which could be relevant.</p> <p><b>6.1.1.3:</b> Suggests ways that the information could be gathered.</p> <p><b>6.1.1.4:</b> Clarifies task for other learners (e.g. "What we need to find out is...")</p>	SS.6.1.1	90 min	<p>Biodiversity</p> <p>Planning</p> <p>Investigating</p> <p>Compiling focal questions and express in own words.</p> <p>Creative and logical thinking.</p>	<p>Learners compile a questionnaire about the biodiversity of the earth.</p> <p>Groups formulate questions and select the most appropriate questions for the questionnaire.</p>	<p>Magazines</p> <p>Old textbooks</p> <p>Reference guides</p> <p>Internet</p>	<p><b>Form</b></p> <p>Pen and paper</p> <p><b>Who</b></p> <p>Teacher</p> <p><b>What</b></p> <p>Knowledge about the earth</p> <p><b>Evidence</b></p> <p>Questionnaire</p> <p><b>Instrument</b></p> <p>Checklist</p>	✓

Act. No.	Learning Outcome	Assessment Standard	Integration	Time duration	Knowledge Skills Values	Activity	Resources	Assessment	Recording
7	<p><b>6.2: Construction Science Knowledge:</b> The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.</p>	<p><b>6.2.1:</b> Recalls meaningful information: At the minimum, describes the features, which distinguish one category of things from another.</p> <p><b>6.2.1.1:</b> Explains the definitions that distinguish mammals (which suckle their young) and reptiles (which do not).</p> <p><b>6.2.2:</b> Categorises information: organisms by two variables.</p> <p><b>6.2.2.1:</b> Categorises animals as mammals or reptiles and then as carnivorous and herbivorous mammals, or carnivorous and herbivorous reptiles.</p>	LO 6.3.1	60 min	Interaction in the environment. Ecosystem. Remembering and using meaningful information.	Learners investigate interaction in the environment.	Magazines Old textbooks Reference guides Internet	<p><b>Form</b> Investigation <b>Who</b> Teacher <b>What</b> Knowledge about ecosystems <b>Evidence</b> Worksheet <b>Instrument</b> Checklist</p>	

Act. No.	Learning Outcome	Assessment Standard	Integration	Time duration	Knowledge Skills Values	Activity	Resources	Assessment	Recording
9	<p><b>6.2: Construction Science Knowledge:</b> The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.</p>	<p><b>6.2.2:</b> Categorises information: organisms by two variables.  <b>6.2.2.1:</b> Categorises animals as mammals or reptiles and then as carnivorous and herbivorous mammals, or carnivorous and herbivorous reptiles.  <b>6.2.3:</b> Interprets information: At the minimum, interprets information by using alternative forms of the same information.  <b>6.2.3.1:</b> Finds information in science texts by using glossaries, indexes and tables of contents.</p>	Eng 6.5.3.1	45 min	<p>Organisms in their natural environment.            Biodiversity.            Categorising, interpreting and applying of knowledge and information.</p>	<p>Learners complete a worksheet about organisms and their natural environment.</p>	<p>Magazines            Old textbooks            Reference guides            Internet</p>	<p><b>Form</b>            Pen and paper  <b>Who</b>            Group  <b>What</b>            Knowledge about environment  <b>Evidence</b>            Worksheet  <b>Instrument</b>            Rubric</p>	

Act. No.	Learning Outcome	Assessment Standard	Integration	Time duration	Knowledge Skills Values	Activity	Resources	Assessment	Recording
10	<p><b>6.2: Construction Science Knowledge:</b> The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.</p>	<p>6.2.1: Recalls meaningful information: At the minimum, describes the features, which distinguish one category of things from another.</p> <p>6.2.1.1: Explains the definitions that distinguish mammals (which suckle their young) and reptiles (which do not).</p> <p>6.2.3: Interprets information: At the minimum, interprets information by using alternative forms of the same information.</p> <p>6.2.3.1: Finds information in science texts by using glossaries, indexes and tables of contents.</p>	<p>SS 6.1.2 LO 6.2.3</p>	180 min	<p>Sexual reproduction Biodiversity Remembering and applying information.</p>	<p>Learners complete a worksheet about sexual reproduction according to the step by step method in the workbook.</p>		<p><b>Form</b> Pen and paper <b>Who</b> Teacher <b>What</b> Knowledge about sexual reproduction <b>Evidence</b> Worksheet <b>Instrument</b> Checklist</p>	

Act. No.	Learning Outcome	Assessment Standard	Integration	Time duration	Knowledge Skills Values	Activity	Resources	Assessment	Recording
12	<p><b>6.2: Construction Science Knowledge:</b> The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.</p>	<p><b>6.2.2.1:</b> Categorises animals as mammals or reptiles and then as carnivorous and herbivorous mammals, or carnivorous and herbivorous reptiles.</p> <p><b>6.2.3:</b> Interprets information: At the minimum, interprets information by using alternative forms of the same information.</p> <p><b>6.2.3.1:</b> Finds information in science texts by using glossaries, indexes and tables of contents.</p> <p><b>6.2.3.4:</b> Identifies external parts of animals (e.g. noses, ears, tails, fur, gills, fins, scales, leathers), and tells as much as possible about their function in the animal's way of living.</p>		60 min	<p>Biodiversities</p> <p>Changing and continuity</p>	<p>Learners do a fun activity about biodiversity, change and continuity.</p>		<p><b>Form Presentation</b></p> <p><b>Who Group/Teacher</b></p> <p><b>What What Biodiversity Evidence</b></p> <p>Questionnaire about activity</p> <p><b>Instrument Checklist</b></p>	

Act. No.	Learning Outcome	Assessment Standard	Integration	Time duration	Knowledge Skills Values	Activity	Resources	Assessment	Recording
14	<p><b>6.2: Construction Science Knowledge:</b> The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.</p>	<p>6.2.2: Categorises information: Categorises objects and organisms by two variables.</p> <p>6.2.2.1: Categorises animals as mammals or reptiles and then as carnivorous and herbivorous mammals, or carnivorous and herbivorous reptiles.</p> <p>6.2.3: Interprets information: At the minimum, interprets information by using alternative forms of the same information.</p> <p>6.2.3.1: Finds information in science texts by using glossaries, indexes and tables of contents.</p>	EMS 6.5.3.1	75 min	Ecosystems and the environment. Categorising information. Interpreting, knowing and applying of information.	Learners answer questions about ecosystems and the environment.	Magazines Old textbooks Reference guides Internet	Form Pen and paper Who Teacher What Knowledge about ecosystems Evidence Answers to questions Instrument Rubric	

APPENDIX C

TOOL FOR DOCUMENT ANALYSIS OF PAM'S TEXT BOOK

Shulman (1987)	Shulman(1986)	Kaiser & Fuhrer (2003)	
Content knowledge	Content knowledge	Declarative Knowledge (of ecological systems)	<p><b>Doc 3</b></p> <p>The knowledge contained in the biodiversity unit, Topic 2 (Doc 3) starts off with a definition: “ the term biodiversity refers to all living organisms and their habitats on planet Earth. This includes all plants, animals and micro-organisms” (Doc 3/1) I illustrates this knowledge with a pie charts which shows all the kingdoms.The pie chart is labelled “Planet earth’s rich biodiversity”. The pictures in the pie chart show individual plants, animals and organisms, unrelated to each other. This definition is immediately followed by Why organisms should be classified.</p> <p>The knowledge provided is more than just an ID snapshot (Doc 3/20):</p> <ol style="list-style-type: none"> <li>The role that bacteria plays in relation to humans is listed: useful in the production of food such as cheese and yogurt, decomposes dead organic matter but can also cause disease such as tuberculosis.</li> <li>Algae includes the ‘plants’ that wash out on the beach, and certain parasites for example, the parasite that causes malaria.</li> <li>Fungi include mushrooms, mould on bread, as well as the parasite that causes athlete’s foot in humans</li> <li>Plants, by trapping the sun’s energy, change light energy into food enegy, and so provide food for animals.</li> <li>Animals feed on plants and other animals. [The biodiversity knowledge is not extended to the role humans play in biodiversity]</li> </ol> <p>Biodiversity knowledge then reverts back to classification into Kingdoms, Phyla, Clases, Families, Orders Genera and Species.</p> <p>Diversity of animals (Doc 3/22) Topic 2: No definition of diversity is given. The Unit starts with the division of animals into vertebrates and invertebrates. Here the animals are depicted in isolation, with no context (Doc 3/22,23). The diversity of plants (Doc 3/25): no definition is given. Classification of plants into seed plants (Angiosperm (further divided in to Monocotyledons and Dicotyledons) and Gymnosperm; and no-seed plants (Doc 3/25-27).</p> <p><b>Doc 6</b></p> <p>A definition of biodiversity can be implied from “biologists classify all living things into groups to make sense of the variety of living organisms on Earth” (Doc 6/23). A definition Biodiversity is the variety of all living organisms and habitats on Earth (Doc 6/26) “habitat” is defined as a “forest, desert, wetland or ocean” (Doc 6/27) [OPPORTUNITY] [and comes the closest to giving all life on Earth a context. However, this context is not developed further, since this definition is followed by classification on pages 27 and 28.</p> <p>The picture on p29 of The Five Kingdoms show the plants and animals in isolation.</p>

			<p>This textbook explains each concept in the finest detail and is an asset to a novice teacher. Page 28 explains each concept within each kingdom e.g. single cells, many cells, complex plants and complex animals. The language used is simple English. On page 30 the concepts of movement, nutrition, reproduction, growth and responses to the environment is explained in simple detail.</p> <p>Diversity of animals is the classification of the Animal Kingdom (Unit 2 Diversity of Animals, Doc 6/34).</p> <p><b>Doc 4</b></p> <p>The definition of biodiversity “ the variety of living organisms in a particular area is called its biodiversity. An environment with many different types of plants and animals has a high biodiversity. If there are only a few plants and animals in an environment, it has a low biodiversity” (Doc4/9). [The consequences of low or high biodiversity is not explained]</p> <p>The activity on p9 places learners in a forest. Learners have to write down all plants and animals, and then classify them.</p> <p>Diversity of animals is dealt with in Unit 2 P14. Diversity of animals seem to be classification of animals s vertebrates or invertebrates. The five classes if vertebrates introduced with one picture for each class and the facts arranged around the picture. The picture has no context (Doc 4/14-16) The pictures on page 16 shows the habitat. The invertebrates are introduced in the same way (Doc 4/17,18) Page 21 The pictures do not show the animals in relation to other animals or in the context of their surrounding (Doc 4/21)</p> <p>The diversity of plants Unit 3 p22 a definition of plants is they make their own food during photosynthesis, they use sunlight, carbon dioxide from the air and water and minerals from the soil [OPPORTUNITY ] The textbook proceeds with classification. The pictures are of plants in isolation, nothing in the background (Doc 4/25,26)</p>
		<p>Procedural Knowledge (skills, know-how)</p>	<p>The process skills of sorting and classifying (Doc 3/17) and grouping p18. Learners first sort objects that they are familiar with (Doc 3/19) before the knowledge of the classification into the 5 Kingdoms is introduced (Doc 3/20)</p> <p>Doc 6: sorting activities (Doc 6/26,35) Knowledge of concepts 6/33,35 and application of concepts (Doc 6/33,35):[knowledge concepts are more important in this textbook than process skills]</p> <p><b>Doc 4</b></p> <p>Draw a table, classify (Doc 4/9)classify 9Doc 4/10), list the characteristics (Doc 4/17) Observe and describe a snail (Doc 4/19), identify and describe, draw, list and compare (Doc 4/27)</p>
		<p>Effectiveness knowledge</p>	

		(consequences of behaviour)	
		Social Knowledge (socially shared knowledge, via socialisation)	Conventional social norms (traditions, conventions)
			The knowledge of the medicinal value that plants have is implicit, and not made explicit (Doc 3/17) The knowledge of the cancer bush is limited to how it should be classified so that the international world will correctly identify the plant.
			Knowledge of the uses of angiosperms is depicted through pictures (Doc 3/28) Rooibos tea, a famous South African tea; African finger millet, an African grain crop is made into porridge and beer and roots such as carrots, beetroot, cassava.
			Moral social norms (rights of others, justice, equality)
Pedagogical Content knowledge	Wood(1996) teachers' plans and monitoring		
Curriculum Knowledge			

## APPENDIX E

### Natural Science Grade 7 Teachers In-depth Interview Schedule

Purpose:

The purpose of this interview is to explore what teachers say, know and believe about biodiversity and biodiversity teaching.

The broader purpose of this study is to contribute to a national programme called Fundisa for Change which serves to strengthen environmental learning in schools.

Name of Interviewee..... Date of Interview.....

1. How long have you been teaching Natural Science? And Biodiversity?
2. How would you describe your school?
3. How would you describe the learners? Their community?
4. When you think of biodiversity, what images/pictures come to mind?
5. Could you choose 3 words/adjectives/phrases to describe biodiversity (as you experience it in your life)?
6. I would like you to take a minute to study these photos. Could you describe what you see in the pictures? What is your response to it? (See Appendix 1).
7. Could you describe or tell me how you approach teaching Biodiversity? Why did you decide to teach it in that way?
8. How were your own primary /high school experiences with regard to Natural Science? How has your own school experience contributed to your teaching of biodiversity now?
9. How has your professional training prepared you to teach biodiversity? Have you done any courses?
10. Has anything you have experienced in the past influenced the way you teach/ your classroom practice?
11. What ideas do you have for the future with regard to your classroom practice/teaching methods with regards to biodiversity?
12. What problems/challenges/difficulties do you experience when you teach biodiversity?
13. Do you believe that perlemoen is less important than rhino?
14. Which values do you think are important for biodiversity and the teaching of biodiversity?
15. In which ways do CAPS and the textbook(s) influence your decisions about how to teach biodiversity? How do you use CAPS? Why? How do you use the textbook? Which? Why?

Photo stimulus for interviews:



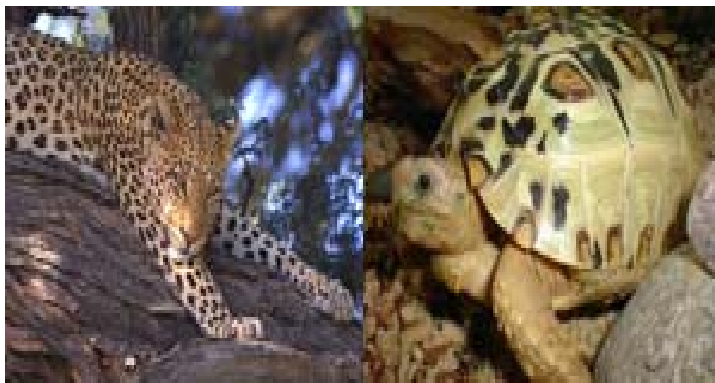
**Figure 1: A Wetland**



**Figure 2: Animal skins**



**Figure 3: A forest cleared for agriculture**



**Figure 4: The leopard and the leopard tortoise**

**References:**

- [www.sanbi.org](http://www.sanbi.org)
- [www.theguardian.com](http://www.theguardian.com)
- <http://ngm.nationalgeographic.com>
- [www.eoearth.org](http://www.eoearth.org)
- <http://ahm.afro.int>

## APPENDIX F

### Interview Schedule: Curriculum Unit SES (Senior Education Officer) for Natural Science

**Purpose of the study:** To explore what grade 7 Natural Science teachers know, believe and say about biodiversity and the teaching of biodiversity.

**Purpose of the interview:** To explore how the Curriculum Unit- Natural Science supports teachers in their teaching of biodiversity.

1. How has the Curriculum unit prepared the teachers to teach the new CAPS NS curriculum, and in particular biodiversity? (Which courses? How long?)
2. How has the Curriculum unit advised the teachers to approach the teaching of biodiversity?
3. What kind of support do you think teachers need to develop their teaching of biodiversity?
4. How has the Curriculum Unit advised teachers to use the CAPS document in relation to teaching biodiversity?
5. How has the Curriculum Unit advised teachers to use textbooks in relation to teaching biodiversity?
6. Our post apartheid curriculum reforms particularly CAPS draws on international and national policies which call for the strengthening of environmental education, in particular education for sustainable development. These policies call for education systems that create an awareness of and concern about the environment, and which develops the knowledge, systemic thinking skills, attitudes, values and commitment to solve current problems and prevent new ones.

To what extent does CAPS enable teachers to implement environmental education and education for sustainable development?

.....

**APPENDIX G**

**TOOL FOR ANALYSIS OF TEACHERS' KNOWLEDGE: Lance, Pam and Mandy.**

Shulman (1987)	Shulman(1986)	Kaiser & Fuhrer (2003)	
Content knowledge	Content knowledge	Declarative Knowledge (of ecological systems)	<p>[Mandy came across the word biodiversity for the first time] this year...with CAPS JSI18/533,537</p> <p>Lance: ...the more pictures the better, because biodiversity is all about seeing all the different creatures that's on the Earth.HIL10/322-325</p> <p>[Lance defines biodiversity as:] life in general that's now really where you touch on all the different forms of life on the planet HIL 2/48,49</p> <p>[Pam defines biodiversity as] biodiversity is about plants and animals...the nature...the pictures of natural resources...the different types of animals (EIP,10/282-283)</p>
		Procedural Knowledge (skills, know-how)	
		Effectiveness knowledge (consequences of behaviour)	
		Social Knowledge (socially shared)	Conventional social norms (traditions, conventions)

		knowledge, via socialisation)	Moral social norms (rights of others, justice, equality)
	Pedagogical Content knowledge	Woods(1996) teachers' plans and monitoring	Mandy: biodiversity the topic is not difficult but its too long...we started this year to do biodiversity, so it was new to me...so I've learned some of my mistakes JSI 13/379-386 Next year I must make sure that everything is well prepared if you are well prepared it becomes easy for you to teach a particular topic If I've got enough time to explain [the terms, concepts] ...I'll have enough of these flashcards JSI15/405,409,414=427
	Pam: I ...use the known to the unknown approach EIP17/486,7. Learners must bring or identify any animals that they know,plants and animals,then I give them a chance to brain storm. I also write everything down on the board, there are lots of new terms...concepts...so I believe when they see the spelling on the board...when they capture the spelling it stays longer in their mind EIP 18/489-511  I studied my primary in homelands, so it was easy for me to go to the riverjust...down my home...crab. But it is difficult with the learners here, because	Lance: It doesn't matter [that he doesn't always have lesson plans] as long as we teach...as long as you teach and cover the work to the best of your ability HIL16/485-486 Our EDO told us we mustn't worry about lesson plans but the last time our Deputy Principal told us last year we must have lesson plans so like I'm caught between a rock and a hard place HIL15/481-483  I started the lesson where I showed them the pictures...different types of pictures...the sea world...birds...animals in the air...animals in the water...to show them	Mandy: We are encouraged not to tell learners everything. You must first find [out] what they knowJSI9/254,5 And encourage them to think for themselves 9/257 there are so many terms here...I have to make flashcards, spread on the wall so with the definition JSI10/287-290

	<p>there are no rivers.EIP 20/ So I have to use pictures 20/</p>	<p>different species we have of those. HIL 5/155-163</p> <p>...because usually our kids relate very well to pictures...things they see6/168-173</p> <p>And all these charts...that I have in my class. Without it it would be difficult to have this lesson and really for them to understand what biodiversity actually means. ...from there [pictures]we actually build the knowledge HIL6/184-190 that's the base from which we work. Pictures are very important in my class HIL7/194</p> <p>Before I teach I look at CAPS what CAPS requires and then I go to my textbook and see what my textbook says about that specific topic for CAPS...if it does I go and teach.HIL15/473-475 I only use one textbook because when I look at the textbook and I look at CAPS...its actually the same. Also the examples of test and exams...lots of definitions of concepts...lots of pictures because our children like pictures HIL16/499-509</p>	
	Curriculum Knowledge		
	Pam: when I was a teacher in Port Alfred, I taught through the textbook. When I came to Port Elizabeth I was		

	workshopped or orientated to the thing that is useful here is the policy documents. EIP6/153-165		
	General Pedagogic Knowledge		
	Knowledge of learners		
	Knowledge of educational contexts	Sanchez & Borg (2014) Teachers' "constructed contexts"	
	Knowledge of educational ends		
Learning and teaching Support Material  (textbooks, curriculum)	<p>Pam: CAPS is in line with the textbook...new textbooks...they are CAPS oriented from page to page. The best way is to take your policy document put it here and take all the references then you look at all the textbooks.... I use all the textbooks. EIP31,32/866-908</p> <p>CAPS is rushing you...I used to panic...if I'm not at school for one day...Even if I'm here at school doing the Admin work...I panic if I lost one period...because CAPS wants you to be in class, in each and every</p>	<p>Two days training... to teach the whole CAPS curriculum...two days only HIL9/273-275 I think it's not enough but under the circumstances I remember it's difficult from the DoE side because time is limited...this CAPS curriculum is very broad...it's very difficult for our kids because of the amount of work that ...must cover for maybe a term or the whole year and I struggle HIL9/277-282</p> <p>The school where I am now we don't have a lot of resources so it affects your teaching because you are quite limited in what you want to do and</p>	<p>Mandy: I think even the DoE is helping us a lot to teach. JSI 12/356 [The DoE has prepared you sufficiently to teach biodiversity] No the honest truth is that maybe they were busy with the workshop since we started this new program this year, but preparing for biodiversity in fact I didn't know that there's something that is new which is so long JSI 15/430-432 ...in our topic until we got the textbooks in February or March...It was late by then 15/434,436 that's why e</p> <p>We didn't prepare thoroughly 15/438,439 the textbook goes hand in hand with the policy document JSI 17/514</p>

	<p>period...[CAPS]does not consider which level...this week you must be finished with...amount of work...while other learners are not at the same level...you have to leave learners behind.EIP32,33/913-944</p>	<p>what you can do. HIL9/285-291</p> <p>We went to training last year we were advised to stick to the curriculum and also to teach as much as we can. They told us we got five years to implement CAPS I don't know how long we will they will stay with CAPS the one EDO told us we don't need actually to prepare the lessons...So they want to make it easier for you. He told us there always remember he said you must just go and teach HIP14,15/448-456</p>	
<p>Social and Cultural phenomenon (developmental, research, social, cultural impacts)</p>	<p>Pam; [My values] come from religion....God ordered that 'you are responsible for all that I've created"EIP29/45-40-45% [of our learners are experiencing learning problems] EIP7/188 Park drive says the LSEN must be given support so that he can be treated as other learners I am co-ordinating the ILST EIP4/97-117</p> <p>There's a lack of managers, there's no one to lead. So I'm heading the Intermediate Phase in all subjects EIP6,7/175-178</p>	<p>Lance: My teachers taught me to have respect for animals and for life in general and...the things I've seen on tv... Animal Planet...that teaches you to appreciate animals and love and care for them. My parents...and my church taught me to respect people and not to destroy animals or kill them...or abuse them and to love and care for them HIL14/434-441</p> <p>My teachers who taught me Biology did a good job HIL7/209 we used textbooks a lot...lots of pictures...lots of teacher talk...our teacher used the investigative method of teaching...we would investigate stuff, draw up</p>	<p>Mandy:My primary school...the way we were taught science is totally different from what we are teaching our learners now.JSI10/295 In fact maybe I was in a totally disadvantaged school then 10/297 there were no chemicals and we were just learning from our textbooks 10/299,301 I happen to go to a good training college what I learnt from the training college that's where it was clear how to teach, even with our workshops we are clearly [shown?] how to teach JSI11/308-316</p>

	<p>[my professional training as a teacher] prepared me a lot...we used to do practical teaching...at the township scholls.EIP21/</p> <p>...the school is being vandalised...can't hang our charts...so we are unable to do teaching effectively...no security, no caretaker...applying now since we are Sction 21. ADT is for the Admin block only.EIP23,24/</p> <p>Every year annually to Grahamstown Science Festival...and Bay World EIP24?</p>	<p>conclusions...used lots of equipmqt like microscopes HIL8/225-234 But at our school we don't have microscopes. We're actually limited. HIL8/236</p>	
<p>Wisdom of teachers' teaching practice( including personal maxims)</p> <p>Carter's(1990) practical knowledge (including personal knowledge, beliefs and implicit theories)</p>	<p>Pam:This syllabus the Natural Science has not changed. The Life and Living is Biology ...I just grab [the content] when I was preparing the lesson,but recalling all that was said by my teacher, because she was talking about something that I saw. The outcomes based education is still the CAPS is still the old-fashioned [that her primary school teacher] used to teach us EIP20/566-569</p>	<p>Lance: Science is the most important subject] I always tell them science is the most important subject ...because science refers to your body without your body there is no life. And also the oxygen you breathe in is science. So without oxygen and without your body there is no you. HIL8/244-254</p> <p>We must expose the child to many examples, it will interest them in scienceHIL 8/241,242</p> <p>I was trained in Commerce. 9/257I'm still a work in progress... for</p>	

		now I am training myself. HIL 10/295	

## APPENDIX H

### TOOL FOR THE ANALYSIS OF TEACHERS' REPRESENTATIONS OF BIODIVERSITY

		LANCE	PAM	MANDY
<b>Definition of biodiversity</b>				
<b>Biodiversity narratives and discourses</b>				
Nature is threatened by humans (Välliverronen & Hallsten)		Humans pollute...if humans could stay away from the wetlands if possible 5/145		
Knowledge: library, book of life  (Välliverronen & Hallsten)				
Bioprospecting/biotic exploration(Välliverronen & Hallsten)		The Earth is still busy proving itself...each day [scientists] discover new species and they are just becoming more and more as time goes by LLO35-37		
A web, a network of relations of which humans are a part  (Välliverronen & Hallsten)				
Apocalyptic narrative  Veldman (2012)				
Survivalist/Limits	There's a limit			

(Dryzek (2013))	Expert, scientists			
	Authoritarian government			Our government can help us to put laws that would be very strict for people not to kill the [lions and zebras] JSI8/222,224
	Effective administration	Government... to say this area is reserved for this or for that 5/147-150	Government should also eip/28 consider the perlemoen	
	Agents who can bring about change			
	Agents are motivated by			
Promethean Dryzek (2013)	Overabundant supply of resources		Many animals have been killed 16/448-458... are very useful... for the skins... these can make floormats 17/458. Animals can also be used for rituals 17/459 although the number of animals won't decrease in number... the animals will always be there... [there will be enough animals because reproduction is still there 17/461-482	
	People/human domination	Where are we going to place those animal, insects, plants, where are they		We water the plants to grow, said the learner. The teacher agrees Yes, we

		going? [people clear land for agriculture] hil4/103/104		have to eater it.JSO/197
	Government ensure economic growth			Environment which is economically stable...like having enough food because we get food from plants...sell some of these, export some of the food 4/92-95
	Agents – everyone		God ...ordered that ‘you are responsible for all that I’ve created’ so human beings[individually ] have to take care of... our biodiversity eip29/	
	Everyone motivated by self-interest, wealth			
Biodiversity metaphors		Continuity ...because we must preserve them...for the future generation hil13/406-409		[biodiversity] is a good picture...all about plants and animals JSI3/76  The forest can be kept like that...untouche d JSI 6/172 [and not cleared for agriculture]



## APPENDIX I

### ANALYSIS OF TEACHERS' BELIEFS AND VALUES OF BIODIVERSITY USING KRONLID AND ÖHMAN'S ENVIRONMENTAL ETHICAL FRAMEWORK

Intrinsic Value					
What kinds of values of nature are constituted?	Inherent worth  (independent of moral agents)	Inherent value  (dependent on moral agents)	Systemic or emergent value  (dependent on transactional processes between nature and humans)		
	<p>People must eat. Just shame, where are we going to place those animals, insects, plants all of them where are they gonna go? HIL,4/101-104</p> <p>I'm sorry...very hurt...because they could find another place... not to harm the lives of these plants...forests cannot be cleared just for agriculture...the farmers must find another place to do</p>	<p>I'm sorry I feel I feel very I'm so very hurt, because they could find they could find another place not to to to harm the the lives of these plants. Cause there's a plenty of of of empty places where I mean a forest cannot be cleared just for agriculture. The the farming the farmers must go find another place to do crop farming. Because this is for all this is a habitat for other animals.</p>	<p>[we need both the [large prominent and small insignificant] the tortoise and the leopard on the earth forever if that is possible , because we need both of them they both play a role in the food cycle. HIL,4/118-121</p>		

	<p>crop farming. Because this is a habitat for other animals. EIP,13/357-365</p>				
	<p>Demand value (nature provides satisfaction for felt preferences)</p>	<p>Transformative value(nature encounters transform people's preferences and meaning)</p>	<p>Constitutive value(the conception of nature constitutes the conception of humanity)</p>	<p>Need value(nature meets human needs)</p>	
	<p>The Zionist Christian Church (ZCC) members used to baptise [in the wetland] EIP,16/433-444</p> <p>Many animals have been killed for the skins...although it is cruel. Animals are useful because they can make floor mats EIP,17/459, and can be used for rituals,17/459,</p> <p>Mandy [animal skins] we need some of these things...to make leather jackets...to</p>	<p>In the old days you couldn't care...that time I wasn't able to value the life of animals EIP,29/ ...but now we know since we have studied the value of animals EIP,29/ ...we have to take our animals to the [vet] EIP,29/</p>		<p>It's difficult like I said its heart sore to see it, [referring to the forest cleared for agriculture] but I understand from...my economic history...people's needs have to be satisfied and their wants and ...needs...food is a basic need. We all must eat. So its just the balance. Some of the area can be cleared for agriculture: we understand that but not all of it. Most of it needs to be nurtured and kept in its natural form, because like I say it will influence the animal life and the plant life. (HIL,3/94-99</p> <p>[Biodiversity is an ...] environment that</p>	

	make us warm JSI,7/191,192			is economically stable...sell some of [the food] export some of the food JSI,492-95  [There seems to be a difference between the animals in the forest and domestic animals] chickens and pigs there are many	
<b>Instrumental Value</b>					
<b>Nature</b>					
Who or what is constituted as Moral Objects?	Non-human animals with the ability to experience pain and suffering	Non-human animals with a sense of self	Social non-human animals	All individual organisms	Eco-systems and species
	Some of the animals that live in this habitat the [dirty] wetland...they can die of that air pollutionJSI,5/124-125 [looking at the picture of the forest cleared for agriculture]I'm thinking what they thinking about the animals, that is their home.JSI,6/156			[A tortoise is not less important than a leopard] what about the life of this tortoise...I'm very sorry hurt about this [that tortoises are just being eaten] my mother use to keep [tortoises] she [had] about three. The lives	

	<p>The home for the animals is like when your home is burnt like this, how can you feel? JSI,6/176</p>		<p>of animals are very important. EIP,13-15/371,3-384,5,414</p>		
	<p>Present human generations</p>	<p>Present and future human generations</p>	<p>Past present and future human generations</p>	<p>Local human generations</p>	<p>Global human generations</p>
		<p>We know the people are killing them [the rhino] selling their horns so we would like to see more of them [rhino] in our part of the big five in our zoos and for our future generation.HIL,12/381-382</p> <p>This is unfair (referring to clearing for agriculture) because here the plants have been abused...they could be useful in the future. EIP,12/341,342</p> <p>We must preserve [wild animals or animals] because if one of the species should become extinct our future generation will not be able to enjoy them or see them. HIL,13/406-409</p>			

<b>Humans</b>					
<b>Integration</b>					
How are the ontological relations of Humans and nature constituted?	Shared geographical space	Shared historical process	Shared biological features	Discursively constructed community	
	<p>The greenishness of the PE beachfront area... That's algae... Now you know what we mean by Protista, all the slime. LLO,98-100</p> <p>The bread is so greenish... with black dots... that is fungi that you see. LLO,104-109</p> <p>Bacteria can be in the air... then</p>				

	enters your body through your nose...a virus as well...enters your body through your nose and grows in your body...LLO,147-153				
	Separate geographical spaces	Separate historical processes	Different biological features	Nature excluded from discursive community	
	I'm sorry I feel I feel very I'm so very hurt, because they could find they could find another place not to to to harm the the lives of these plants. Cause there's a plenty of of of empty places where I mean a forest cannot be cleared just for agriculture. The the farming the farmers must go find another place to do crop farming. Because this is for all this is a habitat for other animals. EIP,13/357,8362-365				
<b>Separation</b>					
How are solutions to the environmental	As identifications with nature and a deeper sense of belonging,	As an egalitarian (democratic) political system that acknowledges the	As practices of care, kinship, love, friendship, etc.	As local narratives of human-nature integration,	Ethical pluralism - people should

<p>crisis constituted?</p>	<p>developing aesthetical and ethical practices.</p>	<p>suffering of both humans and non- humans. Environmental justice</p>	<p>in human-non- human relations.</p>	<p>engage in contextual discourses that bridge the gap between subject and object worlds.</p>	<p>describe their actual reasons for valuing nature</p>
		<p>The government should also consider the perlemoen [preserve it] EIP,28/</p> <p>Our government can help usto put laws that would be very strict for people not to kill the animals JSI,8/222-224</p> <p>It will help a lot...where government come in to say this area is reserved for this ...beacause politicians make these hard choices or decisions and not us teachers HIL,5/147-150</p> <p>Lance believes the law-makers should decide w.r.t what is legal and illegal when it comes to perlemoen HIL,12/377-379</p> <p>If the government should ban the killing</p>			

		of animals it means we will have more animals you know biodiversity would be richer. HIL,13/390-392			
<b>What relational spaces are touched upon?</b>	A space of individual worldviews	A political space (institutions for decision-making) human domination	A gendered space- domination	A discursive space	A situated everyday practical space
		And then that would then help a lot...actually where your spheres of government will come in your local government and your national government. To say this areas is reserved for this or for that uh, because politicians make these hard choices or decisions and not us teachers.HIL,5/147-150			
<b>How are the causes to the environmental crisis constituted?</b>	As inability to identify with nature, no deep connection	As ecopolitical domination inherent in the political institutions and ideologies.	As patriarchal power relations and anthropocentric worldviews, values and practices.	A discourse of colonialism and domination reflecting disconnected and dominant relationships towards nature	People's everyday relationships with nature and their limited debates towards solving problems.
			(He sighs) Oooh, the		

			wetland. ...Humans usually polluted. If there is no humans then normally we'll have a natural water source there for animals and for humans and insects all types of life will benefit but usually the humans pollute. HIL,5/136-139		
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Kronlid and Öhman's Framework

**APPENDIX L**

**COPY OF CONSENT FORMS AGREEING TO PARTICIPATE**

Research Topic: An exploration of what grade 7 Natural science Teachers know, believe and say about Biodiversity and the teaching of Biodiversity.

I want to thank you for taking the time to meet with me today.

My name is Dorelle Isaacs and I would like to talk to you about your experiences with biodiversity and the teaching of biodiversity as you teach it to your grade 7 classes.

The interview should take less than one hour..

I will be audio-recording the interview because I don't want to miss any of your comments.

All responses will be kept confidential. This means that your interview responses will only be shared with the research team. I will ensure that any information that I include in my report does not identify you as the respondent. Remember, you don't have to talk about anything you don't want to and you may end the interview at any time.

Are there any questions about what I have just explained?

Are you willing to participate in this interview?



Interviewee



Date

Research Topic: An exploration of what grade 7 Natural science Teachers know, believe and say about Biodiversity and the teaching of Biodiversity.

I want to thank you for taking the time to meet with me today.

My name is Dorelle Isaacs and I would like to talk to you about your experiences with biodiversity and the teaching of biodiversity as you teach it to your grade 7 classes.

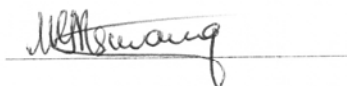
The interview should take less than one hour..

I will be audio-recording the interview because I don't want to miss any of your comments.

All responses will be kept confidential. This means that your interview responses will only be shared with the research team. I will ensure that any information that I include in my report does not identify you as the respondent. Remember, you don't have to talk about anything you don't want to and you may end the interview at any time.

Are there any questions about what I have just explained?

Are you willing to participate in this interview?



Interviewee

11-08-2014

Date

**Research Topic: An exploration of what grade 7 Natural science Teachers know, believe and say about Biodiversity and the teaching of Biodiversity.**

I want to thank you for taking the time to meet with me today.

My name is Dorelle Isaacs and I would like to talk to you about how the Curriculum Unit- Natural Science support the teachers in the teaching of biodiversity as they teach it to their grade 7 classes.


The interview should take less than one hour.

I will be audio-recording the interview because I don't want to miss any of your comments.

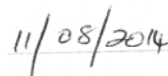
All responses will be kept confidential. This means that your interview responses will only be shared with the research team. I will ensure that any information that I include in my report does not identify you as the respondent. Remember, you don't have to talk about anything you don't want to and you may end the interview at any time.

Are there any questions about what I have just explained?

Are you willing to participate in this interview?



Interviewee



Date

**APPENDIX J**

**ACCESS GRANTED BY THE DEPARTMENT OF EDUCATION**

**5. COMMITMENT FORM FOR CONDUCTING RESEARCH IN THE EASTERN CAPE DEPARTMENT OF BASIC EDUCATION**

I, (Title, surname and names in full) MRS ISAACS, DORELLE  
residing at (Full address)

3 HECTOR ROAD, GELVAN PARK,  
PORT ELIZABETH

Tel no (h): 041-4527318 Tel no (w): 041-452 2638

Cell no: 0833160472 commit myself to the following 9 items regarding my research:

1. To effect no changes with respect to my questionnaire/method of work after having my research application approved by the Department. Any changes I might make shall be submitted to the Department for approval.
2. That I am prepared on request of the department, at my own cost, do a presentation to one preferred audience, once off.
3. That, after having obtained permission to continue with my research project from the Department, I shall negotiate with the relevant areas and/or schools regarding final arrangements for visits.
4. That I will not to use the Department's written letter of consent as a means of making unreasonable demands on an office/institution.
5. To involve persons in my research project on an absolutely voluntary basis – these persons being all those concerned (including pupils) and all others associated with the Department as well as with all offices/institutions under the control of the Department. Parental/community approval shall be obtained should such a measure be prescribed by the Department.
6. Not to remove files/records/documents from the offices and institutions of the Department should information contained in these files/records/documents be needed; to obtain such information under the supervision of a Departmental official assigned by the Department; and to select only information applicable to my research project.
7. To present the Department with a copy of my final paper/report/dissertation/thesis free of charge in hard copy and electronic format.
8. Not to visit (conduct research or any field work) at institutions (schools) during the fourth school term unless permission has been granted.
9. To allow the research to be published on the Departmental website.

SIGNATURE OF APPLICANT: D Isaacs

PRINT NAME IN FULL: DORELLE ISAACS

DATE: 24 APRIL 2014

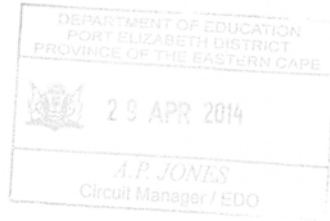
PLACE: PORT ELIZABETH

SIGNATURE (Department of Education): [Signature]

PP DR ANNETIA S. HECKROODT  
DIRECTOR STRATEGIC PLANNING POLICY RESEARCH AND SECRETARIAT SERVICES:

DATE: 29/04/14

Eastern Cape Department of Education Stamp :



Date:

29/04/2014

An approval letter will be forwarded to the University and the student.

END OF DOCUMENT

## APPENDIX K

### ACCESS TO SCHOOLS GRANTED BY THE PRINCIPALS

---

The Principal  
Port Elizabeth

Dear Sir/Madam

Re: Research conducted at your school: Rhodes University

The purpose of this research is to explore what teachers say, know and believe about biodiversity and biodiversity teaching.

The broader purpose of this study is to contribute to a national programme called Fundisa for Change which serves to strengthen environmental learning in schools.

I kindly request your permission for access to your institution.

I will ensure that all visits to the school will not disrupt teaching and learning in any way.

I thank you.

Dorelle Isaacs

Student Number: 1316297

  
.....

Principal

09.06.2014  
.....

Date

The Principal

Port Elizabeth

Dear Sir/Madam

**Re: Research conducted at your school: Rhodes University**

The purpose of this research is to explore what teachers say, know and believe about biodiversity and biodiversity teaching.

The broader purpose of this study is to contribute to a national programme called Fundisa for Change which serves to strengthen environmental learning in schools.

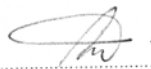
I kindly request your permission for access to your institution.

I will ensure that all visits to the school will not disrupt teaching and learning in any way.

I thank you.

Dorelle Isaacs

Student Number: 1316297

  
.....

Principal

11 / 06 / 2014  
.....  
Date

The Principal

Port Elizabeth

Dear Sir/Madam

**Re: Research conducted at your school: Rhodes University**

The purpose of this research is to explore what teachers say, know and believe about biodiversity and biodiversity teaching.

The broader purpose of this study is to contribute to a national programme called Fundisa for Change which serves to strengthen environmental learning in schools.

I kindly request your permission for access to your institution.

I will ensure that all visits to the school will not disrupt teaching and learning in any way.

I thank you.

Dorelle Isaacs

Student Number: 1316297



Principal

2014-08-06

.....  
Date

## **APPENDIX N**

### **INTERVIEW TRANSCRIPT: LANCE**

Hillcrest Interview: HIL1

D: Okay (Clearing throat) How long have you been teaching natural science?

L: For...for...for fifteen months.

D: Fifteen months.

L: Fifteen months.

D: If you want to speak Afrikaans its fine neh.

L: Okay.

D: And biodiversity?

L: Biodiversity I've started with that this year only so that would be like...like two months or so three months.

D: Okay

L: Last quarter.

D: How would you describe your school?

L: In terms of?

D: Whatever you want to.

L: The school...whooh where do I start? Um we are very difficult the...the socio-economic circumstances of our school is very...very difficult, because we come...children come from poor backgrounds either their parents don't work. They are not that interested in school work in general. They have other interests. Uh we are supposedly a government institution and uh we have committed teachers, but uh... the... we got so much difficult circumstances in which we work.

D: Mmm

L: That's how I would describe the school.

D: Thank you. How would you describe the learners? You already said something about the learners and their community.

L: The learners themselves?

D: Ya

L: The learners like I say they actually very nice kids from my point of view, because they are very helpful. They very friendly in general, they speak, they have freedom of speech with me they, they talk to me whenever they want to, any topic. Um but like I said they come from difficult circumstances and I understand that also some of them lives uh... They come from a family they might have been abused in different ways and uh they also have low self-esteem, because I see some struggle to read yet they face them in class, because some of the other kids might be good readers and then they just look at the books. So we have a mix of children at our school. Most of them struggle with reading and writing. Uh I would say about ten to twenty per cent are top students en dan and then we have those difficult learners who struggle they about thirty per cent and the half is the your average child.

D: Uh thank you. When you think if biodiversity what images or pictures come to mind?

L: Ho that would be lots of pictures, because it's...it's broad spectrum of what we teaching in that topic. It's all the different uh spheres of the environment and the world, and the earth and science so it's a very broad topic.

D: What kind of pictures do you see when you see it?

L: Pictures I see in my mind I see flowers, I see animals. Different types of animals, different types of flowers uh sea creatures, land animals. I see humans, because we also we also fall under there. Um I also see the...the air, fungi all of those things. Micro-org and macro-organisms. So it's very broad.

D: Mmm mmm it sounds full of life.

L: It does because, the topic itself is life in general that's now really now where you touch on all all the different forms of life on the planet.

D: If you could choose three words or adjectives or phrases to describe biodiversity. Three words um as you experience it in your life. Which three words would that be?

L: Bright, life and continuity.

D: Thank you. I'd like you to take a minute to study these photos. Could you describe what you see in the pictures?

L: In my own words?

D: Uhuh

L: Okay over here before I see a leopard and a leopard tortoise. Okay those are...they part of biodiversity. Uh mammals and reptiles and I also see a forest here which is cleared for agriculture so that would be a animal, the in plant worlds, and we have a wetland. Usually, with us wetlands refer to polluted areas especially uh um like in the picture over here. River pollution see the water is full of algae. It looks like green...green

D: So you are saying that wetlands are always polluted areas?

L: Uh correction, not always. Some of them some of them it depends on the human staying close to them, usually that's the concerned, because the animal usually don't pollute wet lands or river or forest or anything is...

D: Mmm

P: Mostly humans and I also see animals skins here. Interesting looks like a tiger. Um animals yes part of the biodiversity...uh it looks like the animals skins are uh in...in a area where there's lots of people. I can see houses here and cars and stuff. So it this, these skins might have been done industrial area or urban area not sure. Interesting...

D: What would you think they are doing with the skins?

L: Interesting (clearing throat)...I'm not sure I don't want to comment on it but, it's just interesting for me to see it not in the factory, but there's a car, there's a house so it could be done in like I said a urban area. So what does it do what does it do there? Interesting

D: So how do you feel when you when you look at?

L: I feel trigger disappointing...disappointing, because whenever you see uh a forest been cleaned for agriculture uh it means the life there, the biodiversity itself the animal life, plant life there have been destroyed. Lots of macro... macro-organisms have been displaced or lost their life's or they must go look for another place to stay to live.

D: Mmm

L: It's actually heart sore to see that

D: Mmm

L: It's the impact of pollution on on on the earth.

D: And and here they've cleared the area for a agriculture.

L: Mmm

D: Which means that they need to plant.

L: Uhuh

D: Crops for people to eat.

L: Crops for people to eat.

D: And on the other hand you say you feel disappointed, because this is what's happening to the

L: That's within the balance the balance.

D: So what would you comment on that? Um

L: It's difficult like I said its heart sore to see it, but I understand also from uh like I say economic my economic history how I was teaching economics. Uh people's needs have to be satisfied and their wants and to needs uh food is a basic need we all must eat. So it's just the balance. Some of the area can be cleared for agriculture; we understand that, but not all of it. Most of it needs to be nurtured and kept in its natural form, because like I say it will influence the animal life and the plant life.

D: Now how is that going to be made possible?

L: That's the thing now like I said sometimes hard choices should be made and certain pieces of lands should be cleared for agriculture. I understand that completely and it has to happen. People must eat. We are also on the planet we also must eat. Just shame where we going to place the those animals, insects, plants all of them where are they gonna go?

D: Mmm

L: That's the question here.

D: So you don't have the answer to that?

L: Mmm that's mostly...

D: Aspiration

L: Politicians will make the decisions, but uh from my side uh it's the just a balance um try to keep most of our agriculture or forest and keep most of it, but some of them must be cleared or prepared so... so people can eat.

D: Mmm if we look at this pictures as you said um the leopard and the leopard tortoise.

L: Uhuh

D: Um do you think the one is more or less important than the other one? Could we um maybe for example just have all the tortoises and make tortoises soup whatever and then there's no tortoises left left and preserve the leopard?

L: From my side from a teaching point of view and a human aspect I would like to see both them on the earth forever if that is possible.

D: Mmm

L: Uh because we need we need both of them they both play a role in the food cycle and uh leopard tortoises. The first time in my life that I have ever seen one. I Remember I'm actually an economic teacher and business teacher.

D: Mmm mmm

L: So first time I see that one I've heard about a leopard before seen him on TV before. One of our big fives in South Africa, but interesting to see leopard tortoise never seen one before in my life so

D: Mmm

L: I know these these mos these are the millions of organisms or animals, plants life that we have.

D: Mmm mmm

L: The we only had so so it's possible to have a leopard tortoise.

D: Mmm

L: And I would like to preserve of both of them if it's possible at all.

D: Mmm and um additional comments maybe on the wetland?

L: (He sighs) Oooh the wetland. The wetland is...its difficult, man. Like I said the algae starts to growing in. Humans humans usually polluted. If there is no humans then normally we'll have a natural water uh source there for animals and for humans and insects all types of life will benefit, but usually the humans pollute.

D: Mmm

L: Usually...

D: Mmm

L: So it's not difficult then chemicals should be used to clean it and all that...algae will be there so uh, but like I say uh if a wetland. Could, if humans could be stay far away from wetland if it's possible.

D: Mmm

L: And then that would then help a lot...actually where your spheres of government will come in your local government and your national government. To say this areas is reserved for this or for that uh, because politicians make these hard choices or decisions and not us teachers.

D: Okay thank you. Um can you describe (clearing throat) or tell me how you approach teaching biodiversity?

L: How do you approach it?

D:Mmm how do you teach it? (Clearing throat)

L: How do I teach it? Well I started the lesson where I show them the pictures of different types of pictures. Especially the sea world I remember that and I show them lots of pictures of birds just to show them the difference between plant life um sorry animal life, but animals in the air and animals in the water.

D: Mmm

L: Okay we didn't even actually show them animals of the land just to show them the difference.

D: Mmm

L: And to show them different species we have of those.

D: Mmm

L: And the they they said they told me sir we I see about twenty to twenty five different pictures of of uh birds, but we know there there's lots more thousands more if not millions we're not sure. And also when it comes to the sea life we show them the picture they responded by saying the the they know more some of them said they know more and they gave me the names of animals that lives in the water and um from where we they started the discussion on biodiversity. That's how started I it by pic showing them pictures, because usually our kids relate very well to pictures...

D: Mmm

P: Things they see.

D: Okay so you decided to teach it that way, because you needed them to see?

L: To see it yes, because if I just talk about things that's unseen

D: Mmm

L: Perhaps they can have concrete thinking if I just mention things and they don't have a background of what I'm talking about.

D: Mmm

L: Uh it would be very difficult for them to grasp.

D: Mmm mmm

L: What I'm saying and to understand.

D: Mmm

L: So I have to make use of pictures and ...and all these charts that I can that I have in my class without it would be difficult to have this lesson and to really for them to understand what biodiversity actually means.

D: So with the pictures do they understand?

L: It helps a lot, because from there we build actually the knowledge, because if they see the pictures then they know all of these are animals that live in the air and all of this the other picture where they see uh animals in the sea they know these are sea creatures.

D: Mmm mmm

L: And then they could add more.

D: Mmm

L: But then at least that's the base from which we work. So in our case pictures is very important in my class.

D: Okay. How was your primary or high school experience? Or how were your experiences with regards to natural science? How has your own school experience contributed to your teaching of biodiversity now?

L: Okay I did biology. We used to call it Biology until grade twelve and I only did physical science, I think to grade nine then I stopped it. Then I did other things. So I'm quite limited when it comes to the physical science.

D: Mmm

L: Okay, but if I'm talking on the right word physical science?

D: Uh ya.

L: Or was it natural science?

D: Natural science is what we do in grade seven.

L: Natural science ya. Biology I did until matric. I have a much better understanding on biology then okay. Uh when it comes to natural science it's quite limited, but I must also say my teachers who taught me biology did a good job, because I really liked this subject when I was younger, but when I went on to university I did other things. I went into the commerce field so I stop stopped right there, but the things they taught me at high school I still remember them. Like for instance um when we did lessons on I think it was human reproduction. I can't remember in grade grade eleven the sir showed us a picture of a embryo. No it was not a picture it was a u model in the class and that really interested me interested me in where does this embryo come from and uhr I still remember that until today so that made an impact in me.

D: Mmm

L: All those years ago when it comes to science physical science usually in my head physical science is the periodic table with metals, non- metals, gold.

D: Mmm

L: All those those things usually with me, because I think that was like my last my last chapter which we did in grade nine science that's all I can remember.

D: Uh so uhm the teachers themselves which methods did they use that made you like the subject?

L: Well I can remember we used the textbooks a lot. Pictures again lots of pictures lots of pictures. We also had examples in the classroom like I said models I remember that uhr the teacher never took us out of the classroom. We were always in the class. Lots of teachers talk.

D: Mmm

L: Where the teacher would talk a lot uhr is that was the teaching method primarily used at our school which I can remember I also remember they asked question a lots and we would also answer uhr they would also use they would use uh uh investigative method of teaching ...where...were we would investigate stuff, draw up conclusions and write them down. I also remember uh lots of examples in the classroom and uh what else can I remember? Um ya I remember also we use lots of equipment like for instance what was that again? Microscopes

D: Mmm

L: Ya I remember those but at our school we don't have microscopes. We actually limited.

D: Mmm

L: Uhmuh

D: So is your teachers in your own school experience seem to have influenced how you now would like to teach biodiversity?

L: Yes I believe in we must have as we must expose the child to many examples in because if we have these examples it will interest them they will be interest in science.

D: Mmm

L: I always tell them science is the most important subject, because science refer to your body without your body there is no life.

D: Mmm

L: And also the oxygen you breath in is science. So without oxygen and without your body there is no you.

D: Mmm

L: And without that we can't have teaching or learning or anything else. So I always tell them science is the most important topic and I also tell them science is very interesting.

D: Mmm

L: And I try to make it as interesting as possible, because I would like them to continue with science in high school if it's possible.

D: Mmm thank you Mr Langford. Um how has your professional training prepared you to teach biodiversity?

L: Well professional training uh I remember I told you previously I was trained in commerce, but we did CAPS last year and the year before that was 2012 and 2013. CAPS training and uh it was very interesting, because we touched on a lot of different top topics uh in natural science that we would do this year. So it was actually preparation for this year and uh this uh topic of biodiversity was also...came up... the lecturer spoke about that in detail and uh asked us for any questions and we got manuals and stuff. I remember he also spoke about the different textbooks that you can have. So I would say that we were quite prepared for natural science to teach it in 2014.

D: So uh have you done any courses in natural science or biodiversity?

L: Me myself I would say no mam, because the last time I went to do anything any studies was in 2005. I did Honours Degree in Education it was the last time I studied and before that I did a degree in commerce it was BCom Education before that I was in high school, so I never did a specific science course.

D: Mmm so how long was this er training that you got from the Department?

L: It was like I think it was a week can't remember I think it was a few days.

D: Two days are you speaking about the two days?

L: Was it now two days or what? Two days ya can't even remember. Two days training for the whole to teach the whole CAPS curriculum for the whole year. Two days training only ya.

D: And how what do you think about it?

L: For me I think it's not enough, but under the circumstances I remember it's difficult uh from department of education side, because time is limited. It's it's very scarce so we have got a limited time, but we have to do all of this and this CAPS uh curriculum is very broad and extensive and uh I might even venture to say it's for our kids it's very difficult for them, because of the amount of work that must cover for maybe a term or the whole year and I struggle.

D: Mmm um has anything you've experience in the past influenced the way you teach now in the class?

L: The past huh it's a difficult one cause I usually just go and teach um okay I would say that um when I started teaching I had my previous school in East London. We had a little bit more resources. Little bit more resources in sometime I could bring the overhead projector to school to the class maybe do some work on that and like the school where I am now we have we don't have a lot of resources so it it affects your teaching, because you are quite limited in what you in what you want to do and what you can do. So we try to expose and the child to as much as possible, but we quite limited, because of what we have a the school.

D: Mmm thank you. What ideas do you have for the future with regards to your classroom practise or your teaching methods with regards to biodiversity any ideas for the future?

L: Improve it uh like I said I'm still a working progress in science teaching, I'm sure in a couple of years' time I'll reach my full potential, but for now I'm training myself. I'm not a top class I never said I'm one of the best teachers just just a normal teacher. I'm doing my best, but what I would say is the more um equipment we could have at this school or resources it could make it much easier for our children just to get them interested in the lessons of science.

D: Can you give some concrete examples of the kinds things you're talking about?

L: Okay like for instance we did the one one lesson on the human body I remember think it I can't remember was it last year or this year. Okay and then we did something on bones and we didn't have a chart in the class to show them the bones of the body like for instance the craniums, the sternum, patella all those bones we couldn't show them.

D: Mmm

L: We didn't have a picture if that.

D: Mmm

L: If we had a picture at least the chart just to show them where is the cranium in all of this.

D: Mmm

L: Just just to make them excited about their own body so they should know where their cranium is.

D: Mmm

L: Where their patella is you know if we could have that or if we can have like um cranium in the class.

D: Mmm

L: You know that would do (giggle) that would really be interesting.

D: Mmm

L: Even for me I have never touch a cranium before.

D: Mmm

L: So that would be interesting if we could have that a concrete example.

D: And what specifically would you like to have for teaching biodiversity?

L: For teaching biodiversity the more pictures the better, because biodiversity is all about uh seeing all the different creatures that's on the earth. That's now in the water you see all of them fungi all of them. To see all of them would be nice to have much as much as possible to pictures of that just to broaden the scope of the child's.

D: Mmm

L: Just to see this is a whole world and there is millions of organisms or this world on the earth, sorry.

D: Okay thank you um what problems or challenges or difficulties do you experience when you teach biodiversity?

L: Problems I experienced I would say limited resources I would mention that if I had more of those. I would also say that uh, because we sit in a class sometimes you know it will be nice it would be interesting to go out of the class just to so they could see organisms for themselves. Per perhaps if we go to the garden you see plants there and I'm sure you'll see ants somewhere, just so they can see it for themselves for yourself. The ground also all of those as for the environment and how uh that's also part of biodiversity, but because we stay in a class and then we do we bring the examples to the class.

D: Mmm

L: Rather then we go to the examples, real life examples.

D: Mmm

L: It could make a difference a small difference I think.

D: Okay so you'd like to take the learners out and

L: Yes I would like to take them out for specific lessons maybe biodiversity could be one of those. Also we had a lesson recently on uh types of of...

D: Say in Afrikaans. (Giggle)

L: Ja blaar.

D: Blare leafs.

L: Okay ons het leafs okay wag ek gaan Afrikaans praat

D: Mmm

L: Ons het n les gehad onlangs oor een saad lobiges en twee saad lobiges, maar omdat ons nou nie uh die blare kon sien nie

D: Mmm

L: Het dit n groot verskil gemaak. As ons kon uitgaan na die tuin toe

D: Tuin uh

L: Om self die een saad lobiges en twee saad lobiges te sien, want twee saad lobiges en een saad loniges verskil en is goed as jy dit self sien.

D: Say that word?

L: Een saad lobiges en twee saad lobiges.

D: Oh saad.

L: Saad lobiges

D: Saad lobiges okay.

L: Een en twee saas lobiges uh hulle verskil ook so as ons nou toe vra ek die kinders bring uh wat julle dink is een saad lobige. Ons het deur die les gegaan. Ek weet dis nou nie biodiversiteit nie.

D: Mmm

L: Ons het deur die les gegaan. Die kinders het dit verstaan se hulle, maar die volgende dag toe bring hulle nie...

D: Mmm

L: Die een saad lobiges nie en twee saad lobiges nie, toe moes ek dit gaan haal uit die tuin uit.

D: Mmm

L: Ja so as ons dit kan het kan ons die lesse soveel interessant maak.

D: Mmm

L: En die kinders sal ook baie geintresant geïntereesd wees in die les.

D: Uh thank you um do you believe that perlemoen is less important than rhino?

L: Huh all of them is important, because all of them fall under biodiversity and we want our children to know what is a rhino and of the future generation to know what is perlemoen and though some believe that perlemoen should be banned, because the uh of the illegal trading that, but uh we don't decide that is not our jurisdiction to decide on what is legal or illegal that's for the law makers. We just here for biodiversity's sake for the sake of animals, plants so that's part of it and we accept it. Even the rhino uh

we know the people are killing them, selling their their horns so we would like to see more of them in our part of the big five in our in our zoo's and for our future generation.

D: It seems as if you saying there is a difference between us and the law makers. What if they make a law that we don't agree with or a law that affects or destroys what we still have left?

L: Neh, because these are the people that make the choices they decide which animals like for instance now I know in certain countries it's it's legal you can kill animals for instance I've heard that you can even uh kill lion. Some of them come to South Africa they buy certain licenses to kill these animals.

D: Mmm

L: Animals and uh they do it so we don't make that law we as teachers. That's the the government that makes that laws so if they should ban killing of animals it means we will have more animals you know biodiversity would be rich richer.

D: Uh okay thank you. What values do you think are important for biodiversity and the teaching of biodiversity?

L: First of all appreciation, because if we do not appreciate what we have now we never will and also just to recognise the difference...bet the difference in species, because we we might just think that a dog for instance a dog, but sometimes we forget hayeana's also falls into that group of a wild dogs also falls into that group.

D: Mmm

L: And is even a cat. Many people have domestic cats, but what about the other the lions, the cheetah, the jaguar all of those are also cats.

D: Mmm

L: But they bigger animals and they are wild now. They live in the wild, but they also cats so...

D: Mmm

L: Just to recognise that also. Appreciation is very important and like I say continuity, because we must preserve them. The only way to enjoy animals is to preserve them, because if one of the species should die out or become extinct extict the future our future generation will not be able to enjoy them or see them.

D: So what what value will ensure continuity?

L: That's a difficult one. I think that is appreciation, but the appreciation should be now; it can't be in the future. We must appreciate them now, before they.

D: Practise continuity. Create continuity.

L: That is...

D: So

L: Just repeat that mam.

D: Um I'm saying that you were saying if there was to be continuity...

D: Mmm

P: And I'm asking what value will ensure that there is continuity. What values in a person?

L: In a person?

D: In our people.

L: I think love of animals is important. Appreciation of animals, um, that's all I can say. (Clearing throat)

D: No it's fine. Where did these values of yours come from? For example you were saying that you were disappointed when you saw this pictures.

L: Mhuh?

D: And um over here your value is they must all live you know.

L: Yes

D: All of them must be allowed to live...

P: Mmm

D: And there you couldn't understand what the skins were doing um in a city

P: Urban area.

D: In an urban in a urban centre yes. So where do those values come from that you have?

L: From my side well I would say uh my teachers taught me to have respect for animals and for life in general and uh the things I've seen on TV um like for instance animal channel animal planet. Sometimes I would watch them and all those channels that already appr appreciate teachers you to appreciate animals and to love them and to care for them.

D: Okay so basically it came from your um schooling, your education?

L: Not just that I would also say my parents taught me that my parents and my church to respect animals and respect people and not to destroy animals or kill them or you know to abuse them, but respect them and love and care for them.

D: Mmm

L: Cause those you know...

D: Okay so religion also played a role family and religion.

L: Family and religion, ya all of those.

D: Okay um in which ways do CAPS... that's now the curriculum and textbook or textbooks influence your decision about how to teach biodiversity? (Clearing throat)

L: Well when it comes to CAPS like I said CAPS is very broad and lots of details, lots of information um textbooks also are we went to the training last year we were advised to stick to the curriculum and also to teach as much as we can. Okay and uh they told us that uh we got five years to implement CAPS. I don't know how long how long we will they will stay with CAPS, but what they told us uh I remember the the one EDO told us that um when it comes to the textbooks okay we don't need actually to prepare the lessons. They told us the is... lesson is they even have pictures of the different examples. Okay and it's like I say very uh dea lots of details. So they want to make it easier for you. He told us there always remember he said you must just go and teach.

D: Mmm

L: Much easier.

D: Okay did he mean using the textbooks?

L: Using the textbook. What's in the textbook you must go and teach it, because it's been prepared for you already. You must just go and implement now.

D: So how do you then use CAPS?

L: Well uh uh like I say when it comes to natural science we were advised not to actually just go and prepare, but we must just teach it and what we do uh we would we have a file of natural science.

D: Mmm

L: Okay and that file got all our information in. This this syllabus for the year, extensive and uh we might also put in there our question papers and tests and all of those examples. Okay and the textbooks, the CAPS curriculum is also in there.

D: Mmm (Clearing throat)

L: So that book booklet was about ninety pages I think. Okay the textbook is not in there.

D: So when do you look at the CAPS?

L: Uh usually before I teach I look at it CAPS, what CAPS requires and then I'll go to my textbook and see what my textbook says about that specific, does it cover all the topics for CAPS if it does I go and teach.

D: You capture it in a the lesson plan? Do you write up lesson plans?

L: Sometimes I do sometimes I don't.

D: Mmm

L: Sometimes not always.

D: Okay is the... does the school not require and check on that curriculum?

L: Uh that's now difficult to say cause our EDO told us we must mustn't worry about lessons plans, but the last time our deputy principal told us last year we must have lesson plans so like uh I'm caught between a rock and hard place. (Giggle)

D: Mmm

L: Ya ma but it doesn't matter as long as we teach, I believe in it, as long as you teach and you cover the work to the best of your ability.

D: Okay um how do you use the text first of all, which textbooks do you use? (Clearing throat)

L: Oxfords mam.

D: Okay.

L: Oxford CAPS Natural Science grade seven.

D: Only one?

L: That's only one textbook.

D: That you use?

L: Only the one text book.

D: You don't use uh others?

L: No only use that one.

D: Okay so why do you decide only to use one?

L: Why I only use that one, because when I when I looked at the textbook and I look at CAPS what they require there was a s s synergy, it's actually the same.

D: Okay

L: So that helped a lot and also that specific there was examples of midyear midyear test and exams. Which also showed us what things could be important for the exams and for November. That helped also and at the back of the textbook there was lots of...of definitions of concepts which was defined for you and also helps a lot if you don't know definition of something you just look at the back of the book.

D: Okay

L: And also what I like about that specific one there's lots of pictures, because our children like pictures.

D: Okay do you have any questions?

L: None.

D: Thank you very much Mr Langford.

L: Okay mam.

D: Um and

## APPENDIX O

### Lance's Lesson Friday, 17 March 2014. Code: LLO Translated from Afrikaans.

Lance/Teacher: Class! Class! I want you to look at the pictures in the front. It is pictures of birds. It also shows us the fish in the sea. That picture shows birds. There is a large amount of birds. Very beautiful birds in full colour. Here too (he points to one chart) are different kinds of fish. Am I right?

Learners: Yes, Sir.

Teacher: There are more birds that are not shown here. Can you name some? Put up your hand please.

L: An eagle.

T: A falcon, okay, good, very good. If we look at this chart we see various fish. Can you name some fish that are not shown here?

L: An octopus.

T: Here is an octopus. Did you see a whale here? No, I don't see a whale. I see a shark. No, here is a whale, here is one.

L: A dolphin.

T: Dolphins. Good. It shows us that there are many different animals, isn't there? Many kinds of birds and many kinds of fish even though they are not shown on the charts. There are many more birds and many more fish but we can't do them all, isn't it? Now when we look at the word biodiversity (He writes on the board: bio/ di/ver/si/ ty. Now this word refers to all kinds of living organisms, not so? It includes all the living organisms on the earth, whether it is found in the air, or in the earth, the lithosphere, the atmosphere or the hydrosphere. It encompasses all the spheres. Now I want you to think...we saw a few birds and a few fish. If you think on all the kinds of animals that exist on earth, and the different kinds of birds, all the different types of plants that we find, all the different animals that we find...all the different plants...Now you know there's a lot...How many do you think there are?

L: Millions.

T: That man says millions. That man is probably right. There may be millions that we can see, there's a lot of life, isn't there? In the atmosphere, in the lithosphere, biosphere. There is a lot of life on Earth. Scientists have thus far identified 1.5 million living organisms. But scientists reckon that there are more than 1.5 million living organisms. They say there is easily between 30-50 million living organisms. But if you look at 1.5 and 30, then we still have a way to go, don't we? The Earth is still busy proving itself, which living organisms, scientists are busy studying this, each day they discover new species and they are only increasing as time passes by. Now we must remember that scientists group living organisms, organise or classify living organisms according to what they have in common, according to their characteristics. For example, you also enjoy to classify things. People who have fair skin and sleek hair, we say they are whites, don't we? People who have our hair we say they are coloureds, Don't we? Then we also get the black people and Indians and so on. That is a classification system. Now it is the same with scientists' classification system, how they group things according to characteristics and features. For example if we think of animals. Animals have certain things in common, don't they? What things do animals have in common or in what things are they about the same? Who can tell us? Someone here says:

They eat. There is nothing wrong to say animals forage [vreet]. One of their life processes, isn't it? They eat and all the animals eat.

L: Reproduction.

T: Reproduction is one of their life processes. Good. They breathe [pointing to a learner who answered softly]. Very well put. A few examples. Now, what do plants have in common? And all the plants? What do they have in common? What do they breathe in? Think.

L: Carbon dioxide.

T: What do they breathe out?

L: Oxygen.

T: And us, people? Oxygen in, carbon dioxide out. Now scientists developed a classification system to classify five kingdoms. We will now name the five kingdoms because it will be the first time you hear it. The first is all the animals we see around us: Animals. Someone says plants. We will say plants. Plants and Animals. We also have Bacteria. Wait ... [teacher refers to a learner who is talking to him while he is writing on the board]. We have Fungi. We have fungi [he is writing on the board]. Then we have Protozoans. These are the five kingdoms that the scientists Animals, Plants, Bacteria, Fungi, Protista, living organisms are classified according to this. Now an interesting question is: Us, People. We don't see a kingdom called 'people'. As you can see, there are only five kingdoms. And there is not a word 'people'. So where are people classified in this classification system?

L: Under Animals.

T: Under Animals. Yes. Because we are not plants, we are not fungi, we are not bacteria, and we are not protista. What kind of Animal are we? I think we had done this lesson already.

L: Mammals.

T: Mammals, aren't we? Right. Very interesting. What we will do now- I want to give you this page that is about the five kingdoms of living organisms. I will give each of you a copy. Right. Here is a very accurate description of the kingdom. There is a picture for you, there are examples and there are life processes. There are seven life processes, aren't there? Do we remember the life processes? Nicole named two.

L: Feeding.

T: Feeding.

L: Breathing.

T: Breathing or respiration.

L: Movement.

T: Movement. There are only three. We are missing more. You must paste it [the page] into your book, in your workbook. Page 23. The colour is beautiful. It shows you the colour too, of these kingdoms. The one right at the top is bacteria. If you were to have a microscope, you know what a microscope looks like, don't you? It is black, you look through thick lenses at whatever you have in front of you, isn't it?

Unfortunately our school does not have a microscope. If we should look at bacteria: This is how bacteria looks [referring to picture on page]. There are examples here. Life processes – they [referring to the bacteria] have only three life processes: they move, they feed and they reproduce. That's three. Let's go to Protista. This is how Protista looks [referring to picture on page]. Almost like Bacteria. A lot in common with Bacteria. This is one example [pointing to the picture]- algae. If I should give an example of algae: if you go to the PE beachfront and you walk around there, there are pools of water, did you see the that greenishness there? That is algae. It drifts on the water. It is slime. Now you understand what we mean with Protista. All the slime. What is its life processes? They reproduce, they feed. They move. We won't go deeper into that now. I just want to show you examples of each. Then we get Fungi. We have multicellular fungi. An example of fungi is when your mother buys bread and she does not eat all the bread. You leave it for two or three days, when you go back to the bread and you touch it, how does it look?

L: Mouldy.

T: There's the word: mouldy, isn't it? It is blackish [black].

L: Greenish. Greenish.

T: It's [the bread] greenish, isn't it? With black dots. That is fungi that you see, not so? Sometimes people can also get fungi. Sometimes people grow fungi on their backs. For example, when people undress, [they have] a brown patch on their skins. That is fungi.

L: [Learners laugh].

T: It [fungi on the human body] is not a joke. There are their life processes: movement, nutrition, reproduction. Then we have plants. Green plants. It is so beautiful in this book. Then we have multicellular plants. These are ferns, mosses and flowering plants. They also have three life processes: reproduction, nutrition, movement. Then we have Animals, which includes us, people. Multicellular animals includes worms, insects, fish, frogs, bird, etc. But you must remember we have five classes of vertebrate animals.

L: Fish.

T: And?

L: Birds.

T: And?

L: Mammals.

T: And?

L: Amphibians.

T: And?

L: Reptiles

T: And?

L: Mammals.

T: Mammals. There's our five classes of vertebrates. Now we see there are life processes: movement, nutrition and reproduction, isn't it? What I want you to do – this is the book's example. You must think. There's a block left open. You can find more examples. You and your partner next to you. Only three life processes have been discussed. You will look in your book for the other life processes. Write it in pencil in your book. For example, excretion. Do excretion completely. We sweat. Animals excrete. What sort of excretion? Excretion of what?

L: [Learners are quiet].

T: Oxygen. That is respiration. It comes out of them. Respiration. Ok. Do plants excrete? We people also excrete. When we go to toilet, that's excretion. Animals? Excretion? Plants? Can we say so?

L: No, Sir.

T: What about Protista, Bacteria? They only grow and multiply because they are micro-organisms. They don't really excrete. They mostly feed and multiply and reproduce. They also have movement. For example, bacteria in the air, moves though the air, it enters through your nose into your body and so, for example, with a virus you can become suddenly ill. Like tuberculosis frequently appears in this way. You then sneeze all the time and you become ill, why? Because the virus that was in the air comes through your nose into your body and grows in your body. For example, the HIV virus comes into your body through contact with blood and then it increases. I don't know if you saw on tv [television] ...in your blood, in your bloodstream. Right. You have a task to do. Complete the other life processes.

### **Lance's Second Interview**

D: I think that's right now ya okay it's recording. Okay sir um thank you for seeing me um there's just one thing I want to ask you. It's a simile. If I say an earthquake is like being tossed around in a automatic washing.

L:

D: Then how would you say is biodiversity?

L: Uh

D: Biodiversity is like... okay you can think about that. Can I ask you the second question? When did you come across the word biodiversity for the first time in teaching? When did you hear about it for the first time?

L: First time last year. I think it was at our one of those courses we did there in the holiday for CAPS.

D: So so that was before the CAPS implementation that was during the CAPS training?

L: Yes CAPS training mam.

## **APPENDIX P**

### **COPIES FROM DOCUMENT 1 (TEXT BOOK 1)**

F. Baxter, H. Collett & E. Snyman. (2013). *Oxford Successful Natural Sciences Learner's Book Grade 7*. Oxford University Press, South Africa, Cape Town. Pages 24, 23, 22, 21 and 26.

### Exam word

**compare** – describe what is similar and what is different between two or more things

### Activity 2 Compare plant and animal kingdoms

#### Individual work

Copy and complete the table to compare the plant and animal kingdoms.

Process	Plants	Animals
Movement		
Nutrition		
Reproduction		

### New words

**phyla** – the first level of subdivisions within a kingdom

**phylum** – the singular form of Phyla

**genera** – the fifth level of subdivisions within a kingdom

**genus** – the singular form of Genera

#### Note

When we talk about a species in everyday language, we are actually referring to both the genus and species names of the organism. So the lion species is scientifically known as *Panthera leo*.

Kingdoms are further subdivided into divisions called **Phyla** (singular = **phylum**), then Classes, then Orders, then Families, then **Genera** (singular = **genus**), and the smallest group is Species. The next diagram shows the full classification of a lion from kingdom down to the species level.

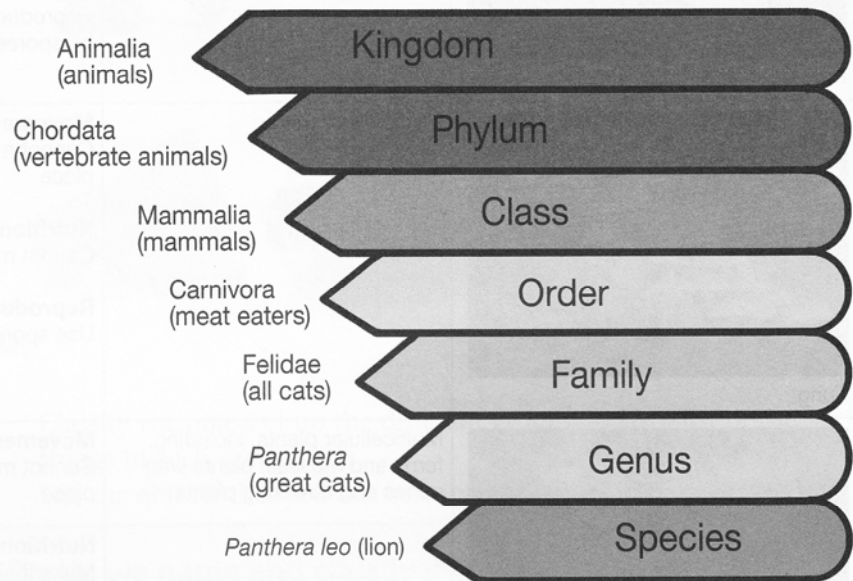


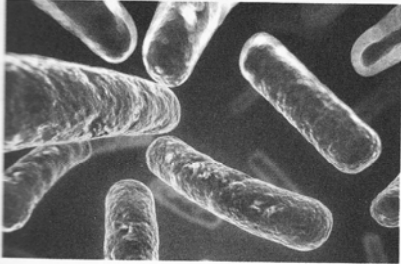
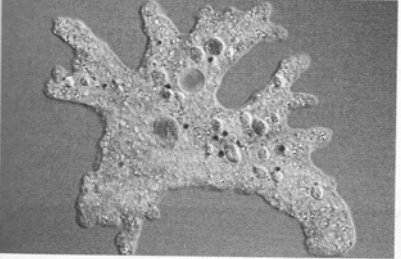



Figure 3 Classification diagram of a lion

The genus and species names are always written in slanted text called *italics* or underlined. The species name always starts with a small letter. All the other names start with a capital letter.

The species name of an organism consists of both its genus name and species name. We call this binomial naming system. According to this system the lion's full species name is *Panthera leo*.

The table shows the names of the kingdoms, examples of the sort of organisms they contain and some of their life processes.

Table 1 The five kingdoms of living organisms

Kingdom	Examples	Life processes
 Bacteria	Ordinary bacteria Blue-green bacteria	<b>Movement:</b> Some can move from place to place  <b>Nutrition:</b> Some can make their own food  <b>Reproduction:</b> Reproduce by splitting in two
 Protista	Protozoans Unicellular algae Unicellular fungi	<b>Movement:</b> Some can move from place to place  <b>Nutrition:</b> Some can make their own food  <b>Reproduction:</b> Reproduce by splitting in two or by spores
 Fungi	Multicellular fungi	<b>Movement:</b> Cannot move from place to place  <b>Nutrition:</b> Cannot make their own food  <b>Reproduction:</b> Use spores for reproduction
 Plantae	Multicellular plants, including: ferns and mosses, plants with cones and flowering plants	<b>Movement:</b> Cannot move from place to place  <b>Nutrition:</b> Make their own food  <b>Reproduction:</b> Use spores or seeds that develop in female parts of plant for reproduction
 Animalia	Multicellular animals, including: worms, insects, snails, fish, frogs, reptiles, birds and mammals	<b>Movement:</b> Can move from place to place  <b>Nutrition:</b> Cannot make their own food  <b>Reproduction:</b> Females lay eggs or give birth to live young

## What is classification?

Scientists group organisms. They look for things that are similar and different in living things. When we group things according to their similarities, we say that we **classify** them. This means we put them into groups according to characteristics that they share. Try classifying things in the next activity.

### Activity 1 Classify objects

#### Exam word

**classify** – group together things that are the same in some way

#### Pair work

The objects in the pictures can be classified into these groups:

- things we use for eating
- things we use for washing
- things we use at school.



Figure 2 Objects to classify

- 1 Classify the objects into the different groups. Write a list of the things in each group.
- 2 List the objects that you can sort into more than one group.

## Why do we name and classify living things?

Scientists name and classify living things to organise them and to describe their features and characteristics. This makes it easier to study them. For example, we name things so that we can communicate about them. This helps us share our understanding of what they are.

### Classification groups

Scientists have grouped organisms into a classification system. The system groups all living organisms into five main groups called kingdoms. These kingdoms represent a very large group of life forms that are all similar in some ways, but can be very different from one another in other ways. The five kingdoms that biologists have developed are the Bacteria Kingdom, the Protista Kingdom, the Fungi Kingdom, the Plant Kingdom, and the Animal Kingdom.

# TOPIC 2

## Biodiversity

### UNIT 1

### Classification of living things

#### In this unit you will learn about:

- biodiversity
- how and why organisms are classified
- the five main groups of living organisms (called Kingdoms)
- the differences between plants and animals
- the classification of living things.

#### LET US CHECK

- ✓ There are different groups of living organisms such as plants and animals.
- ✓ Organisms live in many different habitats on Earth.

#### What is biodiversity?

Scientists use the word **biodiversity** to describe all the different living things on Earth. All the plants, animals and micro-organisms, and their habitats, make up the total biodiversity of the Earth.

#### New words

**biodiversity** – all the different living things on Earth

#### Classifying living things

If you look around you, you will see many different kinds of living things. No one knows exactly how many different kinds of living organisms there are on Earth. So far, scientists have identified and named about 1,5 million different types of organisms. But they think that there are between 30 and 50 million different kinds of living organisms living on Earth!

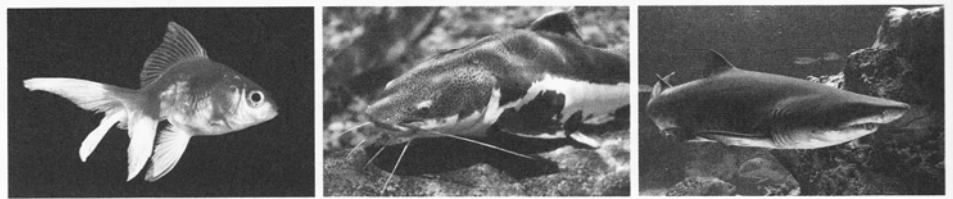


### Did you know?

*Aqua* is a Latin word for water.

### Distinguishing characteristics of fish

- 1 Fish are aquatic vertebrates, which means that they live in water.
- 2 Fish cannot control their own body temperature. They need heat from their environment to keep their bodies warm.
- 3 Their skin is generally covered with scales.
- 4 Their limbs are modified into fins for swimming.
- 5 They breathe with gills.
- 6 They lay eggs that must be in water.



goldfish

catfish

shark

Figure 1 Examples of fish



frog



toad



salamander

Figure 2  
Examples of  
amphibians

### Distinguishing characteristics of amphibians

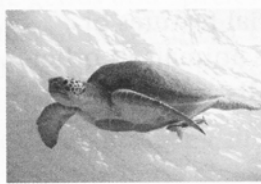
- 1 Amphibians can live on land but must return to water to reproduce. Frogs, toads and salamanders are examples of amphibians.
- 2 Amphibians need heat from their environment to keep their bodies warm. They cannot control their own body temperature.
- 3 Amphibians have moist skin that does not have any hair, scales or feathers on it.
- 4 They lay eggs in water. The eggs hatch into larvae called tadpoles that breathe with gills.
- 5 Adult amphibians develop lungs and can live outside the water because they can breathe air.

### Distinguishing characteristics of reptiles

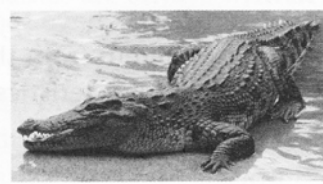
- 1 Reptiles can live on land, like lizards and snakes, or in water, like turtles and crocodiles.
- 2 Reptiles cannot control their own body temperature. They need heat from their environment to keep their bodies warm.
- 3 The skin of reptiles has scales, but no hair or feathers.
- 4 To reproduce, reptiles lay eggs with tough, waterproof shells on dry land, even if the animals live in the water.
- 5 Reptiles have lungs for breathing.



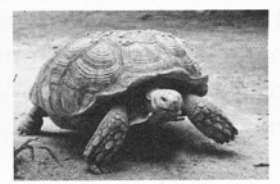
snake



sea turtle



crocodile



tortoise

Figure 3 Examples of reptiles

## APPENDIX Q

First Interview with Pam

Dorelle: Okay are we ready?

Pam: Yes

D: Okay (coughing) you need to um when we are done give me a date for next week when I must do something for children neh.

P: Okay

D: Just to say thank you. Are they writing tomorrow?

P: Yes

D: Me too me too. (Laughing)

P: Laughing

D: Ya I've got all this marking to do plus...

P: Mmm

D: Languages I'm a...my language is lots and lots.

P: Hai aha I don't want it.

D: You know. Okay are you ready?

P: Yes

D: Ya how long have you been teaching natural science?

P: Ooh I've been teaching natural science since 19 2000 and 2009 1997.

D: Have you been teaching since 1997?

P: No I've started teaching 1992, but started with grade one and then the school it was a lower primary school then. A lower primary school in Port Alfred then we upgraded the school for a to a to a primary school so that we have grades five, six and seven. Then we when we started grades five if I'm correct then I was I was one who was opted to go for and teach there since I was the only teacher who qualified for who qualified e senior primary teacher diploma. Then I was the first teacher one to teach there and I started teaching it was general science then ya. When I started teaching in 2000 and yoh 1997 grade fives and the following year grade six and the following year grade seven.

D: Mmm

P: Then all the years I've been teaching natural science.

D: Natural science.

P: It was converted to curriculum.

D: Okay and biodiversity? How long have you been teaching biodiversity?

P: Since... biodiversity is is the is on the strand: life and living so I've been teaching all the natural all the strands in the natural science, biodiversity being included there.

D: But how long since when?

P: Since since since 1997.

D: Okay thank you.

P: Umm

D: Hope this thing is recording. It is.

P: I hope so.

D: How would you describe your school?

P: Okay this school is a in terms of what?

D: Whatever you want to say about your school.

P: Okay mmm the school is a is a is situated in a township yes, but

D: Mmm

P: It's a the area is a disadvantaged area.

D: Mmm

P: In that although it's a the area is situated next to the suburb, but is the most the disadvantaged area in that it it admits all learners irrespective of e e gender e e age disability.

D: Mmm

P: So in in I arrived here through a cross transfer in 2008 whiles the school have been identified to pilot inclusive education and then I went for seminars and workshops and I was one of the teachers who were qualified to studied for some course so that I may be able to cascade the information to other teachers and then whiles was piloted a a to to practise inclusive education. After six years or in 2006 it was declared a full service school. That is a school that can that admits all learners irrespective of the their learning disabilities. Then the school was suppose to be granted human and physical resources I suppose, but unfortunately the Department of Education left left the missed some of those of those kinds, because the school as I've said the ratio fluctuates as you as all other school, but

D: Mmm

P: With us we have to to identify the. Learners with problems and they have to be presented in the ILST institutional level support team at school level.

D: Mmm

P: The the so the class teacher identify the learners with a the problems with the learning problems neh.

D: Mmm mmm

P: And present them to the ILS team. The ILS team support the learners or support the teacher concerned how...

D: Mmm

P: To deal with this: you do the charts, you do this the sentence strips, you do the counters.

D: Mmm

P: And all those stuff and after if the learners is an extremes...

D: Mmm

P: Disabled you could have extreme difficulties then the the ILST interacts with the DBST direct that is the District Based Support Team.

D: Mmm

P: They interact and they work together in order to have the child to be placed at a special school.

D: Mmm

P: If the case is is driving...

D: Mmm

P: The situation to that.

D: Mmm

P: Then when the learner is uh placed there then the teacher has to to or before it is the learner is placed you suppose to fill the forms and all that stuff.

D: Lots of forms.

P: ( ) you have lots of forms so we running that program.

D: Mmm

P: So the school is at in a situation whereby in that we have run the curriculum and they...

D: Mmm

P: Support support centre.

D: Mmm mmm

P: You know mos even their offices are not at the same place.

D: At Park Drive.

P: So the Park Drive wants this and the curriculum section, wants this.

D: Mmm

P: Want this for an example I have a learner maybe she or he is she does not cope or I'm giving him or her the support while I'm teaching neh struggling yes.

D:Mmm

P: I do then at the end of the year the curriculum section comes with it's the requirements that.

D: Mmm

P: A learner must not repeat the phase.

D: Mmm

P: If twice a learner must not in at grade seven.

D: Mmm

P: Whiles his age is.

D: Mmm

P: Is over, than the required age.

D: Mmm

P: Park Drive on the other hand said says the learner must be given a support so that he can he can be treated as as other learners

D: Mmm

P: In in the same scenario.

D: Mmm

P: So we are that type of situation, but we are coping a little bit, because I as a teacher I'm con coordinating the ILST...

D: Mmm

P: I'm the HOD since last year of the Intersen.

D: Mmm

P: And then you running short of staff.

D: Mmm

P: Because we are suppose according to we have to identify those learners and we write there's a lot of paperwork and you submit those ...

D: Mmm

P: Names to the District Office and the District office submits it to the Province.

D: Mmm

P: So that province work on that and assess the the the IQ's of the learners and works out how much teachers will we qualify for...

D: Mmm mmm

P: On the following year. Sometimes we are given a lot like last year about six teachers this year they said those teachers must go somewhere, because...

D: Hmm

P: The IQ of the learners went down...

D: Mmm

P: And then we the only thing that saved the teachers was that we wrote a letter to the the the we jumped the District Office Task Team of Redeployment and.

D: Mmm

P: And went straight to the Provincial custom Task Team.

D: Mmm

P: Whereby we stated clear that we we are were appealing to them that the teachers for the absorbtion of teachers, because this teachers have undergone on certain, such and such workshops and seminars so we cannot afford losing them.

D: Mmm mmm

P: As result we won that, because in the reemployment they were phoning us the Principals, asking for teachers in excuse and the District Office said...

D: Mmm

P: Said you must not touch the teachers from Elundini Primary school Full Service School.

D: Mmm

P: Because they are they have written a motivational letter that their teachers should be absorbed.

D: Mmm

P: So we are that kind of school the school is very busy they has lots of programmes, lots of learning. One thing I can say is that when I was in Port Alfred I was a teacher yes, and I know I was ...

D: Mmm

P: Doing justice I was doing this I was productive, but when I arrived here in this school I I I it's only then that I realize that I was doing nothing yoo, because I taught through the textbook.

D: Mmm

P: Then I was I was o work shopped or orientated that the thing that is useful here is the policy documents.

D: Mmm

P: Then I was very keen to learn and my ex deputy principal we used to to at leave two hours later.

D: Mmm

P: Trying to do the filing.

D: Mmm

P: Trying to do everything then.

D: Mmm

P: I realized that yes I'm a teacher now.

D: Wow

P: Now I'm heading the the the the senior primary.

D: Mmm

P: The senior phase suppose, but since there's a lack of managers, there's no one to to to lead to, to the head of the Intermediate.

D: Inter

P: So I'm heading the intermediate, in all subjects.

D: Yoh yoh

P: Ya I'm teaching Life Orientation, Natural Science in grade seven.

D: Wow wow so so how many learners who are LSEN are there in a class? How many LSEN, because it seems as if it will affect your teaching. How many learners with a disability, with a learning problem is in each class? So is in your class the class that you have.

P: The classes I teach?

D: Say there's forty learners in the class.

P: Mmm

D: How many would be with learning problems?

P: Maybe always is always 45 40 45%

D: Mmm

P: 40 45 40 45% because

D: Just under 50%?

P: Ya just

D: Just under half the class?

P: Ya is are experiencing learning learning problems.

D: Mmm

P: Difficulties

D: Mmm

P: Because others are behavioural.

D: Mmm

P: Intellectual

D: Mmm

P: Others are have hard of hearing.

D: Yes hai shame

P: Others e e social economic factors.

D: Mmm

P: There's a lot of other, because if you can just go here around the school you see that you are dealing with learners who came from who come from child headed families or orphans.

D: Mmm

P: Learners who are living with grandparents.

D: Mmm

P: Maybe their parents the mother maybe died. There there are also...

D: Mmm

P: Also HIV.

D: Mmm

P: Infected and affected.

D: Children ya.

P: Yes

D: Mmm

P: And you see in the the the they are financially affected.

D: Mmm there isn't always enough resources at home.

P: mmm

D: Ya

P: And the school even the the school even is under resourced.

D: Mmm

P: Under resources, because the building have been built afresh.

D: Mmm

P: To accommodate all the learners who who also use to have learners who in are using catheter.

D: Mmm

P: So the teacher have to to make an alarm to make his alarm on.

D: Mmm

P: So that...

D: He can go empty his catheter.

P: Can you see sometimes me as an ILST I in coordinator I'm dealing maybe I feel I help the teaching to fill hat form and then I ask the parent to to to submit a psychological report.

D: Mmm

P: Of the learner.

D: Mmm

P: When there comes a problem, because they don't have e medical aid.

D: Mmm

P: They they they have to use public resources. They have to go to to Dora Nginza hospital.

D: Mmm

P: Whereby it will go- it will take a long time.

D: Mmm

P: But fortunately for this year we have one learner that has been place at Lonwabo there by Rubin Berin

D: Mmm by Lanwabo

P: Is other there's other they are the other two that are also in process and for those that are in grade seven, because you'll see there's no full service school at high school level so we have to do emails that those that are passing from grade seven to do their high school.

D: Mmm

P: Because they are going to be drop outs at high school, they are not coping at all. So we are doing means to find other

D: Placements for them.

P: Institutions

D: Ya

P: Other institutions like like Siyaya I can whereby.

D: Mmm

P: They are going to register there.

D: Yes

P: And study there according to their...

D: Learn something ya.

P: Learn skills.

D: Mmm

P: According to their abilities.

D: Mmm mmm

P: And then they they they obtain e stipend...

D: Okay

P: And then so we have to sometimes I'm being caught going to class time have to assist the parent to show him or her how to fill the form

D: Mmm mmm

P: Where is the this place where is the learner go.

D: Mmm

P: And go to Home Affairs to to obtain an ID for this learner.

D: Mmm

P: So he can open an account, because the money from this institution will be deposited on his on his learners account.

D: Mmm

P: Not in your account so I have to ask advice I've got a lot to do.

D: Yoh I feel it with you. When you think of biodiversity what images come to mind? What pictures do you see in your mind when you think of biodiversity?

P: Since biodiversity is about about plants and animals you the nature the pictures of natural resources natural pictures

D: Mmm

P: Um

D: What specifically do you see now in your mind?

P: The different different type's of animals.

D: Animals okay.

P: Mmm

D: Okay

P: Sorry

D: Ya no it's fine.

P: Ya different types of animals, where, how how and where do they live or what is their feeding locomotion, how to categorise the animals, what dangers whatever mmm.

D: Thank you can you choose if you could choose three words or three adjectives or three phrases to describe biodiversity as you experience it in your life...three words.

P: Biodiversity

D: As you experience it in your life.

P: Biodiversity um biodiversity is about living.

D: You think you think about life you okay living.

P: Living living.

D: Describing okay.

P: And uh the environment or eco system.

D: But a word to describe it.

P: To describe it?

D: Ya if you say eco system what word would you use to describe it do describe that eco system that you are seeing in your mind.

P: Um when I think of biodiversity I should think uh...

D: Just three words...three.

P: Three words.

D: To describe that will describe biodiversity like for example you if I say doll.

P: Mmm

D: You'll say red maybe the doll has red hair.

P: Mmm

D: I will say um plastic.

P: Mmm

D: And I will say um boy maybe it's a boy doll. So I'm giving three words just to describe that.

P: Life

D: Okay

P: Diversity various.

D: Okay

P: Variety

D: Variety

P: Mmm

D: Okay

P: Then study.

D: Study?

P: Mmm

D: Study it?

P: Ya

D: Okay thank you (giggling) I'd like you to just spend a minute looking at these pictures. (Clearing throat) I'd like you to describe what you see in the picture and you're how you feel about it.

P: Okay here i see the plants.

D: Mmm

P: Then here I can see that the there's been veld fires.

D: Mmm they ya.

P: It was cleared for agriculture ooh okay.

D: Mmm mmm what do you?

P: This is unfair, (Referring to clearing for agriculture) because here the plants have been have been abused. The life of this plants was they were whiles they could be useful in future.

P: Mmm

P: And then.

D: So how people?

P: It's cleared for agriculture?

D: Ya to plant for food ya, but people cleared this to plant food.

P: Plant food okay.

D: Cabbage whatever so now how do you feel about the fact that the forest had to be sacrifice so that people can eat?

P: So this has been cleared for for planting?

D: Yes

P: So come again with your question.

D: How do you feel about that?

P: About this forest?

D: That's been cleared and the fact that.

P: I'm sorry I feel I feel very I'm so very hurt, because they could find they could find another place not to to to to harm the the lives of these plants.

D: This forest.

P: This forest...

D: Mmm

P: Cause there's a plenty of of empty places where I mean a forest cannot be cleared just for agriculture. The the farming the farmers must go find another place to do crop farming.

D: Mmm

P: Because this is for all this is a habitat for other animals.

D: Mmm

P: Ya

D: Mmm and okay the leopard and the tortoise how would you feel if if we decided catch the leopard catch tortoises eat them you know, but let's not ever harm the the leopard how do you feel about that?

P: This is very wrong also.

D: Hmm

P: Because the tortoise this is what you call nton ton animal eating another animal.

D: Yes like the food web or food cycle.

P: Yes I can.

D: The

P: I can see, but what about the life of this tortoise, because.

D: Sometimes we we spend a lot of money conserving the leopard, because we say the are are extinct we must take care of them.

P: Okay mmm.

D: But we we don't care how.

P: Care what.

D: How much we are and um are they not in danger as well?

P: Oh mmm mmm you know what I'm very sorry I'm very hurt about this, because my mother use to to keep this she got was got about three. (Referring to the tortoise.)

D: Mmm

P: There at home.

D: Mmm

P: In Pedi

D: Mmm

P: She loves them very much.

D: Mmm mmm

P: She's feeding them.

D: Mmm

P: They've got a just like the dogs you know how to keep the dog in the chain.

D: Mmm

P: They've got a she's got a long string .

D: Really?

P: Whereby I don't know how she did.

D: Uh

P: To have something here on this.

D: So they can't get away?

P: They didn't get away.

D: Hai

P: But if it happen unfortunately that they they go outside the whole it in homeland os mos in Pedi the whole location know that...

D: Mmm

P: About it.

D: It's your mother's. (Giggling)

P: The mother's tortoise, because it's only her that's keeping them.

D: Aww hai shame.

P: Then about this one.

D: So you feel both are important? I feel both are important.

P: They are both. The lives of animals are very important.

D: Okay and how do you feel about this wetland that looks like this?

P: Why is it so so so so dry?

D: Um people probably uh blocked the flow of the further on maybe by throwing paper or whatever pollution so now it's dying.

P: And and even

D: It's dying behind.

P: Okay

D: Yes this is also.

P: Dirty

D: Mmm

P: It looks dirty.

D: Mmm

P: It's no longer healthy, because I the wetlands I use to look to view the wetlands near M70.

D: Mmm

P: And even when I teach them about the wetlands.

D: Mmm

P: I I refer them to to that that wetlands.

D: Mmm

P: Where they ZCC members of the church use to bap baptise there.

D: Mmm okay.

P: So it's I I use to say that wetlands are always green. They are always green, because the plants that are there only live.

D: Mmm

P: In water.

D: Mmm

P: They cannot survive, but I'm very surprised that the area around the wetland is so dry.

D: It'd dying.

P: It's dying.

D: It's dying.

P: Yes what suppose is the causes?

D: I don't know what has caused this.

P: Mmm okay.

D: This one ...but usually it's it won't be animals, so neh I mean we can just assume.

P: Ah animal skins.

D: Yes

P: This is due...

D: What you got to say about that?

P: This is due to the animal cruelty.

D: Mmm

P: It means many that animal many animals have been killed.

D: Mmm mmm for their skins.

P: For the skins which is animal skins we can say although it is cruel.

D: Mmm

P: Animals are very useful, because these can make e mats or floor mats.

D: Mmm

P: They can also be used for rituals.

D: Mmm

P: Mmm

D: So is it people won't stop, because as you say you need it for rituals also.

P: Mmm

D: What is going to happen if we don't stop or if we don't have a balance.

P: Seemingly (Sighing very heavily) although the number of animals won't decrease in number.

D: Mmm

P: Because those numbers of animals won't decrease won't decrease in numbers. The animals will always be there, but this is unfair, because seemingly there could be many more animals in the in the in the environment. There could be many more animals and it means that people I are people don't even don't even farm these animals for this I don't know where or how they.

D: Hunt them.

P: Maybe they go and hunt them to get the the skin.

D: Mmm but are you saying that despite that people need these skins there will always be enough animals?

P: They will, because reproduction is still there.

D: So are we not killing more animals faster than they can reproduce?

P: Hai we are killing them more I can agree I see now there will be a shortage of animals.

D: Or or

P: Or no animals at all. I see.

D: Mmm it's scary.

P: Mmm

D: Um can you describe or tell me how you approach teaching biodiversity?

P: Um approaching teaching bio bio biodiversity I can only use them the known to the unknown approach.

D: Mmm

P: Maybe you saying teacher yoh learners must must bring or identify, any animals that they know.

D: Mmm

P: Plants and animals that they know then we we we you can be a group discussion it can be a group discussion. You just let them brain storm you give just the topic.

D: Mmm

P: That today you going to talk about animals then give them the chance to brain storm.

D: Mmm so you go from the known to the unknown?

P: Unknown yes.

D: I've also seen that you use the black boarded a lot.

P: Mmm

D: You write everything down?

P: Yes yes and I'm also, because there are a lot of new terms that new concepts.

D: Mmm

P: That they they made they may be new to them so you they they I believe that when they see the spelling on the chalk board. When they capture the spelling it's it's stays longer in their mind.

D: Okay it helps their learning.

P: Ya, because when you say it whiles they see it.

D: Mmm

P: It's always better.

D: Okay

P: For them.

D: Okay um how were your primary or your high school your own primary and high school experiences with regards to the natural science and how has your own school experiences contributed to your teaching of biodiversity now?

P: Oh my experience as a natural science teacher is.

D: No as a learner when you were at school.

P: How or...

D: How did you experience.

P: How?

D: Natural science when you were in primary school and when you were in high school and how did that experience of yours as a child in the bench.

P: Mmm

D: How did it affect the way you teach today?

P: I can say it affects them in it has a positive impact in that when I was a learner.

D: Mmm

P: My my my general science teacher use to say if she was going to teach us about crab she would say you must bring the crab. If she was going to teach us about millipedes we should.

D: Look for one.

P: Look and bring them so.

D: And that's what you do today.

P: Yes that's what I do.

D: Mmm

P: Although it is very, because I I I studied my primary in homelands so it was easy for me to go to the the river just down.

D: Mmm

P: My home.

D: Mmm

P: And ask for my brother to get me the crab there.

D: Mmm

P: And put it on the bottle and close then bring to school.

D: Mmm

P: The following day.

D: Mmm

P: But it's difficult to with the learners here, because there are no rivers.

D: Mmm

P: Close here.

D: Mmm

P: And if even if I talk about the sheep, mammals , mammals just simple mammals they cannot have the pictures of a sheep, but there when I was a learner when my teacher talked about taught me about the the the vertebrates and invertebrates I know.

D: Mmm

P: I knew what she was talking about.

D: Mmm

P: Because the the goats and the sheep, mammals are there.

D: Mmm

P: The millipedes are there crabs, crustaceans are there.

D: Mmm

P: Spiders are there. And all that stuff.

D: Mmm

P: Now with them it's very difficult impossible for them to bring it.

D: Mmm

P: So I have to to use the pictures...

D: Mmm

P: With them.

D: Anything else about your experiences as a learner?

P: Mmm I can say there's a lot experience, because I use to say to them this this syllabus the natural science has not changed. The life and living is biology then you see when I when I teach you learners the the body parts of a crab when I talk about this segments of when I talk about e e e e nansika e body parts.

D: Mmm

P: Or covering.

D: Mmm

P: Locomotion I just grab them when I was preparing the lesson, but recalling all that was said by my teacher eyoba, because she was talking about something that I saw.

D: Mmm mmm

P: So it helped me a lot.

D: So your teachers actually had a profound effect on you?

P: Giggling

D: Did you ever tell them that?

P: My my.

D: Your teachers?

P: Ya yes.

D: Do they know that?

P: Even now my teacher has retired she has invited me to her farewell.

D: Aww

P: And I'm going to be a speaker

D: Aww

P: And I'm going to touch all that stuff...

D: Oh I see.

P: That we we outcomes based education is still the CAPS is still the the...

D: Mmm

P: The old fashion that.

D: Mmm

P: That she use to use.

D: Oh

P: To teach us yabo.

D: Wonderful

P: Mmm

D: How um how has your professional training as a teacher prepared you to teach biodiversity?

P: Oh it prepared me a lot, because when I went I was was training at Algoa College of Education. We use to do e practical teaching to the to at the township schools.

D: Mmm

P: And I pre I use to choose biodiversity lessons around out lessons around by the biodiversity.

D: Mmm

P: Because we were given a chance t choose which which topic you'd like to teach so I.

D: Since I had a choice I use to choose that side that section.

D: Mmm okay.

P: Mmm

D: Okay so be be you were at the college?

P: Mmm

D: And what other courses? Um yes so you say you were at Algoa and anything...

P: Yes

D: Anything else you did?

P: I went to to Pretoria University of Pretoria to do my FDE Further Diploma in Education.

D: And what courses did you specialise in there?

P: Education management.

D: Okay

P: Then I went to to university of Port Elizabeth Nelson Mandela.

D: Mmm

P: When I I do where I do Education Management on B Ed Honours.

D: So good.

P: Then I went to university of then there at NMMU to do Masters; unfortunately I couldn't reach e average. I was left with 1, 4% to do it. Then it was converted to post graduate diploma then I went to University of Pretoria to do my dugmentative and alternative communication regarding to the to this learners who have little or no speech.

D: Hmm so that's like a remedial course?

P: Ya

D: Okay

P: But I was granted that was granted by the report Department of Education Eastern Cape.

D: Mmm

P: Since I'm here at Elundini full service school.

D: Mmm

P: Then I'm registered now with e masters, but 'm like a tortoise I'm not in a hurry mmm.

D: Okay um we've already spoke about your past experiences.

P: Mmm

D: Uh how has your past experiences influence towards the way you teach?

P: Mmm

D: Or your classroom practise. You already told me about your teachers and that is there anything else in your past that is affecting the way you work in the classroom now?

P: Yes there's a lot, but e since we are challenge here with e classroom situations the the school is being vandalise. You can't even hang our charts there at I hope you s observed that that our classrooms are are neat. The walls are are are have no posters we have posters I I I I wanted to photo to make a photocopy.

D: Mmm

P: From this yaba. (Showing a file of posters.)

D: Mmm

P: There's a lot here, but since we are we have this challenges.

D: Do they...

P: Xhosa word.

D: Do they come and steal?

P: Yes every weekend.

D: Oh shame.

P: Every Monday we we we we know that we'll hear bad news.

D: Oh

P: So we are unable to do teaching effectively.

D: So there's no security at the school?

P: No security no care taker. Security was just applying it now since we are section 21 now just to apply for security measures ADT and all that stuff just so that and even that is for the admin block only.

D: Mmm mmm

P: So the classrooms...

D: Are not safe neh?

P: Mmm

D: Okay what ideas do you have for the future with regards to your classroom practise or with regard to your teaching uh biodiversity? What ideas have you got for the future?

P: Um there's a lot that I have for the future mmm and I've already aluded we are planning to to do install more security in the cla our classrooms and we are also applying for prefabs so that you we'll deal for the actual number that were suppose to deal at class, because our classes are suppose to be with fifteen to twenty learners fifteen to twenty one learners.

D: Mmm

P: So that the inclusivity be effective and efficient.

D: Mmm

P: So we we've got we are the installation of burglar gates in the fence in the windows and also the doors. We we plan to make more security measures so that we when we are doing e e requisition.

D: Mmm

P: We ordered all the the that stuff all the stuff the charts all all the.

D: That can help them in biodiversity?

P: Yes yes I was doing it for myself.

D: Okay

P: For my natural science. So I've ordered all the stuff so when they ah arrive at the end of this year I'm sure maybe the prefects that we apply.

D: Mmm

P: There for them we will be in place. So we are planning to have to even have the natural science corners and we also have e excursion.

D: Mmm

P: Every year annually to to Grahamstown science festival.

D: Mmm mmm

P: And even at the Bay world they are.

D: Wonderful

P: They are going

D: Ex yes yes

P: Every term every term we taking them there grade seven.

D: Okay

P: Then we'll go the on the 17<sup>th</sup>.

D: Mmm

P: At five or ten o'clock so they are also giving the learners yoh e lessons and the lessons will be about the lesson that they are going to for for this term is about water.

D: Mmm

P: What is in the water so...

D: Mmm

P: Biodiversity will also feature.

D: Good good thank you um we already spoke of the problems and the challenges.

P: Mmm yes we also engage to SASTA South African do you know SASTA mos just forgotten SASTA, but it's also about natural science whereby the learners are given there already returned examinations ssss which covers...

D: Okay

P: All the strands of natural science.

D: Okay

P: Whereby.

D: Later you must sms me what SASTA is neh.

P: Okay

D: Thank you

P: So there are the the one this is that is a natural program all the grades seven, eight's yoh four to eight grade nine are engage in that program.

D: Mmm

P: So I entered I encourage my natural science teachers to to participate in that program and the scripts arrived on the by the courier and then the learners wrote examination from the first...

D: Mmm

P: To the 14<sup>th</sup> of May and the courier them back to Pretoria and if the school won wins...

D: Mmm

P: Or e or all the learners that obtained 50% and above that is level four will qualify to go and attend e annual annual nton annual program in Pretoria for free of charge and be given.

D: Mmm

P: A free accommodation and free and...

D: Mmm

P: Free catering so I'm trying to engage a a I'm all ears to hear about natural science.

D: Mmm

P: So that my learners became...

D: Clearing throat.

P: Engaged.

D: Lovely lovely.

P: Mmm

D: Um (clearing throat) do you believe that perlemoen...

P: Perlemoen?

D: Perlemoen is less important than the rhino?

P: Ntondi perlemoen? What is perlemoen? Fruit?

D: That one that they get from the sea. Big bags then the police catch them.

P: Mmm ohr.

D: They export it to China. They come take it from our seas big bags of perlemoen like that they go to jail and they spend many years in jail for stealing our perlemoen.

P: It's a animal?

D: It's um it's a shell.

P: Mmm

D: And then the food is inside the shell.

P: Mmm

D: Ya like that round like that hard shell on top and bottom and soft fishing meat is on the inside.

P: Ooh

D: Now it's a delicacy in China and they pay lots of money for it so they steal it from the seas.

P: Mmm

D: They make our seas empty.

P: Mmm

D: And they sell it for lots of money.

P: Mmm is it that we don't know the the value of them here in our country.

D: We know that's why we get lots of money for them how do thieves know that?

P: Ye okay unfortunately I don't know them.

D: Okay enough about it. It'd always in the newspapers when they catch them the perlemoen thieves, but um you can't get a stop to it.

P: Mmm

D: Goes on and on on they go sit in jail and then others just carry on with the.

P: Mmm

D: Catching of the perlemoen.

P: Mmm

D: And selling of it.

P: Mmm

D: So now do you think perlemeon is less important than rhino, because we spend lots of money to protect the rhino.

P: Rhino?

D: Because they also now kill the rhino to cut of...

P: Mmm

D: The horn.

P: I'm sure to assist the rhi... rhino that is important.

D: Mmm

P: Because we are taking care of it.

D: But that's just, because you know about the rhino?

P: Ya (laughing) that might be the problem.

D: So do you think our government must give?

P: Must consider.

D: Not worry about perlemoen and look after the rhino or must we also look after the perlemoen?

P: They must they should also consider the perlemoen.

D: Okay

P: Mmm

D: Ya what values do you think are important? We almost done neh.

P: Mmm

D: For biodiversity and the teaching of biodiversity which values?

P: Think a value that are important is that er importance the value of of animals lives the value then teaching them to.

D: The value?

P: Ya to value the the animals to value them and er we know we we we we always knew about SPCA.

D: Mmm

P: And even me I remember one day I came I go I went to Pedi at home and I was bringing my mom KFC I I I still not sure how many pieces, but there was a lot, but whiles we busy hugging...

D: Mmm

P: And all that stuff the cat took the plastic go with it outside near the kraal. When we checked it there was no chicken there was no more KFC.

D: Giggling

P: And e I was so angry that I took that e cat and killed it.

D: Ohr!

P: I killed it.

D: Laughing

P: Then I was I I I that time I wasn't unable to value the life of the animals.

D: Mmm

P: But by now I think that I have to teach to teach them.

D: Mmm

P: Teaching biodiversity have to deal with e e e how how could the learners at which of level could they value the lives of the animals you know.

D: Okay

P: Because even biblically from a religious point of view God created all the all the animals and e e eventually created a human being and ordered that that “you are responsible for all that I’ve created”.

D: Mmm

P: So the human beings that have to take care of the the bio...

D: Mmm

P: Our biodiversity.

D: So it’s your values also come from your religion?

P: Yes yes yes they also come from religion and we we now know that even if your a dog that is your domestic animals is is sick...

D: Mmm

P: You have to take it to the doctor.

D: Mmm

P: But... in the old days you couldn’t care even if it was hit by the car it will take it’s time to heal, but now we know that the since we have studied the values of the of animals you know that we have to take the animals to the doctor.

D: So it seems as if education is also a value for you.

P: Yes

D: Because it it was the knowledge you didn’t have.

P: Mmm

D: In the past that made as kill the animals you say.

P: Yes

D: And now you say now you have the knowledge.

P: Mmm

D: Now you will never treat the animals like that again?

P: Yes I won’t.

D: So you are saying without that how do we get knowledge it’s through education?

P: Through education ya.

D: So so you said valuing of animals lives?

P: Mmm

D: Uh and you said education there was something else that came through strongly, but anyway I can't get on it now.

P: Isn't it that the religious the religion.

D: Your values are based in.

P: Mmm

D: Your religion ya.

P: Ya

D: That is true ya have you always been uh in this religious?

P: Yes

D: Always a Christian?

P: Yes I'm also I'm a Christian I'm a Christian.

D: Mmm

P: Mmm

D: Okay

P: I'm Christian.

D: And then the last question. In which ways do CAPS and we already spoke about the importance of the policy document.

P: Mmm

D: In which ways do CAPS and textbooks influence your decision about how to teach biodiversity? How do you use CAPS and why and how do you use textbooks?

P: Okay which CAPS and the textbooks CAPS is in line with the textbook. I cannot lie about that the the new textbooks.

D: Mmm

P: That are CAPS oriented.

D: Mmm

P: Are in line CAPS from page to page.

D: Mmm

P: But they they differ in in the the levels on how the teacher could understand others other textbooks are are going deep otherwise others are are just coming near it. The best way is to take all your policy document put it here and you take all the references and take and put them here. The you look at all the around all the textbooks.

D: Mmm

P: And then you choose for for myself I use all the textbooks.

D: How many are those?

P: For natural science I have o Solutions for all I have o Platinum, I have ooh Successful so I use all of them.

D: And you decide which one is best for certain lesson?

P: Ya

D: Okay or you combine a few things?

P: And I've combine I use to combine few things in the same same lesson ya maybe it is maybe for for the activity I use that one for for my...

D: Mmm

P: For my teaching.

D: Mmm

P: I use this one.

D: Mmm

P: I use Platinum.

D: Mmm

P: Maybe then for e e activities I take all Solutions for all for another maybe a case study.

D: Mmm

P: You see that uh.

D: Mmm

P: It has been clearly structured here.

D: Okay

P: Let me take Oxford.

D: So for you the policy document and the textbooks go hand and hand you must.

P: Yes

D: Okay

P: Yes and policy document is always a guideline.

D: Mmm

P: Is a guideline it won't take you away.

D: Mmm

P: From what is needed.

D: So the the amount of of uh the week the time that policy document give you to teach CAP to teach biodiversity.

P: Mmm

D: Can you can you finish it in that time?

P: No no yoo CAPS is rushing you like this is rushing rushing you like this you cannot even you are I used to panic panic even if I'm not at school for one day. Even if I'm here at school doing the admin work.

D: Mmm

P: I panic if I lost one period.

D: Mmm mmm.

P: Because CAPS wants you to be in class.

D: Mmm

P: In each and every period, because it goes with the week so if you if you missed one week...

D: Mmm

P: Or one lesson for a week.

D: Mmm

P: You won't get it.

D: Okay so you...

P: You have to make an extra class.

D: So if you teach everyday every period you can finish?

P: Mmm yes.

D: You are saying...

P: It goes like that.

D: So you are not saying it is too much. You are saying it is for the time spent at school all the time has been used up right.

P: But it doesn't not consider not consider wh which level, because it want sometimes we have to leave other learners behind.

D: Mmm

P: You have to leave other learners behind you know.

D: Mmm mmm

P: Because it says this week you must be finish with the certain type of of the certain amount.

D: Mmm

P: Of work.

D: Mmm

P: Whiles other learners are whiles the learners are not at the same level of understanding.

D: Mmm um thank you very much my dear. Do you have any questions?

P: Aha I don't (Giggling).

### **Second Interview with Pam**

D: Okay this is just um formality just to make sure the evidence is there.

P: Laughing

D: Yoh you know how it goes.

P: Yay know.

D: Sweetie pie all I want is to know I want you to think of something Ima ask you now.

P: Mmm mmm

D: If I say an earthquake...

P: Mmm

D: Is like being tossed around in a automatic washing machine...

P: Okay

D: Then what would you say biodiversity is like? Think about it neh. Then I just want to know when did you come across the word biodiversity for the first time in your teaching? When did you hear about it for the first time?

P: Mmm that you know the the word biodiversity is a compound word, because bio means eh living.

D: Mmm

P: And diversity is the viral variety so I'm not sure whether you are talking about concept or mere.

D: Yes the concept yes.

P: Ya

D: In the teaching.

P: In teaching.

D: When did you come across it for the first time to teach it to our learners or even before that did you maybe hear other teachers talk about it?

P: Yoo it's been a long time, but one specific...

D: Ya more so it wasn't last year?

P: It wasn't last year.

D: Or the year before?

P: Aha

D: It wasn't since you teaching it? You heard about it before you teaching?

P: No since I was teaching maybe.

D: Since

P: At the arrival of (heavy breathing) of for the new curriculum.

D: Of CAPS?

P: Ya

D: So that's when you heard it for the first time?

P: Ya

D: Okay dear I brought your transcripts of our that was the class visit, that was the class visit you need to go through it.

P: Okay

D: No no no no no I'm giving you the wrong things I'm giving you the wrong one. That is the classroom visit and this is the interview.

P: Ooh okay.

D: You I'm suppose to show it to you.

P: Mmm okay.

D: And you suppose to say whether you feel yes it's in order or what...it's word for word.

P: Mmm okay.

D: Exactly, because it was recorded.

P: Ohr shame.

D: And then.

P: So it's a transcript?

D: It's a transcript and then word for word.

P: Ooh

D: It's taken from the recording typed out.

P: Ooh

D: Because that's how Rhodes wants it.

P: Okay shame.

D: I have to use your exact words for anything I.

P: How wow my God.

D: They that is research that is proper evidence no tampering no nothing I didn't change anything.

P: Okay is exactly.

D: Exactly my dear.

P: Hoh you...are we together all that stuff? Are we together yes?

D: Yes my dear, but as I say I know you also love studying if ever you need me.

P: Mmm

D: Don't know you must always be close to a library to be able help, but if any if ever you want somebody to talk to stuff your ideas with.

P: Mmm mmm

D: I'm available, because you help me.

P: Okay yoh you work very hard.

D: Okay so I did do that.

P: So even this is a transcript?

D: Of our re of our interview.

P: Oh okay.

D: The one we did here you remember?

P: Okay yes okay. Who is D?

D: It's me Dorelle.

P: Oh and P (she says her name).

D: No you are not P (her name), you are Pam.

P: (Laughing) okay.

D: Yes you don't.

P: Don't use names.

D: Ya there your name is is Pam.

P: Okay

D: So I'm I'm when I write of you in my report in my thesis.

P: Mmm

D: You will be Pam.

P: Laughing.

D: Okay so we did that neh.

P: Mmm

D: So now you must please stud sign this agreement to have participated the interview.

P: Mmm

D: Should have happened right in the beginning I'm sorry.

P: Okay

D: Giggling

P: Interview we ...date?

D: You can put today's date here it's no use lying about these things um the 11<sup>th</sup> neh.

P: Today's date.

D: The 11<sup>th</sup>.

P: Oh 08:2014.

D: Okay so we did that. Mr Samson mentioned a file he gave to each teacher can you remember such a file?

P: File file.

D: He said when he trained the Natural Science teachers last year for grade seven for this year last year he gave them each a file is this the file is talking about?

P: Ooh (unclear) CAPS?

D: It can't be this neh.

P: Ooh

D: Is this the file?

P: It must be that.

D: Did he give you any other file?

P: It must be this one.

D: Is it this one? Is it only this one?

P: Ya and and and I'm not sure whether I went it with it.

D: He said... everything.

P: Rather it was everybody.

D: He says everything is in there, but I can't see that this can be it.

P: Mmm (unclean) mmm

D: He says everything is in that file. The teacher can just take the file and teach.

P: Haibo let me see.

D: It's no this is grade seven and grade eight and grade nine snipped from the old syllabus so it can't be it.

P: Ya

D: So you can't remember such a file?

P: Aha aha and you know at this point in time we we are going for for content gap workshops you know.

D: I know by us all of us.

P: We are clustering and it's not that I'm getting to to it.

D: To ask him to ask them things.

P: For two executive weeks he was not here. We were all alone at our cluster.

D: And then who who guides?

P: It Is cluster there'a a cluster.

D: You just help each other out?

P: It's a cluster there's a class leader that has been trained.

D: Okay

P: Mmm Mrs Andreas.

D: So so you haven't seen anyone else with such a file?

P: Aha aha I even asked him. Mrs Andreas about about he's her file.

D: Mmm

P: And when when I I thought man aha let me not take the file let me just take her index.

D: Mmm you going okay.

P: Her index I'm using her index.

D: okay

P: As our cluster leader now I was doing my file.

D: Mmm

P: Yoh sorry I was now doing my file according to her index you know.

D: Okay...yoh.

P: Mmm otherwise there's nothing.

D: Mmm okay and then you going to give lend me this one. (Referring to the textbook.)

P: Ya

D: Going to lend me this one?

P: Ya

D: And this one I said I do have neh.

P: Mmm

D: Let me just write there you use Viva.

P: Viva

D: Viva and Platinum so I must check on Platinum...and can I lend this one? Ima.

P: Viva Africa.

D: I will bring it.

P: It's Viva Africa.

D: I've got a copy.

P: Okay

D: So I will check that one out.

P: Okay

D: Just now on our interview we did neh you you when we spoke about animal skins and rituals you sighed me (sigh) why?

P: When you say we talking about?

D: Animals skins.

P: Ohr

D: You know that pictures I showed you about.

P: Ohr

D: Animal skins.

P: I remember.

D: Ya

P: Mmm

D: Can you remember why you sighed?

P: (Laughing) whew maybe it was, because I was thinking of e that there's a lot of slaughtering of animals, animals are being destroyed.

D: And how does that make you feel?

P: That we we are damaging the the our Gods nature, Gods creation.

D: Mmm and how do you think can it be stopeed? Can it be stopped?

P: Shoe I don't know, because people like like meat, people like meat a lot.

D: For eating?

P: Sometimes their eating, sometimes they want they want to manufacture something from the skin...

D: Okay

P: Of the skin.

D: Okay

P: Or manufacturing purposes.

D: Okay you also mentioned in our in that interview that wetlands are always green you referring to some wetlands here on your way to school neh.

P: Clans?

D: Wetlands

P: Oh wetlands yes.

D: You said it's always always green...

P: Mmm

D: Clean and all that.

P: Mmm

D: Who ensures that the wetlands are always green and it doesn't go dry and that it's not polluted? Who takes care of that?

P: Is it not the muni yoh municipality? I'm not sure maybe it's municipality here in the urban are you areas, but in our rural areas as I've mentioned that I'm from Pedi the wetland are always are always in that manner maybe...

D: Okay it's just that.

P: Maybe nature.

D: It's just that in another interview that teacher was feeling the wetlands that he sees are always polluted so I was just trying to say in the same city you know.

P: Mmm

D: Why are why other wetlands you are seeing green and clean and the wetlands he seeing um always polluted maybe we talking.

P: You talking about different wetlands in different areas.

D: Yes

P: Though in the same city.

D: Yes yes that is so.

P: Mmm

D: That is so and then who so you think must ensure must make sure that the rhino and the lion are not killed or wiped out completely?

P: Unclean?

D: The rhino rhinosticall you know.

P: Mmm

D: And the loin they kill them for their bones.

P: Mmm

D: The they make...

P: Mmm you asking who must ensure that?

D: That that they are preserved.

P: The farmers.

D: Who own them? Do the farmers own them?

P: Ya

D: And the lion?

P: Yoh I'm sure, because the farmers maybe there own them for for business purposes.

D: Mmm mmm okay.

P: Also

D: That's also done.

P: Mmm

D: Thank you my dear that was all.

P: Laughing

## APPENDIX R

Interview with Mandy

D: Okay

M: Forty to forty five minutes.

D: Yes please just about forty forty, forty four, forty five minutes.

M: Yoo ah busy busy busy.

D: So can we start with those questions that I...

M: Yoh I didn't have time, because it's...

D: It's no problem.

M: My house we are busy.

D: It's not thinking.

M: Renovating the house.

D: Yes...oh shame.

M: And I was very busy this.

D: Yes no it's.

M: The weekend.

D: It's not thinking very thinking questions so can we start?

M: Yes put my phone on silent, because it can disturb me and I wanna try to and uh write some answers so that we can finish earlier, but I didn't have.

D: Don't worry darling. (Heavy breathing) While you standing how long have you been teaching Natural Science?

M: Um I've been teaching for about twenty five years now.

D: Natural Science?

M: Yes

D: And biodiversity? How long have you been teaching biodiversity?

M: Biodiversity biodiversity it's all about plants and animals so in science that's what we've been teaching. It's was the same uh lessons on plants and animals that we were teaching and uh eco-system something like echo-systems.

D: Mmm

M: So now we've got this new term which is biodiversity which is not that different from what we've been doing, because it's about plants and animals so...

D: Okay so no different meaning?

M: Yes

D: How would you describe your school?

M: Oh my school um it's a a school with place that is friendly with lots of learners.

D: How many learners?

M: It's about 1.2 learners.

D: Okay

M: Because of the environment

D: Big school.

M: Yes it's a big school so we've got those learners which are very with big numbers.

D: Okay

M: Is in big numbers.

D: Okay ya.

M: But at least now it's much more better, because we've got prefects so even with the numbers in class are much more better than before.

D: So if you have wh...

M: We use to have overcrowding.

D: That means you have more teachers?

M: Yes we have more teachers, because we are about thirty thirty thirty one.

D: Okay and it seems as you very busy, lots of projects going on at the school can you quickly tell me about some of them?

M: Um GM as is engaging us, helping us to make our school at least in fact they helping the the teaching, because now we are equipped with how to deal with learners to have patience, because they as school we know that for the learners to learn better they must be happy at school. So those are the things that we are learning from them you see?

D: Mmm

M: So and especially the learners that we we are getting are from uh uh informal settlements.

D: Mmm

M: With parents who the learners they are challenged a lot, because they have problems in their homes. Their parents are sick these areas the parents eh sickness like HIV and AIDS. So and TB to, but e now we also help them with those challenges you know.

D: Okay

M: Just to make them feel that they are not alone you see.

D: Mmm okay.

M: Yes

D: Uh you already said the learners have lots of challenges and their communities as well. So let's go to biodiversity.

M: Mmm

D: When you think of biodiversity what images or pictures come to your mind?

M: Umm in fact it's all about plants and animals that you are that is all the living things.

D: Okay

M: Maybe in an area you see.

D: Okay

M: Yes

D: Are they good pictures, bad pictures? What what kind of pictures?

M: Um the plants and animals oh no it's it's a good pictures.

D: Okay

M: To have plants, animals around with you.

D: Okay if you can choose three words only...

M: Mmm

D: Or or three adjectives to describe biodiversity.

M: Mmm

D: What three words would you choose?

M: Ah to describe biodiversity?

D: Biodiversity

M: Maybe beauty of the.

D: Mmm

M: Environment.

D: Mmm

M: Um yes I think they the beauty there is the beauty is plants.

D: Uhuh

M: And um and environment which is economically stable.

D: Okay

M: Like having enough uh food, because we get food from plants and um we also we can we also all sell some of these exports some of the food...

D: So so if we.

M: Country eh yes.

D: If you if we can take one word to describe what you are saying now you want biodiversity to sustain, to feed people.

M: Yes yes yes yes.

D: Okay okay and a another word.

M: Um to feed people.

D: Okay

M: Beautify

D: Ya

M: Ya yes.

D: Okay if you think of.

M: Mmm

D: We can we can come back to that again.

M: Mmm

D: I would like you to take a minute to study these photos. You see it's these aren't things you can prepare for neh you can't prepare for it it's just um can you just look at those pictures?

M: Wetland animal skins.

D: Can you tell me what you see in the pictures and tell me how you feel about what you see.

M: Um in the picture with wetland. I can see pollution that's what I I can see here, because I can see field fires across there's fire and the water is like polluted.

D: Mmm

M: Because there's that green algae.

D: Mmm

M: Are a bit dirty.

D: And how do you feel? (Clearing throat) Looking at it how does it make you feel?

M: I feel sad, because you see people can get lots of diseases, because of air pollution.

D: Uh

M: And some animals that live that live in this habitat in this wetland. So they can die, because of that air pollution.

D: Mmm

M: That I can see here.

D: I see a lot of wetland coming to your school.

M: Yes

D: On that side of the road on this side of the road.

M: Yes

D: In fact the school and the road there.

M: Yes

D: There's a diverse wetland.

M: Yes

D: Ya (Clearing throat)

M: So what what we.

D: No I'm just saying there is one.

M: Oh that's what you see.

D: There's a wetland close to...

M: Hai yes yes.

D: The school.

M: Yes yes .

D: Ya

M: Yes yes there's this wetland.

D: And and the next picture?

M: Also I can see another pollution here.

D: Mmm

M: Forest

D: Mmm

M: Um um where they are destroyed and I feel bad to look at this picture, because they are animals that stay here. It's a habitat for for other animals.

D: Mmm

M: And it is said here it's cleared for agriculture.

D: Mmm

M: And then I'm thinking what they think about the animal that that is their home.

D: Mmm

M: You see I feel sorry for those animals.

D: Mmm

M: Because

D: But but if we can just look at this picture neh.

M: Mmm

D: Um on the other hand people must eat.

M: Yes

D: So what what do we say about that we we need the forest to remain untouched.

D: Mmm

M: But on the other hand we need to plant vegetables for people to eat so um what would you say about this dilemma?

M: Um but I think, because you see the land is big so for the forest I think they can be kept like that then they look.

D: Untouched?

M: Yes untouched and look for other lands there's plenty of land where they can.

D: Yes for.

M: Use for agriculture not to burn.

D: Okay

M: The home for the animals is like when your home is burned like these house how can you feel.

D: Mmm

M: That's what I feel for them.

D: Okay

M: Yes

D: And and the picture here?

M: I was trying to find out trying to find out about this picture it's it's an animal skin.

D: It's animals skins hanging on poles.

M: Yes, but.

D: How do you feel?

M: What I know about animal's skins. They are used to to make um leather and other things. So I'm not sure what this picture is for I, because I don't know what the animals skin comes from, which animals skin is the that's all I know about animals skins it will.

D: How do you feel about the skins being on display like that? Obviously to be bought on sale how do you feel about that?

M: Yes um it's only that we we need some of these things like the to make leather jackets you know to make us warm so.

D: So maybe you think maybe it's just uh it's for sale for people to buy.

M: It's for sale.

D: Because they need it.

M: Yes that's what I I thought when I when I see this.

D: Oh and you don't think that's a endangered animal or animal where there's a few numbers left. Could be tiger could be leopard could be I'm also not sure.

M: A yes it's a it's a it becomes a a confusion, because all of us we eat meat and yet we are worried that we don't want those animals to be extinct.

D: Mmm

M: I know that, but life is like that (giggling) we have to eat food.

D: Uh

M: So it's sad it's sad, because.

D: Oh uh what are you saying about the numbers is it just going to drop and there's nothing we can do about it.

M: Yes they can they can drop, because if it's a skin of a a loin or.

D: It means it was killed.

M: Yes it means it means it was killed you see.

D: And and are you saying that in the end they are just all going to die off, because people need and there is nothing we can do about it?

M: Yes yes, because ke there's there's nothing, but you see with the the the animals like lions and zebras I always feel sad for them, because they need to be protected. It will be easy for them to be extinct.

D: Mmm

M: You see, but chickens they grow every time you see.

D: Okay ya.

M: That's what I think, but things like animals they can be extinct they can...

D: Now?

M: Be killed all the time.

D: So how are we going to prevent that from happening?

M: Our government if it can help us to to put laws that would be very restrict for people not to kill.

D: Okay

M: The the animals.

D: Okay

M: Yes

D: (Clearing throat) Okay um here over here this one here. (Referring to the picture.) We have a leopard and we have tortes. Do you think we can catch all the tortoises and make soup and eat it and take the money from government and preserve the leopard? Or do you think both must be preserved?

M: Yes that's what I was saying that this the animals like these that are are found in the forest.

D: Mmm

M: I I I I they need to be protected really, because it's easy for them to be finished and not have them.

D: Mmm

M: It's different from like chickens where or pigs where they there are many.

D: Mmm

M: You see.

D: Mmm and and people ensure that there are many?

M: Sorry?

D: People ensure that there are many.

M: Yes yes.

D: But, now when you look at the leopard and you look at the tortes. Which one is more important than the other one?

M: Ai I think they are both important (giggling) they are both important this, because...

D: Any of these?

M: Both of them they are few already.

D: Okay

M: So it's easy for them to be extinct they are already few.

D: Okay

M: Yes

D: Okay um can you tell me how you approach teaching bio biodiversity? How do you teach it in the classroom and why did you decide to teach it in that way?

M: Um to teach biodiversity?

D: Mmm how do you teach it and why do you teach it in that way?

M: Okay uh first of all usually we are encourage to not to tell learners everything. You must first find what they know.

D: Mmm

M: And encourage them to think for themselves.

D: Mmm

M: So I I can usually group um my class into two. Others they go out others are left in class and then I give them some questionnaires to to follow like they will those who go out they can just look around the school grounds as a habitat and see any animals that they can see.

D: Mmm

M: And they can even uh take some rocks and see the animals that are under the rocks so they have to write everything.

D: Mmm

M: The plants and animals that they can see even the one that are flying as long they around they write everything there and then the next question they divide those plants and animals that they have written.

D: Mmm

M: Down into plants and animals.

D: Mmm

M: that in class I give them different pictures and then they write down all their names of the animals and plants that they can see and then they divide those into plants and animals.

D: The way how you did it when I was in the class?

M: Yes

D: Yes that was interesting.

M: And then ke I can go further like um telling them that in this animal there are animals with a back bone they will know the back bone there and animals without a back bone and then they further write the answer another colom.

D: Mmm

M: With animals with bones and animals without a back bone it's just introduction so that when I...

D: Mmm

M: Teach at least it they have their own thing that they came with.

D: Mmm

M: You see so that's how I always teach.

D: Like this.

M: Yes and terms, because there are so many terms here. I have I make things like that.

D: Flashcards

M: Flashcards, because now we are in a electricity. They must have flash card that are specials on the wall so with the definition things and all that.

D: Mmm very lovely. Um how were your own primary your own primary and high school experience with regards to Natural Science? How has your own experience as a learner in the bench neh contributed to your teaching of biodiversity now?

M: Wow my primary school maybe uh in primary school um I I happen to love science, because the way we were taught science is totally different from what we we are teaching our learners now.

D: Okay

M: In fact maybe I in a totally disadvantage school then.

D: Oh okay.

M: Because, you were there there were no chemicals and we were just learning from.

D: A textbook?

M: Our textbook.

D: Okay

M: Looking at those textbooks and all that you see.

D: Mmm

M: And maybe even the teacher they were not doing their best to to teach us, because sometimes we bring some other things from our homes like e e tartaric acid things that are that we use in every day.

D: Mmm

M: In our homes so we were not encouraged, but I happen to go to a good uh training college where my interest grew more in Maths and as Science so where...

D: So

M: We were learning, using uh many material learning material we have lots lots of chemicals so so that's when I figure

D: If I can come just back to your to your primary and high school experience. So you are not teaching now the way your teachers taught you, you are not.

M: No no, because what I learn from the training college that's where they was clear how to teach them and even with uh uh our workshop we are told clearly how to teach...

D: Okay

M: Our learners.

D: Okay so which training college did you go to?

M: Afatingiwe Training College.

D: Where? Where is that?

M: Near Transkei.

D: Okay and and what is your qualification called?

M: E it was SPDD.

D: A teachers training.

M: Primary e teachers.

D: Was it a Diploma then?

M: Yes it was

D: Was it thr three years?

M: Yes

D: Okay

M: And then I further did Maths and Science at UPE. Specialise on Maths and Science.

D: Wow what how what was that course called?

M: E e e

D: S

M: S e (Banging on the book.) thing Maths and Science it's only Maths and Science.

D: At UPE?

M: Yes at UPE.

D: And was it.

M: In Maths and Science.

D: At UPE oh okay.

M: Maths and Science.

D: And was it one year?

M: It was two years.

D: Two years two years part time?

M: Yes two years part time.

D: Okay

M: One year full time.

D: Okay so you actually a Maths and Science teacher?

M: Yes

D: Okay good thank you. You already told me that your professional training prepared you to teach biodiversity and you've already told me the courses that you've done. Have you done other course?

M: No that's the only thing.

D: And you feel that it has it has besides what you told me now how it's prepared you. Is there anything else you want to tell me about how it has prepared you to teach?

M: Ya I think even the Department of Education has is helping us a lot to to teach.

D: Mmm you part of a cluster?

M: A cluster.

D: No.

M: No no.

D: With the Department. So um okay maybe we will come to that later neh. Um has anything that you've experienced in the past influence the way you teach now influence your classroom practise?

M: Um I uh I experience that learners they learn much more better when they are happy. That's what I I've noticed that if they if they are happy they they are easy to to ask questions there's it's easy for them to to answer you. So if they are happy in class they learn much more better.

D: Mmm so what do you do to create that happiness in the classroom?

M: You know just to allow them to ask questions to encourage them all the time to ask questions.

D: Okay

M: And the another thing working in groups it makes them to feel free.

D: Okay

M: Yes it's it's not something that makes everybody do. Think they answer...

D: Mmm

M: Alone you see.

D: Mmm

M: So learning to work in groups makes them happy makes them to feel much to do better.

D: Okay

M: Yes

D: Um what ideas do you have for the future with regards to classroom practise or teaching methods with regards to biodiversity? What ideas do you have for the future?

M: Future yoh I think there's nothing mote accept that they can help us more, because you see their their their their the topic is not difficult, but it's too long so in future I think I must really come to class prepared, because if you you you've got everything in fact we started this year to do biodiversity. So it was new to me though I've learned of my mistakes so now I know what to do next year to come prepared with everything, because there...

D: So you.

M: There there the topic is too long.

D: So how long how long did you take now to teach biodiversity? How many periods?

M: Mmm I didn't check the number of times.

D: But do you feel you need to do it in less periods?

M: Yes yes.

D: Okay

M: Yes

D: And is it possible?

M: Because, I didn't finish if I can tell you honestly.

D: Okay

M: Especially when it comes to plants.

D: Mmm

M: So I didn't do just it plants.

D: Mmm

M: So that's why I'm saying that next year I have to know what I'm dealing with a topic that is a which is which is()

D: Mmm

M: Which is long you see.

D: Mmm

M: So I must make sure that everything is well prepared.

D: Okay

M: Because, if you are well prepared it becomes easy for you...

D: Mmm

M: To teach a particular topic.

D: What problems or challenges or difficulties so you experience when you teach biodiversity? now you already said it's long.

M: Yes

D: Anything else?

M: Even the terms.

D: The terms.

M: Yes

D: The concepts.

M: Concepts yes.

D: Mmm they are difficult for the learners.

M: Difficult for the learners.

D: Mmm

M: But, if you got enough time to explain then at least I don't think I'll as I'm saying I'll have enough of these flashcards.

D: Flashcards.

M: In my class so that.

D: It will help?

M: Really it will help yes.

D: Okay um do you feel that the Department of Education has helped you sufficiently, prepared you sufficiently in the teaching of biodiversity?

M: Uh no the honest truth is that maybe it's just us, because they were busy with the workshop since we started in this new program this year, but preparing for biodiversity in fact I was I didn't know that we we there's something that is new which is so long...

D: Mmm

M: In our topic until we got the textbooks in February or March you see.

D: Which is also late.

M: It was late by then.

D: Okay

M: You see that's why we didn't prepare thoroughly. I usually prepare on there on my two weeks of my holidays.

D: Mmm

M: You see.

D: And I also.

M:

D: I also came home.

M: () I didn't know at all there's this.

D:

M: Yes

D: Of biodiversity?

M: Yes biodiversity.

D: Then it also came along still.

M: Yes yes. (Giggling)

D: So sorry dear. What values do you think are important for biodiversity and the teaching of biodiversity values?

M: Mmm you mean, because I'm thinking you why is it important what do mean values.

D: Uh like like I could pick up a value you had was that life is important whether it's a small life or whether it's a big life.

M: Okay

D: For you life is is valuable it's a value.

M: Mmm

D: Now preservation of life.

M: Mmm

D: What other values do you think are important for the learners to develop in ( ) here?

M: Like uh love of nature.

D: Okay

M: You see the the it's one of the v.

D: Values

M: Values the value that I'm thinking of now.

D: Mmm

M: You see they must value the nature and they must um protect e it.

D: Okay

M: You see protect the nature. I think that's all I can think about...

D: Mmm

M: Right now.

D: Okay

M: Yes

D: Lovely. In which ways do CAPS and the textbook...

M: Mmm

D: Influence your decisions about how you teach biodiversity and then how do you use CAPS?

M: Mmm

D: And then uh why do you use CAPS in that way and how do you use the textbook, which textbooks do you use and why?

M: In fact for every for every lesson that we have to teach the first thing is we have to prepare the lesson, but...

D: Mmm

M: Before that you have to consult your policy document.

D: Mmm

M: And see what you have to teach before you come to the textbook. So that is what I always do. I check the policy document what is needed for me to do and then I I...

D: Go to the textbook?

M: Go to the textbook.

D: Now which textbook do you use or how many? Which ones do you use?

M: Platinum

D:

M: Platinum yes.

D: Okay

M: Okay um did I ask you all this questions now okay.

M: Giggling

D: Okay so why do you only use Platinum?

M: Because, that book I think it goes uh goes hand in hand with the with the with our policy document, because before you decide the book you must you must make sure that it it goes with your policy document in fact you get everything.

D: You did that before you ordered the book? Did you check that before you ordered?

M: No we were having the this other book where two books here. There were people who came for to our school to to to sell some books, but we know which one, because by then I I didn't have a a policy document. So when we had to order fortunately I had the a policy document and then I went through those Oxford was the other one.

D: Oh

M: But when I look at Platinum I could see that it goes straight. Everything that is needed...

D: Okay

M: Is there.

D: So you only use Platinum?

M: Yes, but not only.

D: Mmm

M: I also use Oxford.

D: Okay

M: For other questions ( )

D: Okay okay.

M: And other information.

D: Okay okay we are finish with that now I just have one question: If I say an earthquake...

M: Yes

D: Is like being post around in a automatic washing machine.

M: Yes

D: Um what would you say biodiversity is like?

M: Diversity earthquakes it's.

D: If I say if I compare them.

T: Oh oh.

D: If I say earthquakes is like being tossed around in a washing machine.

M: Mmm

D: Then what would you say biodiversity is like what other thing can can be compared to what?

M: Mmm diversity is like yoh. (Giggling)

D: Okay we gonna come back to it. When did you come across the word biodiversity for the first time in teaching?

M: I think it's this year this year.

D: Okay

M: In

D: With CAPS?

M: With CAPS yes.

D: Okay

M: Yes

D: Um this I have to do. This is the transcript of your classroom observation. You are called Mandy, because I can't use your name.

M: Okay

D: So you are Mandy so the M is Mandy this is this is classroom. Remember the lesson?

M: Mmm

D: This is it so I have to show it to you.

M: Oh

D: So word for word um as it comes from the recording you have to do the same today is, bit I don't know.

M: Mmm

D: I have to then also bring it back to you so you can see it you see it's.

M: Yes

D: I have to show it to you and you suppose to go through it and but, we don't have time, but you suppose to go through it yes everything is right just like I said you know.

M: Mmm

D: Um okay so I so verify that I'm being truthful.

M: Yoh okay.

D: And that using your exact words and not putting my own words.

M: Okay, because we don't have time. Can't you make copies for me so that I just go through them and then I ( ) your go through and then whenever, because I don't yoh really really.

D: Because, you don't have time now.

M: And we won't have time now.

D: Yes we won't have time now.

M: Yes

D: Okay and then uh can you please sign this. Thank you very much you can read through quickly it's just to say who I am my name there and what this research is about.

M: Okay

D: The research is about about biodiversity. It's about teachers your experience, biodiversity and the teaching of biodiversity.

M: Okay

D: It being now new to our ( )

M: Okay

D: Um and then I'm just saying how I would I'm recording everything.

M: Okay

D: That I've recorded that I will bring it back to you.

M: Okay

D: Thank you very much and sign here.

M: Here by signature?

D: Mmm you can put today's date 11<sup>th</sup>.

M:

D: 11<sup>th</sup> ya. Mr Samson mentioned a file he said when he trained the teachers last year.

M: Yes

D: He gave them each a file. Do you know about a file like that? He said everything is in that file.

M: In fact it's which file, because we she he gave us the CD where we have to make copies.

D: And what was on the CD?

M: No it's the the the the thing that we were a trained at.

D: Okay

M: Yes

D: So that could that be the file he's speak of? Because he says there the teacher can just go out and teach.

M: Mmm, but what I know he said how we can bring another CD, because there are so many things.

D:

M: There are other things that I did.

D: Okay

M:

D: So so you can't quite recall?

M: That is to get some as a result the is still here.

D: Okay

M: Because, he forgot in fact she was going to go to to training centre, but they are not sure if ( ) grade so.

D: Mmm

M: Or he couldn't.

D: Mmm okay can we just come to the last one?

M: Mmm

D: What would you like to compare biodiversity to biodiversity is like.

M: Yoh aha the plants and animals life, because that's all I'm thinking about ( ) biodiversity.

D: Mmm

M: So so to compare the plants and animals can you compare to another thing not plants and animals. Biodiversity is about living things.

D: Mmm

M: I think it's a difficult question for me.

D: Okay

M: Giggling

D: Okay

M: That I'm not thinking about now.

D: No thank you very much.

M: Okay

D: Do you have any questions?

M: Ah no no.

D: Okay thank you very much.

## **APPENDIX S**

### **TEXTBOOK:**

J. De Beer, D. Gibbon, R. Jones, T. Kuneni, J. Patrick, J. Sampson, B. Subramani, E. Whitlock. (2013). *Via Afrika Natural Sciences Learner Book Grade 7*. Via Afrika Publishers, Cape Town. Pages 22, 20 and 23.

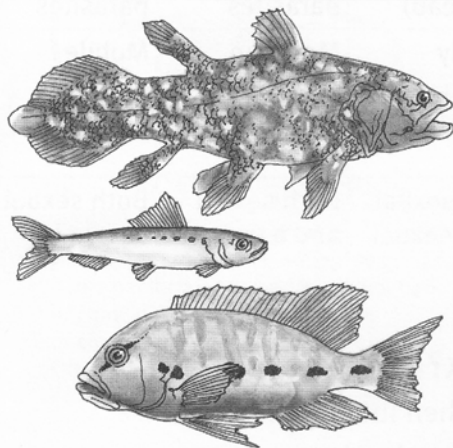
## 2 The diversity of animals

### 2.1 Animals are vertebrates or invertebrates

Animals can be grouped into invertebrates (soft bodied animals without backbone) and vertebrates (animals with a backbone/skeleton).

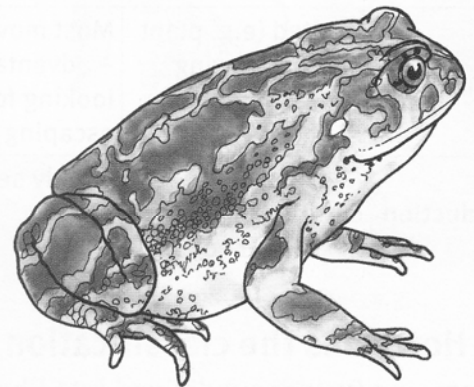
### 2.2 The vertebrates

Animals with a backbone are classified as belonging to Phylum Chordata. We can distinguish between five Classes of vertebrates on the basis of their distinguishing characteristics.



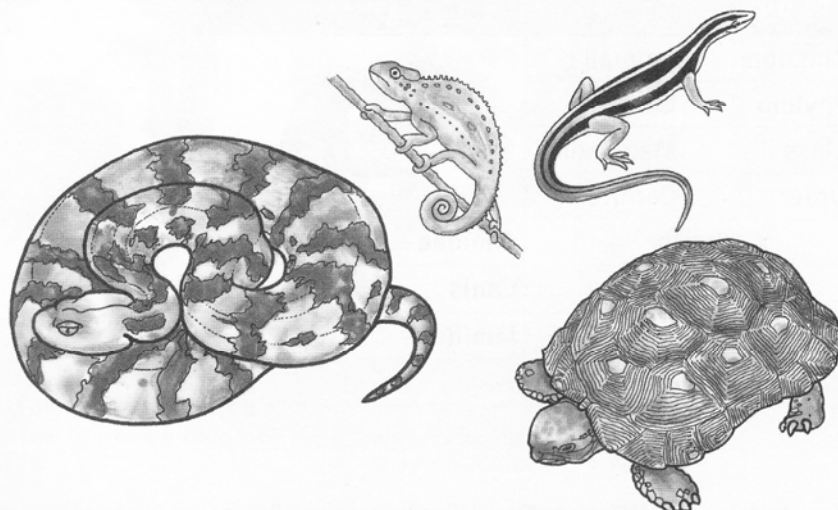
#### Fish

Fish are adapted to live in water.



#### Amphibians

Amphibians are adapted to live in water and on land.

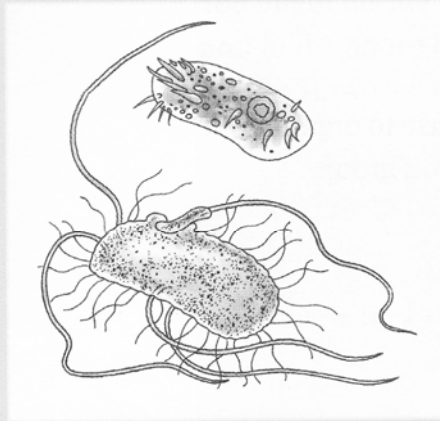


#### Reptiles

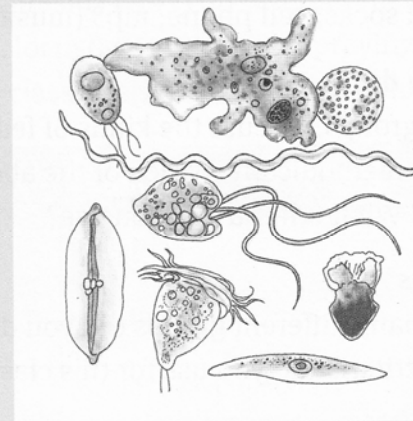
Reptiles are more active when it is hot than when it is cold, because they are cold-blooded.

### 1.4 The five Kingdoms of life

Scientists have classified all living organisms into five main groups which are called the five Kingdoms of life:



**Bacteria (Monera):** Bacteria are microscopic organisms. Some are very useful and help in the production of food (e.g. some bacteria assist in the production of cheese and yogurt). They also decompose dead organic material. Other bacteria are harmful and cause disease, such as tuberculosis (TB).



**Protista:** This Kingdom includes many microscopic organisms. It includes algae, e.g. brown algae, the rubber-'plants' that one sees washed out on the beach, and certain parasites, e.g. the parasite that causes malaria.



**Fungi:** This Kingdom includes mushrooms; the mould that grows on old bread; as well as the parasite that causes athlete's foot in humans.



**Plants:** Plants play an important role in the environment. They trap the sun's energy and change light energy into chemical (food) energy. They provide food for animals.

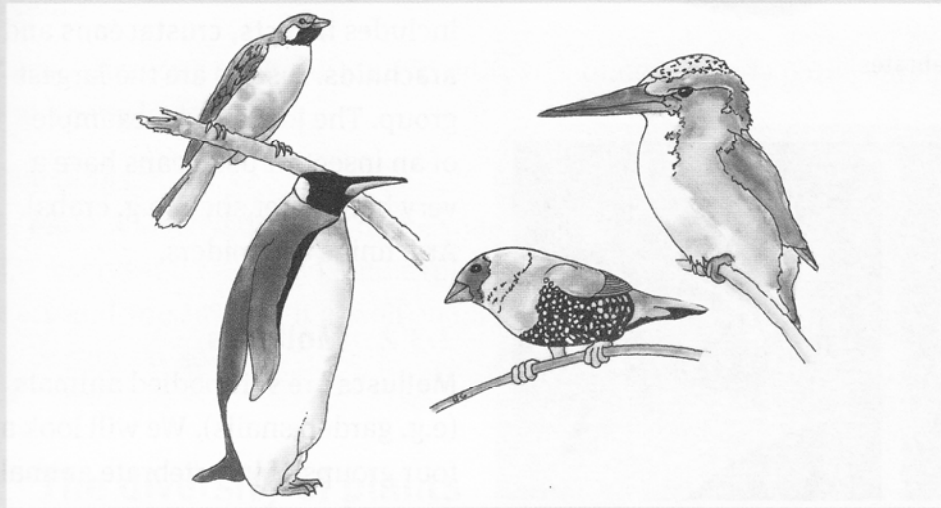


**Animals:** Animals feed on other animals, and decompose food. Animals are able to search for food.

FIGURE 3 The five Kingdoms of life

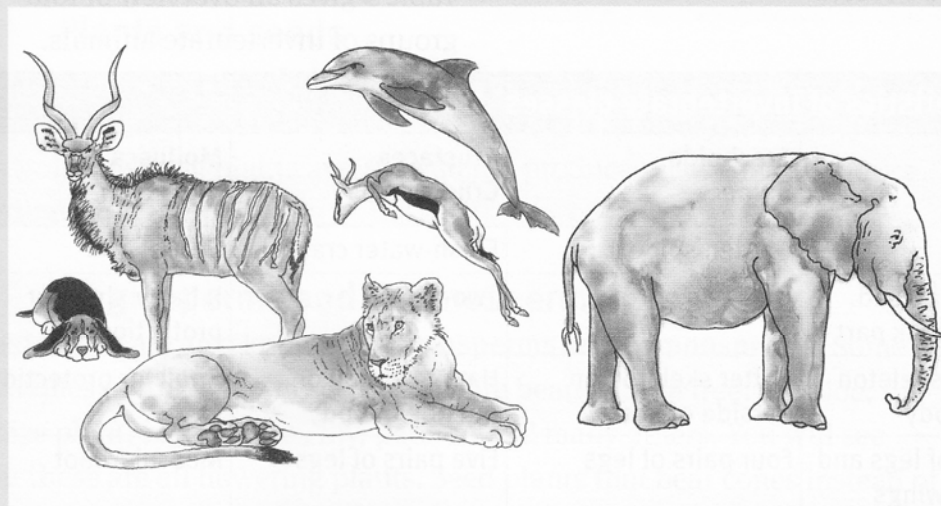
**Table 2** Some characteristics of vertebrates

Vertebrate group	Body covering	Locomotion	Body parts used for locomotion
Fish (Osteichthyes) e.g. goldfish	Scales	Swims	Fins
Amphibia e.g. frog	Thin, slimy skin with glands	Jumps and swims	2 pairs of legs. Back legs are strong with webbed feet
Reptilia e.g. lizard	Dry skin with scales	Walks or slithers	Most have 2 pairs of legs. Some have no legs (e.g. snake)
Aves (birds) e.g. pigeon	Feathers and scales	Flies and walks	2 wings; 2 legs
Mammalia (Mammals) e.g. rat	Hair or fur	Walks and runs	2 pairs of legs



**Birds**

Birds have developed wings which allow them to fly.



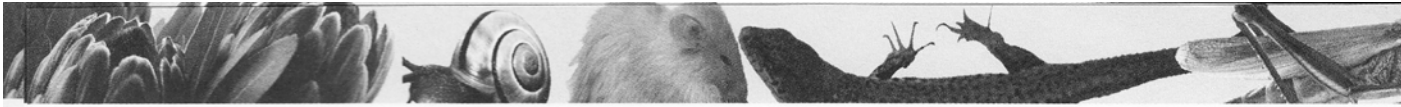
**Mammals**

Mammals are born live or give birth to live young.

**FIGURE 4B** Different vertebrates

**TEXTBOOK:**

R. Brooksbank, J. De Fontaine, L. Marchant, R. Marriot, C. Mayers, C. McLaren, H. Skinner. (2013). *Solutions for All Natural Sciences*. Macmillan, South Africa. Pages 28, 27, 26, 24.



The Five Kingdom classification system classifies all living organisms into one of five main groups, called kingdoms (Figure 2.4):

- **Kingdom Monera:** This kingdom includes very tiny organisms made of only one cell. These organisms are so small that they can only be seen with the aid of a microscope. They include bacteria and blue-green bacteria (sometimes called blue-green algae).
- **Kingdom Protista:** This kingdom includes a wide range of organisms made of either one cell or many cells arranged simply together. They are larger than the organisms in Kingdom Monera. The three main types of protists are protozoa, algae and slime moulds.
- **Kingdom Fungi:** This kingdom includes organisms made of many cells. They get their food from decaying plant and animal materials. They include tiny microscopic yeasts, larger moulds and mushrooms.
- **Kingdom Plantae (The Plant Kingdom):** This kingdom includes organisms made of many cells arranged to form complex plants. They make their own food by the process of photosynthesis. They include algae, mosses, ferns, cone-bearing plants and flowering plants.
- **Kingdom Animalia (The Animal Kingdom):** This kingdom includes organisms made of many cells arranged to form complex animals. They get their food by eating plants or animals. They can move. They include sponges, worms, starfish, jellyfish, snails, insects, spiders, crabs, fish, amphibians, reptiles, birds and mammals.

**Word bank**

**habitat:** the place where a living organism lives

There is an enormous variety of living organisms on Earth, ranging from tiny bacteria to large plants and animals. There is also an enormous variety of habitats on Earth. A **habitat** is the place where a living organism can live and survive, such as a forest, desert, wetland or ocean.

So far, biologists have identified about 1,75 million different types of living organisms on Earth. However, biologists estimate that there could actually be between 3 and 100 million different types of living organisms on the planet.

### The importance of classifying living organisms

Due to the enormous biodiversity of living organisms on Earth, biologists find it useful to sort and classify living organisms into groups. Living organisms are classified according to their shared characteristics. Living organisms with the same characteristics are placed in the same group and those with different characteristics are placed in different groups.

Classifying living organisms helps us to:

- make sense of the enormous biodiversity of living organisms
- show how living organisms are related to each other
- identify living organisms.

### The Five Kingdom classification system

Over the years, as biologists have learnt more about living organisms, they have designed many different classification systems for living organisms. Today biologists are still debating the best way to classify living organisms. One of the most commonly used classification systems is the Five **Kingdom** classification system. In the Five Kingdom classification system, living organisms are sorted and classified according to their shared characteristics.

**Word bank**

**kingdom:** the highest level of classification used in the classification of living organisms

## Classroom activity 1

1. Define the term classification.
2. Figure 2.3 shows a selection of everyday objects. Classify them in three different ways based on each of the following observable features:
  - a) shape
  - b) colour
  - c) use.

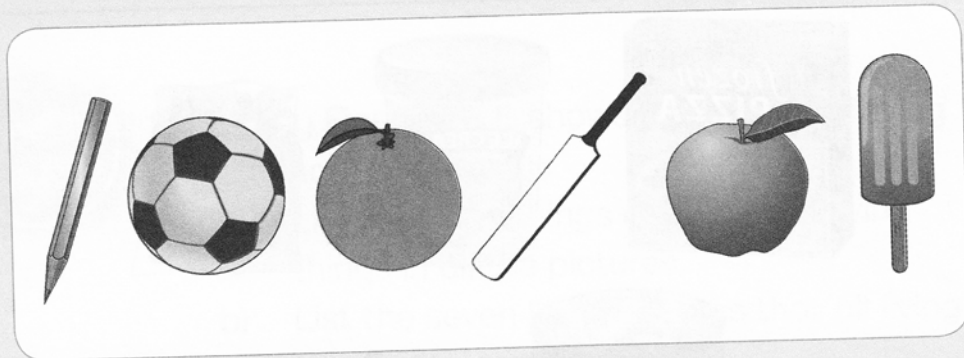
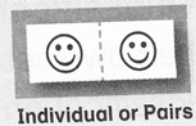


Figure 2.3 Examples of everyday objects

3. Draw a classification diagram for each of the three classification systems in Question 2.

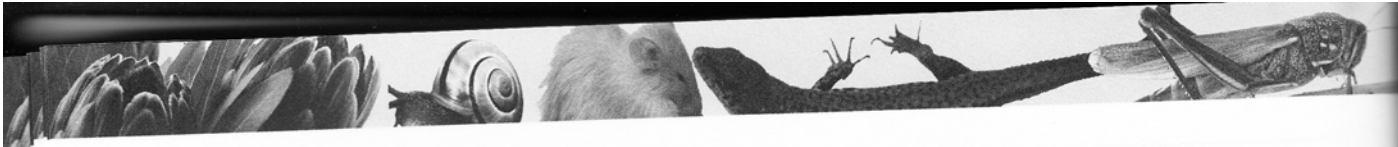
## Lesson 2

### Classifying living things

Biologists classify living things into different groups based on their characteristics. This allows us to see how the millions of different types of living organisms are similar or different to each other.

### Biodiversity

Biodiversity (bio = living, diversity = variety) is the variety of all living organisms and habitats on Earth.



## Unit 2 Diversity of animals

### What you already know



In Grade 4 you learnt that there are many different kinds of animals. Some have bones that form a skeleton inside their body and some do not have bones. Some have a hard outer covering called an exoskeleton. There are visible differences in the structures of different animals, including size, shape, body covering and sensory organs. You learnt about the basic structures of an animal including a head, body, tail, limbs and sensory organs.

### Check myself

Study this list of animals: fish, millipede, frog, spider, lizard, bird, cat, ant, earthworm, crab.

1. Which of the animals has a skeleton made of bones?
2. Which of the animals has an exoskeleton?
3. Describe the body covering of each of the animals.

### Lesson 1

#### Classification of animals

In Unit 1 you learnt that all living organisms can be classified into one of five kingdoms: Kingdom Monera (bacteria), Kingdom Protista, Kingdom Fungi, Kingdom Plantae and Kingdom Animalia. In this unit you will learn more about the classification of animals in the Kingdom Animalia (the Animal Kingdom).

#### Vertebrate and invertebrate animals

The animals in the Kingdom Animalia are divided into two main groups: vertebrates and invertebrates.

**TEXTBOOK:**

J. Avis, M. Bester, M. Bezuidenhout, A. Clacherty, S. Cohen, J. Cowan, S. Doubell, J. Erasmus, A. Joannides, G. Lombard, E. Nkosi, R. Sadie, L. Schreuder.(2013). *Platinum Natural Sciences Learner's Book Grade 7*. Maskew Miller Longman, Cape Town. PAGES 21,16,15,11

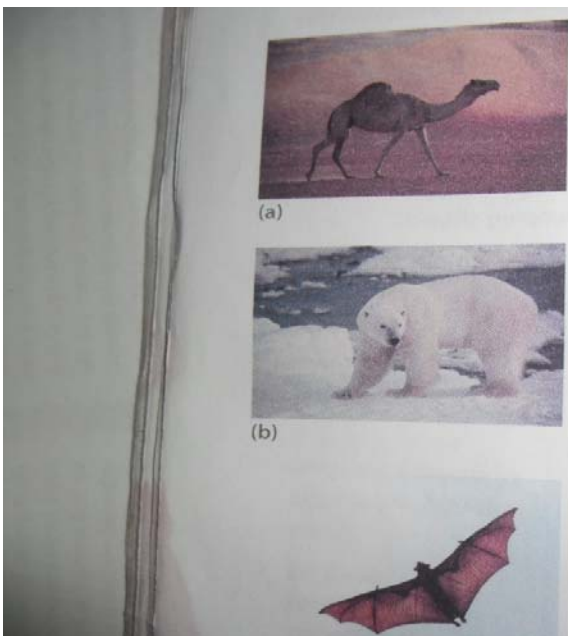
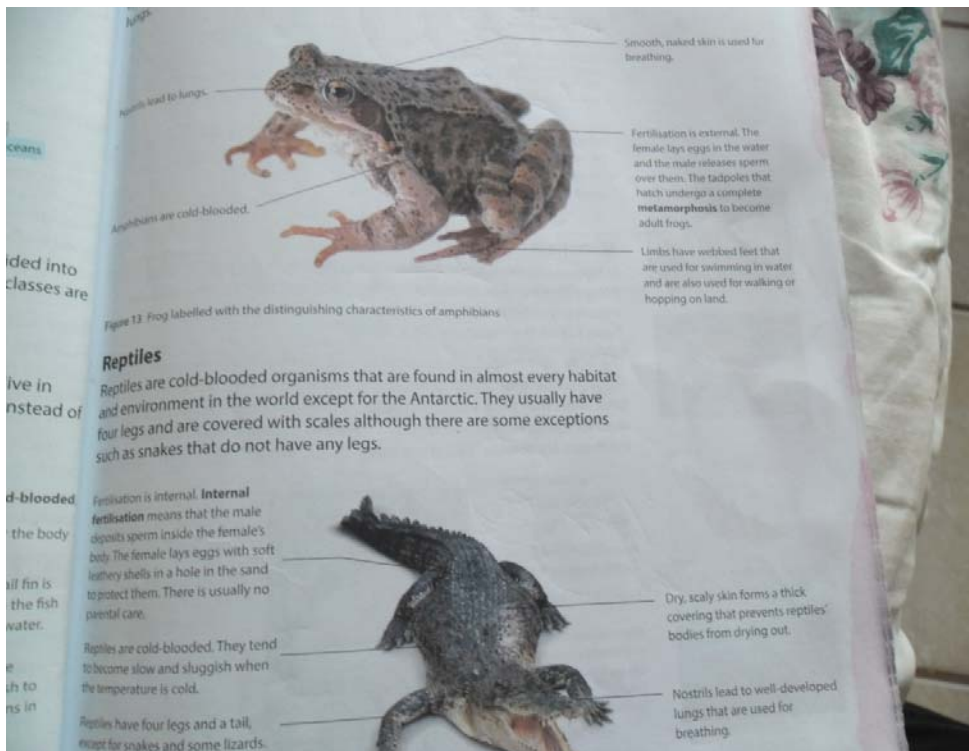


Figure 15 Distinguishing character

### Mammals

Mammals are the class of many different types of animals that live in almost any habitat. For example, bears live on the frozen ice.

The limbs of mammals are adapted for different uses. Some mammals have limbs that are adapted for walking, some are used for flying. Whales and other aquatic mammals are diverse, the



lungs

Nostrils lead to lungs.

Amphibians are cold-blooded.

Smooth, naked skin is used for breathing.

Fertilisation is external. The female lays eggs in the water and the male releases sperm over them. The tadpoles that hatch undergo a complete **metamorphosis** to become adult frogs.

Limbs have webbed feet that are used for swimming in water and are also used for walking or hopping on land.

Figure 13 Frog labelled with the distinguishing characteristics of amphibians

**Reptiles**

Reptiles are cold-blooded organisms that are found in almost every habitat and environment in the world except for the Antarctic. They usually have four legs and are covered with scales although there are some exceptions such as snakes that do not have any legs.

Fertilisation is internal. **Internal fertilisation** means that the male deposits sperm inside the female's body. The female lays eggs with soft leathery shells in a hole in the sand to protect them. There is usually no parental care.

Reptiles are cold-blooded. They tend to become slow and sluggish when the temperature is cold.

Reptiles have four legs and a tail, except for snakes and some lizards.

Dry, scaly skin forms a thick covering that prevents reptiles' bodies from drying out.

Nostrils lead to well-developed lungs that are used for breathing.

ms is called **taxonomy**.

f classifying living organisms. The classification divides living organisms into **kingdoms**. These are the bacteria, protists, plants, and animals. An example of each is shown in Figures 2–6.

### Kingdom of organisms

and contains many different types of organisms. Organisms belonging to a kingdom share the defining characteristics of that kingdom. A pie chart in Figure 7 shows the number of organisms in each of the kingdoms.

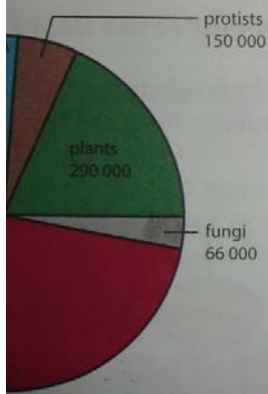


Figure 3 Example of a protist

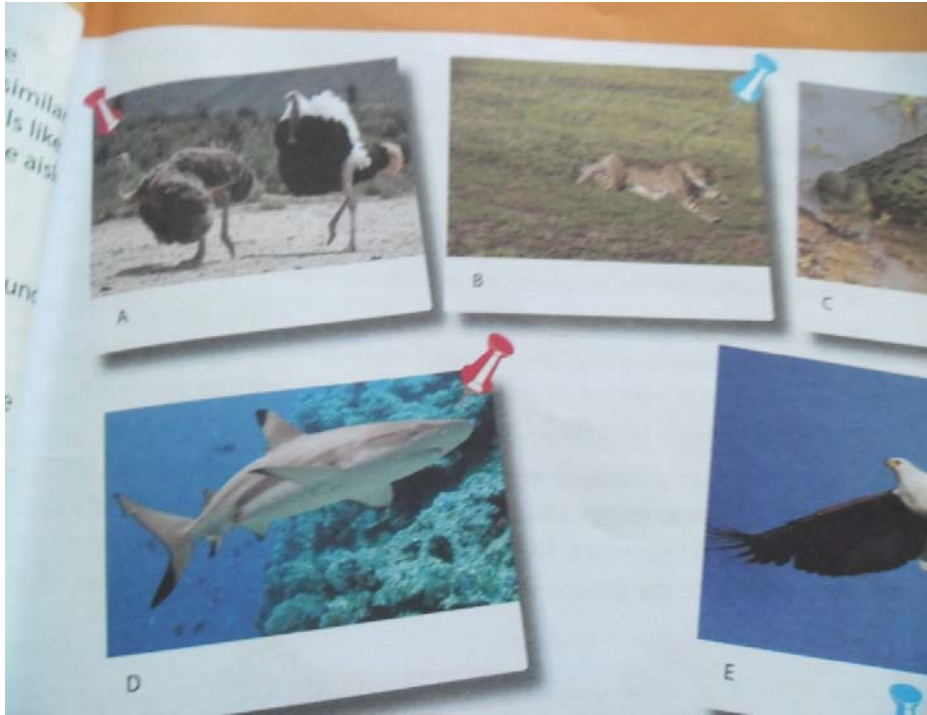


Figure 4 Mushrooms belong to the fungi kingdom.



Figure 5 Aloes belong to the plant kingdom.





## **APPENDIX T**

### **TRANSCRIPT OF PAM'S LESSON**

Pam: Your story. Sorry right. Okay now. Good morning learners.

Learner: Good morning teacher.

P: Okay. Today we are going to deal with child heritage. First we deal with the burglars between the little and on that store we are going to take back from the little organisms just have got that have got on eh on our (cellphone rings). We are going to look back at the beginning organisms that we have and we all know that we say the truth that can be called the kingdoms. Isn't that so?

L: Yes

P: And then we said we said how many kingdoms we have? Five kingdoms neh.

L: Five kingdoms.

P: And if we can name them we all know that all the others are not important, but we are going to take only two (phyte) two kingdoms two biggest two the two biggest kingdoms which are?

L: Plant kingdoms.

P: Plant kingdoms and?

L: Animal kingdoms.

P: Why do we take them because they are the biggest that can be seen with our naked eyes and we know that all the world are occupied by the world that mostly occupied by plants and animals.

L: And animals.

P: Yes and then if we classify...if we go into biodiversity. We are going to classify we have already classified the living things into five groups and we said we are going to take only two groups. The plant kingdom and the animal kingdom. We know that the animal kingdom have have the biggest number of species in the world isn't that so? And the plant is following on.

L: Yes

P: Right and the plants is the following ones. Right and then if we take this this two kingdoms (writes on the board)plant kingdom and animal kingdom when we call them according to their kingdoms. You say kingdom plantania and animal kingdom animalia. Isn't that so?

L: Yes

P: But now we are going to deal with these kingdoms which is animalia.

L: Animalia.

P: Then you say animal kingdom. Right. Those are the two two important kingdoms that we deal with in biodiversity. Animalia and plantania neh but we are going to deal with animalia which is animal kingdom neh.

L: Yes

TE: The animal that we have in the world are grouped into two classes we still remember from grade 6 the plants oh the animals are grouped into two classes and so you still remember from grade 6 grade 5 which two groups can we classify our animals.

L: Invertebrates

P: Huh

L: Invertebrates

P: We classify in to two groups invertebrates, and? (writes on the board)

L: Vertebrates

P: Vertebrates right what is the difference between these two groups? What is the difference between these groups? What is the difference between these two groups? Mamma? Just tell me what invertebrates is all about what is the little invertebrates are all about. Yehke

L: Vertebrates are the

P: Vertebrates are the animal that have backbones. Class:

L: Vertebrates are animals the animals that have backbones.

P: Have backbones and obvious the invertebrates are animals that do not have backbones.

L: Do not have backbones.

P: They do not have backbones that is the animals that is the scenario according to the animal kingdoms. So we got invertebrate and then we got vertebrate the vertebrates are the animal that have no backbones and the invertebrates the animal that have no backbones.

L: No backbones.

P: Right and then we are to go just to leave this class vertebrates and go down with the vertebrates

L: Vertebrates

P: With the vertebrates right we start with the scientist the scientist when they are looking at living organismsthey are looking for the characteristics as which what is similar to that one in order to be able to group any species you look for the characteristics. And when we look for those characteristicswe look for the characters. What are the characters? Where they stay... we look for the... the eating what they eat we look for the we look for the uhm their bodies are... they are warm blooded animals or are they cold blooded. We look for their what they use for gaseous exchange we know that animals feed uh oxygen from the plant to exchange they need oxygen from the plant to exchange they give out eh carbon oxygen in order to get what?

L: Oxygen

P: Oxygen so what plant do they use in order to gaseous exchange are they using the... the gills or are they using the nostrils or what or what do they use? So we look for those things and another one who are just often production what do in they their production. Its does it involves internal fertilization or external fertilization that the animal get parental care or no parental care? Are we together?

L: Yes

P: And then the scientist they use those things those things in order to classify the animals are we together?

L: Yes

P: They also look for the movement and when we talk about the animal movement we are talking about locomotion which fast movement. What type of locomotion does animals have? Is it the swimming a flying eh walking, hopping etc. So it can be a walk a walking move of the locomotion. It can be extremely move of locomotion it can be a flying move of the locomotion it can be a hop move of the locomotion neh and then they say we know vertebrates vertebrates are moved into common classes in common classes are they grouped. Shjoe! Now they are grouped in five classes. They are grouped into five classes and so neh. Right what classes can you name can you name the classes? Mammals

L: Fish

P: Heh?

L: Fish

P: Second one?

L: Mammals

P: Mammals. Third one .....(Other learners are making a screaming noise outside)

L: Amphibians

P: Amphibians. Forth one forth

L: Reptiles

P: Reptiles and the fifth one? Children Zondo

L: Birds

P: Birds... birds so... so those are five classes of vertebrates and then they are grouped according to the characteristics that I was talking about if we can take the fish for an example if we can take the fish and look for its locomotion... and we are going to change the following one mammals... and the third one which is amphibians... and the forth one which are reptiles... and birds and look for only one characteristic look for that mode. So all fish should have the same mode of locomotion what is the mode of locomotion of fish which is flying jumping swimming... swimming what does it use for swimming? What does it use for swimming?

L: Fins

TE: Fins. So whenzan ntondi? So it is use that things for swimming and you look for mammals... mammals or can have one of each class before we go further. Can you have one of it for each class I want one example of a fish.

L: Shark

TE: Hmm?

L: Shark

TE: Shark. Okay shark an example of a mammal. Heen heen heen heen. Neil

L: ( )

P: Huh? (C)

L: (C)

P: Or huh?

L: (C)

P: An example of a amphibian in an example of an amphibian hm an example of an amphibian. Only two people three. Miah heh Neo?

L: Frog

P: Frog an example of an reptile?

L: ( )

P: Huh? Liezl An example of birds (name)

L: Chicken

P: So those are the examples of each and every class of vertebrate's heh. Right then only coming through to... to said the fish use fins to swim neh and then what do mammals use what is the locomotion of mammals? Walking further walking and they use what? E legs neh.

L: Legs

P: For walking right and amphibians what move of locomotion?

L: They jump.

P: Or they?

L: Hop

P: So its hopping... and locomotion of reptiles example of reptiles just an example of reptiles so if you know what I am talking about the reptiles an example of the predator that I know of the commotion. The class and must know the example also what is the mode of the locomotion of the reptile, mammals?

L: Slithering

P: Huh?

L: Slithering

P: Sl... mmm

L: Slithering

P: They slide

L: They slide

P: Slide

L: Slide

P: Sliding right what is the locomotion of birds? Give me an example of each one. Flying and what do they use for flying?

L: Wings

P: Wings. Right so we know that all the birds. Listen. All the birds what they do when they are they are they go again they use more flying so we look for these characteristic in order for us to... to have classification of these mammal. Then we come to uh wasn't going to complete them all because of time uh and we come to body covering going to covering finishing by ya. Body covering... fish

L: Scales

P: Huh?

L: Scales

P: Scales, scales scales. Mammals, mammals... mammals.

L: ( )

P: And? Amphibians Are their bodies covered? Are their bodies covered?

L: No

P: No body covering no body covering. Reptile's... reptile's

L: Scales

P: Scales... birds?

L: Feathers

P: Feathers. Right then we come to we come to cold cold warm... warm blooded. Fishes that they call warm blooded animals. Results heh Cold blooded animals we know that when we animals called cold blooded animals whereby it feels cold and when... when it is cold we say it it hibernates ..... It's .....just m... just in summer we see the... the the the the the snakes and lizards the difference and are all just cold ...and warm they they don't ...when it is a cold blooded animal it feels the cold ....cold blooded or warm blooded animals?

L: Cold

P: Mammals: warm blooded or cold blooded animals?

L: Warm

P: Warm ehm...Amphibians?

L: Cold

P: Cold blooded. Reptiles?

L: Cold

P: Cold blooded. Birds?

L: Cold

P: Cold blooded animals say e habitat Where do they live? where do they eat? Where do they eat? Where they get... where... where do they get the fish?

L: Water

P: In organism of just can't say in water.

L: Water

P: Whatever water so this is

L: ( )

P: You get them in water. Where do you get mammals? Mammals where do they live?

L: On lands.

P: On lands on lands and then when you talk about habitat when we talk about e habitat we talking about where the animal lives, where animals sleep. Where does it survive with when they are not un reproduce it sleep it can survive it can feed on it the... the place where it sleep doesn't effect it. Jaba and then amphibians where do we get?

L: In the forest.

P: The forest. So from that moment they survive on land and also survive on water.

L: Water

P: You afraid to answer and e reptiles where can they survive? Reptiles on land or water?

L: Land

P: So on land. And the birds birds?

L: Land

P: And and also be

L: On land.

P: Ya see reproduction. If you look for the reproduction we look for just the respiration internal or external fertilization, when it is internal when whereby the fertilization is happening inside the body of a female animal. Fertilization the the combination of a sperm cell and then female egg is... is happening inside the body of an animal. Some animals have the first internal fertilization where by the... the combination of these sperm cells and female egg is carried all inside the body of an animal and it's got also internal fertilization whereby the female animal place the unfertilized egg in a specific area and then the male animal come and deliver into the sperm cell so that the animal sperm cell can combine with the egg. In order for this fertilization to take place by that fertilization take place outside the body of an animal and then we say that is external fertilization right.

L: Yes

P: So for this fish to know that got external fertilization... fertilization external fertilization is?

L: External

P: Fertilization is external. And for mammals... mammals do not have an external fertilization. Whereby the fertilization is done on will be taking place inside the body of a female mammal. Are we together?

L: Yes

P: So if you have internal fertilization and what is the interesting with e mammals. They do have parental care with all other classes with all okay. Only the mammals... only the mammals and the birds that do have parental care. Otherwise all other classes of our vertebrates they do not have parental care. The female will protect the course of production with the complete term fertilization or external fertilization and a mother doesn't care whether the baby how it is getting on how on getting out for the food. The baby develops on its own, no mother is taking care after the baby. Are we together?

L: Yes

P: So the only class that do have parental care is the birds and the mammals.

L: Mammals

P: You know mos if you knew you fed at home mother and if there's her mammary glands until you are old she washes you she washed you... you she bake you food she made sure she made sure that you are there you get dressed so that you don't get cold from outside. So that is called parental care (Xhosa

words) otherwise the snakes, the reptiles amphibians um the fishes just produce and they do not care what is happening around their babies. The babies are together just developing on their own. Are we together?

L: Yes

P: Right and another interesting is that the the only class of vertebrates that eh all other classes of vertebrates they give back to the younger ones the younger ones. So if eh birds give back to the young ones the younger ... parents. So if eh birds give back to the young ones eh the... the food...will....are we together?

L: Yes

P: But only with the amphibians. The amphibians undergo process that is called metamorphosis. What is it called?

L: Metamorphosis

P: Whereby the... the female amphibian reproduce eh give back to a younger one eh and the young one of an amphibian search for a tadpole when it is bigger it is called a tadpole we have the fertilization is outside so it is external fertilization isn't that so?

L: Yes

P: So they react there and the female and the male releases the sperm so the egg is fertilize and then the egg are stay there for about eh a couple of weeks and after that they get hatched. (Xhosa words)

L: (Xhosa word)

P: And the young one will get outside. Like that neh and they will always develop and get something like a chain and then if goes bigger and bigger until it becomes a frog a big frog. So unfortunately until it begin becomes a big frog.

L: Big frog.

P: So it undergoes big stages and call this stages. Ntondi Meta....

L: Metamorphosis

P: Metamorphosis this is happening only in one class of the vertebrates. Which is?

L: Amphibians

P: Which is?

L: Amphibians

P: You cannot get metamorphosis in mammals, fish, reptiles. You only get with the class of amphibians. Are we together?

L: Yes

P: So if the fertilization is also external even in reptiles it is also external. And with the birds fertilization is internal.

L: Internal

P: It is? Internal

L: Internal

P: Because when the chicken or when the birds lay that egg it has already been fertilize inside the body of the mother of the bird and then its kept warm until it has an (Xhosa words) hatched.

L: (Xhosa words)

P: And the young ones come out of that shell, that egg, it is then the mother isn't that so?

L: Yes

P: It doesn't go metamorphosis. You understand?

L: Yes

P: Right and another thing is that uhr among all those classes its only its only the birds and mammals that have parental care. Right?

L: Yes

P: That have only parental care.

L: Yes

P: That have parental care. There is another thing that I wanted to... to... to talk about but if we can go we can take our books and see. I'm going to... to... to group you neh.

L: Yes

P: In groups of six. Two four six two four six two four six two four and then what you are going to do. I'm going to give you these types you take them. (Interacting with the class) I just want to see the task of what I want you to do for me. Informal task is not going to be an formal task. What you are going to do with your paper with our chart in front of youyou are going to divide you are going to divide in two half's neh. You are to divide it in two half's Boetie horizontal not... not vertical like this. Put it in horizontal and then you'll draw a straight line neh. You write on top vertebrates. You write this side you write this side vertebrates and you write this side invertebrates. No you write vertebrates neh. You write what? Vertebrates

L: Vertebrates

P: And then you divide equal. You make five equal five neh. Horizontal and write fish, mammal, birds, reptile amphibians neh. You understand?

L: Yes

P: And then what you are going to do. You take your magazine. Somebody take it. Where are the magazines? Take the magazines. You put in the groups and then you are going to look for all the vertebrates. Vertebrates in the in the magazine. And then you cut them according. You understand? You put them according. So under the fish you are going to put the pictures of the fish. Under the amphibians you put the pictures of amphibians. Jalo Jalo Jalo Jalo.

L: Yes

P: So this something like this. Nxolo... Nxolo. Listen we don't know listen... listen listen. You write vertebrates verte.... You write vertebrates.

L: Verbrates

P: Write it on top of it. Listen. (Xhosa words) and you write fish you write mammals you write reptiles you write? (Names)

L: Birds

P: Birds you write amphibians

L: Amphibians

P: Hai hai hai

L: Not a hai

P: And then we'll draw a line like that but yours should be straight and you divide your chart like this. Divide the chart like this and then. Listen and then what you are going to. After number b you look for the pictures of a fish first your fish. You paint the pictures you don't get paint the fish. Pictures of the mammals... mammals amphibians... amphibians. That is your formal task. (Name) Where are the painted pictures? (Interaction with the class) Talk to your book talk to your book. (Interaction with the class) where are your painted pictures? (Interaction with the class) hai hai hai (names) Listen don't get eh confusion. It is not a fish. Its type of mammal. That of mammal that swims in water. What you of mammal. What you say e mammal. There's so may also the bird the bird now we got the bird. (Interaction with the class) Listen... listen. That is your informal task and you can be able to identify whether it is a mammal it is a fish is it a what. This is the type of activity that you are going to do. Some of these mammals some of these fish animals are dangerous you cannot get. So that's why you have to make sure and tomorrow please bring pictures of ( )

L: Pictures

P: Bring more magazines tomorrow neh. Bring more magazines cause we are going to other class of animals that which is invertebrates. Are we together?

L: Yes

P: So tomorrow you must bring that and don't forget that eh on Wednesday we are going to do our formal task. We are going to do our formal task on Wednesday on Wednesday.

L: Wednesday

P: Huh? Wednesday

## APPENDIX U

### TRANSCRIPT OF MANDY'S LESSON

M: Okay today we are going to know more about in fact I'm going to introduce to you a lesson about biodiversity. You know?

L: Yes

M: So biodiversity heh first of all we do everything. You must know. What is biodiversity?

L: Biodiversity

M: Biodiversity is the variety of living organisms in a particular?

L: Area

M: Area can you read it for me?

L: Biodiversity is the variety of living organisms in a particular area.

M: Is a variety. Biodiversity is the variety of living organisms in a particular are. Read again.

L: Biodiversity is the variety of

M: Okay... okay variety (correcting their pronunciation)

L: Variety of living organisms in a particular area.

M: Who can tell me the examples of living organisms, because here we are talking about living organisms...living organisms that give me a living organism because we talked about (Close your books) when we are talking about living organisms what we are talking about give me one living.

L: Plants

M: Good plants what else? Yes

L: Animals

M: Animals we are talking about plants and?

L: Animals

M: Next so when we are talking about living organisms we are talking about... plants and animals

L: Plants and animals.

M: So they say it's a variety so it means there are we are talking about different plants and animals.

L: Animals

M: Something that is a variety challenges me neh but now we are talking about plants and animals.

L: Animals

M: Animals yes now let's imagine maybe we are walking in the forest neh.

L: Yes

M: And then there in the forest you find many different plants and animals.

L: Animals

M: But I've given you some few plants and animals. Right we can get when we are in the forest. Can you please open a paper in front of you and then look at those pictures that are on your desk. Don't forget to look a bit to it, because my picture is not nice here. I will try to make a copy of this you see. So on top of it this picture you'll put your thing here. I don't want to say what it is. You see?

L: Yes

M: So you must put on top. That spread your pictures ...spread your pictures so that you can see them so ( ) okay and then on your pictures please write the names of those pictures. The names of those pictures ...of those pictures you know. Please don't write those that you don't know. Write the pictures that you know. They're names. Can we quickly... quickly do that. Okay you can write the in front so that we can see. Not at the back neh.

L: Yes

M: Okay other noise... everybody must work and shape the plant that you know. It is not one person. You can take another pen and then you write. So that you can finish up

L: Make capital letters.

M: And then you spread them again. You must do it together. Write the one you use your pen to write the one you know. Everything must write if you know it.

L: Capital letters neh.

M: Okay can we stop now. I know there are pictures that you don't know neh and then I said you must wait if you don't know the picture. Who can show me the picture of a dragonfly. Okay just let's lift your pictures. Each group will show me examples of dragonfly. Wooh (Claps for the learners when they get it right) that's good that is ( ) that is just write dragonfly and then a picture of a woodpecker... woodpecker

L: Yes

M: Oh sorry you don't have that page you can look here. That is a woodpecker cause you don't have, what is that?

L: A woodpecker.

M: So this bird it's very hairy, because it's big. Do you see? Because the bird don't say this is the mouth neh. It say it's a beak neh. You see the beak is sharp. You understand?

L: Yes

M: Sharp and pointed. So it use to pack and open the what where it can get ( ) you understand?

L: Yes

M: And they ( ) it can even lay eggs so you take the mouth it's very strong. You understand?

L: Yes

M: So (Xhosa words)

L: Yes

M: So now you know the woodpecker. So you see what it is doing. You see?

L: Yes

M: Okay now I think you've written 'woodpecker'. If you wrote wrong word you can scratch and write the right words neh and then the ( ). Show me the picture of the page. You don't have neh. The ( ) the ( ) the ( ) Heri heri so ( ) All the books that are... okay you don't have the bird. The ( ). See the pack those who don't have the ( ) Okay good...good good good. So you see here we got the parent uhr we got a variety of living organisms and then we say living organisms are?

L: Plants and animals.

M: So in your desk there's this paper. You see?

L: Yes

M: So the other side you have to write plant you with your capital letters and write animals and you draw your line. Draw a straight line. So on this side you put your pictures of plant on the other side animals. Can you please just quickly do that please? Even if you put your ( ) you understand?

L: YES

M: Oh thank you. Use your pritt child. Oh shame they keep their pritt in the classes, but you must always bring your pritt your pritt neh. Every time you come you bring you must bring it up to your teacher cause you know we always... Let's quickly do what we are going to do today. So that we must not waste time. Plant... animals and please when you put your pictures you must give enough space. Don't waste space. So they won't be ( ) If I was... if I was you with you...we are going to ( ) and see how to arrange it so it can...can fit. So I ( ) Don't waist space neh. (Interacting with the class)

L: (Xhosa words)

M: Your plant ( ) Okay here I was trying to...to copy a picture of a grass neh. So I having a grass here neh. You understand?

L: Yes

M: So instead I will...we'll know that this is the? Our? Grass

L: Grass

M: Our grass yes. Our grass neh. So you can just stick this and then put there on top neh. So you are not going to put grass... so you can put grass on top. (Interaction with the class) Okay so I show you your plants and animals. So you've classify plants and animals. Let me see. Okay... okay give me your plants yes. The name of your plants

L: Grass

M: Yes grass yes

L: ( )

M: Yes

L: ( )

M: I can't hear you and they don't hear you.

L: Trees

M: Trees yes there are... there other plants

L: ( )

M: Oh...let's find the animals.

L: Elephant

M: Elephant. yes...sorry (writes on the board)

L: Frogs

M: Yes

L: Woodpecker

M: Woodpecker

L: Dragonfly

M: Dradonfly... yes

L: Bug

M: A bug any other animals?

L: No

M: Okay now we are going to look at these... so I think everybody knows now. If you put the wrong picture... the wrong picture the wrong part you'll see where you go wrong. If you went wrong neh.

L: Yes

M: Okay now we must look at your... just put your pictures in the so everybody can...can see and then you must look at the different pictures. You understand?

L: Yes

M: So you'll see the plant and you see your animal. You understand?

L: Yes

M: So you just write the differences between the plants and the animals.

L: Animals

M: You understand?

L: Yes

M: You see most plants they are like this because, you done this in grade 6neh.

L: Yes

M: The plants and animals so when you doing photosynthesis and other things neh.

L: Yes

M: So you just write what you remember uh when you when we are talking about the differences between plants and animals.

L: Animals

M: So you must write the different ( ) Just write like this okay... okay okay okay. Ypu can talk but, please don't disturb the others next to you neh.

L: Yes

M: You must talk together. Don't disturb the others...don't talk loud. So you write it like this - photosynthesis. (Interaction with the class) So please just make something like this and then you write your differences on the paper that I gave you, write it. (Interaction with the class) So we finish now neh.

L: Yes

M: Most of you but when you know you didn't but the others.... So you still writing. (Interaction with the class) Okay we can stop now neh.

L: Yes

M: So when you were putting plants and animals... okay thank you... thank you okay. Pens down. Look at me now. Where you were putting plants... plants only and animals only you are were classifying the ( ). You understand?

L: Yes

M: So now... okay before I say this. Can you give me the difference you wrote about plants from animals? I'm not going to write it down, because the time now ...we thinking about time. So now others know what to learn. Okay... mamma... listen... listen listen. Yes

L: Plants make their own food.

M: Yes plants make their own food.

L: Own food.

M: Yes what about animals? Okay let's write both sides.

L: Animals move.

M: Okay let's talk about plants make their own food

L: Own food.

M: What about animals? What happens to animals?

L: Animals eat plants and other animals.

M: Yes animals eat plants and other animals.

L: Plants cannot move.

M: Plants cannot move so they doesn't have what?

L: Legs

M: Legs to move. They cannot move yes.

L: The leaves of the plants are green cause of chlorophyll.

M: The leaves of what or green trees...oh yes good. They are green because of chlorophyll.

L: Chlorophyll

M: Yes.

L: Plants... plants cannot move.

M: They ( ) although ( ) I like that although because they can grow towards light.

L: Light

M: You see. So the light they get sometimes attracted to the sun or the plant.

L: Plant

M: So they just move swiftly yes that's good yes.

L: Animals.

M: Yes because they cannot make their own food. So its yoh...they have to move around to get food from the shelter.

L: Shelter

M: What else? What you don't want to repeat...what is said here yes.

L: Animals drink water.

M: Yes animals drink water. What's happening to plants? Where do plants get water? Yes?

L: We water the plants to grow.

M: Yes we have to water it...the plant.

L: The plant.

M: To water the plants in order for them to grow.

L: Grow.

M: Is there anything else?

L: Yes

M: Yes let me show mine. They are similar. I'll show everybody so that that you remember. All of us we are going to look at mine neh.

L: Yes

M: They are not different from yours. Okay here... okay difference between plants and animals?

L: Plants do not move.

M: Animals?

L: Animals move.

M: Yes. Plants

L: Plants absorb water from their store ( )

M: Animals?

L: Animals get water by drinking it.

M: Plant?

L: Plants can make their own food by a process called photosynthesis. Animals get food by eating plants and other animals.

M: Yes

L: Plants reproduce by producing seeds...seeds. Animals reproduce by giving back.

M: Yes good. So that e those are the difference between...between?

L: Plants and animals.

M: So for today we are going to ... to group because you got plant the plant they belong to plant kingdom. You understand?

L: Yes

M: And then the animals belongs to a uhm animal kingdom, but today we are going to...I'm going to introduce the animal kingdom. So the animal kingdom have two groups. The ...the the vertebrates and in...vertebrates.

L; Vertebrates

M: Vertebrates and...invertebrates. (writes on the board)

L: Vertebrates.

M: The vertebrates I said two groups. It's one and two, the second group. The vertebrates are animals with a backbone.

L: Their backbone.

M: Yes that's here... your backbone (pointing to her back-spine)their backbone. Where's your...

L: Spinal cord.

M: Just touch your spinal court or your back bone. Touch your spinal cord. So you can hear it neh.

L: Yes

M: But the vertebrates they doesn't have the spinal cord.

L: Spinal cord.

M: So that is the difference between the between vertebrates and invertebrates.

L: Vertebrates.

M: Vertebrates have got what?

L: Spinal court.

M: Yes on?

L: Their back bone.

M: Invertebrates does not have.

L: Not have spinal court on their bones.

M: Okay so now we are going to going to learn about vertebrates. You see we've learned the plants. We are talking about animal but still you cannot learn about all you must learn about vertebrates now because why we cannot learn about all this because furthermore the vertebrates are divided into five groups. So the first of the group... fish your second group, amphibian, the third group... um reptiles, fourth mammals....fifth group uh birds.

L: Birds

M: Yes you birds... you see so those are the... the groups of vertebrates. You see so now I again we are going to look back at out pictures. You understand?

L: Yes

M: Okay from your pictures that's another question. You are going to skip one line neh.

L: Yes

M: And then you list these are groups of the vertebrates neh.

L: Yes

M: And then you give me. I know some of the...the the groups are not written here, but while what you have here. What you have here in you pictures. You understand?

L: Yes

And then you look here for the amphibians the reptile's mammals and other things. Okay before we do that lets first write anything of what you know about the fish. So the characteristics of fish. What all they have... all fish got what? So we trying to this all fish have got?

L: Fins

M: Fins yes we all know that fill yoh fish have got fins and what else?

L: ( )

M: Yes good.

L: Scale

M: And scale we know there are so many characteristics but this two you must not forget to write them. You understand?

L; Yes

M: Because (Xhosa words) you must get that even if you forget the other, but those are things you must know. By the time you read the other characteristics at least you got these two that you know. Another characteristic of amphibians mm uhm uhm. Okay can you give me one example of amphibians mm... mm ooh so it means you are going to get zero... way... way. We are going to classify. Okay a frog is an amphibian.

L: Amphibian

M: So what you can say about a frog, because different from urh a fish is different from a whale. You understand?

L; Yes

M: There are similarities but there is something that is different about the... the the yes the frog. It has got a ( ) naked skin.

L: Naked skin.

M: (Xhosa words)

L: Yes

M: Amphibians have got naked...

L: SKIN

M: The reptile's yeh?

L: Crocodile

M: Yes an example is a crocodile.

L: Crocodile

M: Yes so an example of a eh reptile. So characteristics what you know about reptile's yes.

L: Reptile's drink water and ( ) on the land.

M: Mmh so oh yes because so they can live near water. You understand?

L: Yes

M: But we know...you remind me something else the frogs they also live in water and on land.

L: Land

M: You understand?

L: Yes

M: What else okay. Can't make it wrong you are write live um water and near water because it must not be too far from water. Understand and the mammals what can you tell us about mammals. I know there

are so many characteristics that we are going to read now. I'll give you the books so that you can know more, but just want to know from you what you know about mammals. Okay the example of a mammal?

L: Goat

M: The goat good. A sheep so there are many mammals the cows.

L: Cows

M: The cows as you are saying and also you are a mammal neh. Okay why there are special or they ...they they call them mammals, because they got mammary glands to feed their young with milk. You understand?

L: Yes

M: They have mammal they feed their young with milk. (Interactions with the class) So if you look at the birds. What you can say by just looking at it. So what can you just say looking at that yes.

L; Have feathers

M: Yes all most of the birds or all birds have got feathers.

L; Feathers

M: Have feathers. Okay at least now we understand that... let's try e...e. you've got these mos neh. These animals neh.

L: Yes

M: Just write uhr these groups and then you just try and put eh... eh example of the group neh.

L: Yes

M: So you write all these five groups then you write an example. So that I can see whether you know the groups that I've presented there on the board and the groups that are not written. Just skip a line and then you complete this for vertebrates. Just write there's vertebrates and you write fish, reptiles, mammals neh.

L: Yes

M: Invertebrates...First we write vertebrates please. Write vertebrates aha... write vertebrates and then you write fish. You first write fish amphibians mammals... and don't forget that we are talking about ( ) neh. (Interaction with the class) please write the name of the animal neh. (Interaction with the class) okay okay uh okay okay. So next time when we come back here we will have to complete this task. You understand?

L: Yes

M: Alright I can see you still busy the vertebrates. You understand?

L: Yes

M: So we will continue with vertebrates. You understand?

L: Yes

M: And then urh invertebrates. Alright so what we have to do is put your things... fold it like then and then you put your things here and this you know mos your books are here neh.

L: Yes

M: So you put your work inside there. In fact I know not everybody just take one... one portfolio and then you put inside. So that tomorrow when we continue just take it out so ( )

L: ( )

M: Okay Thando. Please listen don't make noise and somebody collect my pritt okay.

## APPENDIX V

### Transcript of Interview with the Department of Basic Education: Senior Education Specialist (SES) for Natural Science

Department of Education Interview

D: Okay I'm sure this will do the trick?

S: Yes

D: Okay you can give me as much information as you'd like nuh if um...

S: Mmm

D: Because I mean it's only the one interview.

S: Clearing throat.

D: How has the curriculum unit prepared the teachers to teach the new CAPS NS curriculum and in particular biodiversity?

S: Okay uh at the CAPS train...

D: Take another copy.

S: Oh okay.

D: Number one.

S: Uh okay number one okay. First of all I explained it that at the CAPS training uh last year in June what we did was we ensure that that you know we cover the the content right. What we did was we show them what we expected of them in the past and now what CAPS is. They immediately saw it was one and the same thing so what we did was we went to the content.

D: Um sorry what what is what was the same?

S: The content. Basically for Natural Science we were very lucky the content itself didn't change.

D: Mmm

S: But here and there the emphasis, because CAPS was a bit different in that at the end of each chapter or strand sorry they now require they tell you and stipulate precisely what they expect of the learner and therefor it affects your teaching. So in the past with the NCS we had also biodiversity the same topics, but not necessarily uh requirements that was the new thing whereby they would just ask we were just following the LO'S okay which was replaced by the SAS, but now they that was the only requirements that they cover that content.

D: Mmm

S: There was like no skill involved basically you had to devise there was no uh prescribed way of how to teach biodiversity it was just given as biodiversity and the various animals.

D: Mmm

S: Okay like that and so the children had to know you know the various invertebrates and vertebrates.

D: Mmm

S: And that was it.

D: Uh is there skill involved now?

S: Now when a person looks the requirement of CAPS.

D: Mmm

S: And I can refer you to a relevant page at your leisure. Biodiversity is on page seventeen of the CAPS document senior phase CAPS document.

D: Mmm

S: It says there the classification of things...right that is you get the first Column of how many weeks you must spend on it.

D: Mmm

S: And the next Column is the topic under that strand and this case under the the life of living in the first term.

D: Mmm

S: And then the third Column you find the classification of living things. Then it gives you a rundown of the content.

D: Yes

S: You know what the depth and the breadth of biodiversity in grade seven. Then in the next Column now we find this is the new thing.

D: Mmm

S: Whereby they say grouping, drawing and sorting. Those are skills, because now they tell you with this content of biodiversity of living things and of classification of living things they want now you not to teach in your way that is now very prescriptive in that they say now the children must do the do the following suggested activities. They say suggested, but it's actually the way the textbook also want it and I mean I didn't write that chapter (giggling) I wrote energy and change... I'm just saying now they tell you next to the content they would like you to do the following; grouping and selection of everyday objects according to observable features for example shape, colour size of use. So they teaching the children how to first group things, cause how they must first learn the skill how how would you group the things right.

D: Mmm

S: Then they say you have to draw up the table of differences of the basic differences between plants and animals and now the sorting out the the invertebrates using observable characteristics.

D: Mmm

S: Then in the resource Colom now they give you this that you must use drawings and pictures and that magnifying lenses for them to look at various specimens. Now that is the the level at which we gave the support of biodiversity.

D: You explained it to the teachers to that extent?

S: Yes so that everybody was doing the same thing now.

D: Mmm

S: So when we deal with biodiversity when I open up this I find in the teachers planning this what I I just read out now should be in the children's books.

D: Mmm

S: This brings about uniformity.

D: Mmm

S: It brings about standardisation so you know you can't expect from one school one page thing I've done...

D: Mmm

S: And another school did five pages now it's prescribed it tells you these activities will teach the child yes to learn about the various animals and you understand and plants.

D: Mmm

S: But now we want them to, it's almost like them developing a key. Like how do I know what are the difference between insects you know the insects and the arthropods and you know? So so the children learn to group so they can see the visible differences...

D: Mmm

S: And similarity. So it's quite clear so we we that's the level of our support. We didn't we did do some examples like with power point presentation like this is how you can do it in class.

D: Mmm

S: For some people you ...don't know to read this what must I do what must I actually do.

D: Mmm

S: So the presenters that did this uh they actually showed what they did in class so they had a power point presentation.

D: Mmm mmm

S: Like here is a interesting thing that they did.

D: Mmm

S: I did my own thing whereby I took the the bag to do that first activity grouping of everyday objects as you take a pencil bag ask someone one of the teachers I took it out on the table in front of the class I open it up and threw out the content.

D: Mmm

S: And then I said what would you see in the big heading? So I took them through this lesson a practical thing.

D: Mmm mmm

S: I said now the had a big heading is the pencil bag.

D: Mmm

S: So now we can break it up.

D: Mmm

S: To objects and then that was the next biggest heading then try to get through the smallest heading.

D: Mmm

S: So I ask them what you think. No we can divide into pens and they said an eraser I said okay right so the pens the pens we can further sub divide.

D: Mmm

S: Because different colour pens right.there were two metal pens, plastic pens so the plastic pen was a red pen typical teacher with the red pen.

D: Mmm mmm

S: And the two were the ball point pens.

D: Mmm

S: So we could even further sub divide the pens even though they fall under one family

D: Into material and into their colours.

S: Yes yes exactly so that is the practical example I did with them.

D: Mmm

S: On the flip chart in front and they went through it with me.

D: Mmm

S: They were part of the lesson so that is the support I gave dealing with the start of biodiversity and how we what type of activities associated with this.

D: Mmm

S: Besides the knowledge.

D: Okay and and how were you supported in order to support the teachers?

S: (Sigh) okay we went uh they call it TOT Trainer of Trainees. We first had to be trained and then we come and train here. I was supported with a file.

D: Mmm

S: Right but, the file it was this was my ingenuity of how how I would have done it, because this how I did at the College with my students you understand? I have to teach them ca categorisation you know we expect people just to know what is categorisation.

D:Mmm

S: It's a skill it has to be taught so that that examples that I used there...

D: Mmm

S: Okay didn't come from anywhere except (giggling) my... the the training material that was given to me was like this black and white.

D: Mmm

S: So it was you know like 'guys, find activities'. That was the instruction. 'Find activities what you think will suit your audience' like that so there were not the... I feel sorry for other colleagues perhaps do not have the experience or perhaps the creative minds you know, because it wasn't said do this activity you know we were just told oh by the way the training program we divert we diverted a bit away from, because you know noticed that perhaps let's rather do it this way, cause I was surrounded by teachers that support me with the training.

D: Mmm

S: There were two teachers.

D: Mmm

S: That assisted me...

D: Mmm

S: In this and so we were throwing around ideas and I first look at what how they do it. First I said okay I think I know how to get them till there. So I did that activity.

D: Mmm

S: So my support was a supported file, but not as blatant as down to how to do an activity.

D: Mmm

S: Like for example grouping and this and that.

D: Mmm

S: So it was just like a heading; you guys, you must deal with the content, as big as that.

D: Mmm mmm

S: But when I noticed there are verbs here you understand. So the training was basically the support was here. What is the content, what is the new and the old the new and old here you know. So I when I see skills the the skills we were it was dealt with under the specific aims you know all the skills, that activity we did there.

D: Mmm

S: But not how to teach it as per say. We were told remember they must know all it was done in separation to the content and to what I did here. It was just broadly please guys know your specific aims.

D: Mmm

S: You know here they are and I got now Photostat copies where they could cut out then out and the people had to say oh this skill, process skill, falls under this lesson.

D: Mmm

S: So that was the level of support.

D: Mmm

S: Where I didn't want to leave it as that. You know being an ex- training college lecturer in the university I wanted I always put myself in in the shoes of a novice. Here I'm given this now.

D: Mmm

S: Now how..the question is always how do you teach this?

D: Mmm

S: So with the content so that is what I did. I did a practical example. I did it out of my own.

D: Yes I'm just interest to know um you spoke of comparing the curriculum.

S: CAPS ya.

D: The CAPS to the previous one. But did they oh when you were trained on train the trainer um course.

D: Mmm... Did they explain the intentionality of the current uh curriculum maybe um vertically instead of like horizontally?

S: They they explained it in horizontal parallel manner to familiarise the teachers. Now... You see the idea was to show the teachers 'that things didn't change so much so don't think it's big change', because their biggest fear was this you know the teachers will say yinne we doing it now like this and now you want me to do it like this.

D: Mmm

S: So the idea was to get the buy in from the educators by saying 'look here here's your continent; it's still the same'. Other subjects I cannot talk about them I don't know uh just said for Natural Science it was a nice thing, cause we had the teachers we divide them into groups and told them okay you be doing seven you be doing eight you the grade nine.

D: Mmm

S: And we gave them a file. I just wanna get the file.

D: Uhuh... Thank you.

S: And you can have that one.

D: Ah thank you

S: I know where it is its page 44. Okay you see here in the front here as you page over you see this that this is the example of the old NCS content grade seven is on the far left there.

D: Ya

S: Then we read through this.

D: Uh

S: And then they had to open up the CAPS document, right.

D: Mmm

S: And then they could see okay. Just look at the contents so we gave them a section like like the one group had grade seven life and living.

D: Mmm

S: But we did it per grade.

D: Mmm

S: Per strand.

D: Mmm

S: So everyone did grade seven, whether you were a grade nine teacher you had to go through that.

D: Okay

S: Okay the rest of the stuff that you see there that was personal development file that didn't that is from Port Elizabeth.

D: Have you any...

S: In my group.

D: You designed it yourself?

S: This is compilation of myself and

D: Mmm

S: My two assistants.

D: Mmm

D: That is that didn't come from anywhere else.

D: Mmm

S: But from the PE district, cause this is the way we wanted to do things in the ordered fashion. So the first day that we saw them in the orientation was this.

D: Mmm

S: Because I know as an ex teacher the first thing I need to know is what do I teach, how do I teach it, how do I mark it and how do you want the mark you understand?

D: Mmm

S: And so um this is what we did. So we showed them this the old the way it was.

D: Mmm

S: Okay as you can see here when I just look at words they just say here the invertebrates have no back bones and no exoskeleton. You don't see any activities there you just see the content the the depth and the breath.

D: Mmm

S: Now we had to tell them now gradually we once they familiarise themselves with the content and see it's not so much different, so (blowing) sigh of relief yes, but then I said now there's a difference we just had our LO'S loosely not related to any topics, like in Mathematics for example the the LO contained the content, here in NS it doesn't do that.

D: Mmm

S: You had to come up with an idea so everyone would have a different way of teaching this.

D: Mmm

S: So I reminded them now later on you gonna see here's the content, but this how we all gonna teach it.

D: Mmm

S: Because I knew, being an author I knew that now the the they know how to write the book they know which activities must be in here.

D: Mmm

S: Because the CAPS been telling us this stuff.

D: Mmm

S: So I told them that's the big change now in the Natural Sciences.

D: Mmm

S: Okay so that's the way we did and then they had the CAPS document open and then this it was better this time around with the senior phase, because we intermediate phase, I had no CAPS documents, but I was told to go on with the training, but luckily you know living in electronic media where the support came from the internet where I could just get the the...

D: Mmm

S: You know download.

D: Downloading something.

S: And then put it on the data projector and show the people and then you know I just photo copied the relevant pages.

D: Mmm

S: Not the whole document.

D: Shoe!

S: Ya so anyway that's the conditions sometimes a person has to work under

D: Oh

S: Show has to go on.

D: Shoe!

S: And a person is left alone, but anyway I don't complain, cause I don't feel alone. I have help.

D: Mmm

S: And very good teachers experienced teachers.

D: Mmm

S: So that's how we did it that was the support with the content then the reminding them later on in the session.

D: Mmm

S: Now that we know the contents and now that we have learned this specific aims and the process skills.

D: Mmm

S: But you don't have to now go and choose process skills. You just have to now follow the CAPS and then they could see oh with this content I have to do for those activities.

D: Mmm

S: And then at the end of the chapter of the strand we see then what is the requirement in the assessment regarding that, because that is the classwork: the grouping and classification right. Then I referred them to here, this is to standardize the test and the exams.

D: Mmm

S: I told them these individual bullets, you can group them, they are your tests, but the whole...all these bullets are your expectations of your exam. So what must the child be able to do with that content?

D: Mmm

S: It says here the child has to sort plants. Now remember they did sorting so they know now.

D: Mmm mmm

S: They know it's not the first time they see the word sort in the exam or tests.

D: Mmm

S: They had to sort plants and animals into groups based on observable similarities. Okay they have to give so that is also memorisation of sorting is and more higher skill in Blooms taxonomy and then they say here okay give the distinguishing characteristics and give it... okay all five. So in those in the preparation in the classroom when we look at the activities. The grouping the drawing and sorting they can now do it, because they were taught that skill.

D: Mmm

S: They know they have to look at the number of legs, must look at the body parts, they must look at the body covering. They have look at the leaves: are they left parallel you understand?

D: Mmm

S: So they know now how to look so that skill has now been taught.

D: Mmm

S: So you can see there the expectations in the assessment is linked to what what you have done in the class and this is for everyone so we know you understand it now.

D: Mmm so when they do when they teach biodiversity you expect them to teach classification of animals and plants?

S: Yes

D: Is that all?

S: No it says here classification of living things that is the big heading.

D: Okay

S: Then under that it says plants and animals and microorganisms make their habitats so in the bio... okay that makes up the biodiversity. Living organisms are sorted and classify according to shared characteristics.

D: Okay so they must...

S: They they know that insects here's the example of different insects from the fly, the ant, the locust they're all insects, the three examples.

D: Mmm

S: Why? They say now shared characteristics, they all have six legs; they all have three parts body parts.

D: Sections

S: The head thorax abdomen ... they have wings most of them have wings. Sometimes ants will have wings during mating you know.

D: Mmm

S: Then they lose them again. ... the shared characteristics ... so what they did was they took the classing sector and looked at the various examples of them.

D: Mmm

S: So you could see even that's the fly that's the ant and that's the locust.

D: Mmm

S: You have the shared characteristics.

D: Mmm

S: So obviously use more than two examples we had to use three, but everyday ones.

D: Okay

S: That is familiar.

D: Ya

S: Ya does that answer that question?

D: Yay ya it does.

S: Okay

D: Yes thank you let me see.

S: And then of course it goes further you the... it also then talks about the various groups of plants and there the same thing would happen.

D: Mmm ya ya

S: You know you have the angiosperm you show them all the daisy.... different ones.

D: Mmm mmm

S: Then you must remind them that the angiosperms the flowering plants can be divided into monocots and dicots

D: Mmm

S: And then again the similarities and the classification.

D: Mmm mmm

S: Ya so it comes with different examples, but it tells you exactly there what you must do under the heading biodiversity.

D: Mmm mmm okay.

S: Things are different you know and there's a diverse thing.

D: Mmm

S: Not all animals and plants look alike.

D: Mmm no thank you. How has the um maybe we have covered this how has the curriculum unit advised the teachers how to approach the teaching of biodiversity, but I think you may have covered that.

S: Yes you see this this the way the content is dealt with there's no ethical issues. The only ethical issue is that like you could say the hidden curriculum, but it's not emphasized like you know when you dealing say you looking at different animals in the class you know they not gonna kill the insects you what I'm saying.

D: Uh

S: There there are certain uh moral issues when you deal with living things, but it's not as much emphasized here it's just perhaps taken for granted that when you know we don't go and destroy the environment to go on with our lesson like pull out the plants and stuff like that and kill a cockroaches you know.

D: Mmm

S: Then there must be some moral obligation towards nature, but it's not emphasized there's no uh moral values and believes systems given here.

D: How do you feel about that?

S: I think it should have been included, because me being involved in the science expo you know some children have a live exhibit of snakes or animals cameleons... you know then there are strict regulated rules that they must follow its stipulated.

D: Mmm

S: In in in the in the requirements sheet of your exhibit. so I think you know I don't how it's been done, but hopefully with ... butI think it has to be included.

D: Mmm

S: Because remember this curriculum and if one remember the critical outcomes and the developmental outcomes which is obviously they say both in here, but anyway they say that here we must make a child a responsible citizen you know so so I would like to have it as a foot note just as a reminder.

D: Mmm

S: Because if I tell the children that look here I just want you to bring some insects tomorrow or on Wednesday you know so we can look at the differences in class how do they capture these things you know what they do you understand.

D: Mmm

S: And I mean there's also dangers during go to see there's a beehive you know so there should be a warning remember these are grade sevens (coughing) the age group.

D: Mmm

S: So I think there should have been be foot note saying, cause I think there is a foot note now and again, but not here about the moral implications the respect for mother nature.

D: Mmm

S: Ya

D: No thank you we are going to come back to that later (giggling).

S: Okay

D: What kind of support do you think the teachers need to develop their teaching of biodiversity now that they are six months into the new way of teaching?

S: Right. My biggest concern is the following; that a small percentage say about thirty per cent of my teachers are new to this subject.

D: How many school do you cover?

S: 316

D: Could you just explain what you said earlier about so many grades and so many...

S: Okay in I in the Eastern Cape and in the Limpopo Province the Intermediate and Senior phase are grouped together and it's commonly known as Intersen: intermediate-senior phase. So - the marriage of those two words - so that means that I in my capacity I have to cover grades four till grade nine. Now when we talk about support if I just have to give you the rough mathematics there's 236 primary schools in Port Elizabeth in Port Elizabeth district and there are 80 high schools these are government schools neh now that brings us to a total 316 now if I multiply that by 12, because there are some schools primary schools that are you know well endowed teachers, because they have two per grade so that is why I get to that.

D: Mmm

S: So it's six grades times two is twelve and so 316 times twelve that should give you an idea of the amount of people I'm expected to support.

D: Mmm

S: Now that will have an effect on the quality of support and the amount support that I can give in a year, because on average there's about 200 to 201 school teaching days in a year and obviously I have more schools than that.

D: So I assume you are alone in this role?

S: I am the only appointed person in the Intersen for Natural Science and Technology and for Natural Science in the Senior phase so when we talk about support I therefor do not want to waste my time or the educators time, because they are also over burdened with large classes and others are again blessed with smaller classes, but now I coming back now to this thirty per cent when I say thirty per cent these are people that are novices to science they have qualifications in perhaps EMS or PT or something else, because of their age they were trained in something else and now they are expected to teach NS Tech or NS.

D: Where do you get thirty per cent?

S: I'm making an average, because that is about the numbers of teachers... when I stand up in a meeting... I have circuit meetings.

D: Mmm

S: Geographical circuit meetings

D: Mmm

S: Say for example circuit eight is in front of me now and now the attendance is quite good, but...

D: Mmm

S: It's never hundred per cent so anyway so when the I have the people there, and I see a new face I normally ask.

D: Mmm

S: Because that person might be fearsome to ask me the thing, but it will be to save time I would say okay, but you new, you new, you new, so in a group of ten there will be three of them, on average okay. They say 'Yow! Sir! we have nothing' so that tells me there was no support at the school.

D: Does nothing also mean they've also never taught Natural Science before?

S: Correct, cause now they don't have a file.

D: Mmm

S: The person that I saw from that particular those schools has taken these file, because now he been given or she's been given a new allocation at this school.

D: Mmm

S: You understand?

D: Mmm

S: So I'm always kept busy.

D: Mmm

S: So what my plan there was this I have down stairs and on my laptop I have your entire everything everything every lesson for every topic for every week for the entire year for grades four and I got as far as grade seven, now with that.

D: Did the grade seven teachers get this?

S: The grades, yes it's it's when they come to me they say they have nothing, but I tell you in the meetings listen here guys it's from the planning actually file you know we used to call it your Day Book or your file where you have everything for every week.

D: So are their lesson plans in there?

S: Yes there's worked out lesson plans, like a textbook it's there. I have accumulated that from teachers with good practise I use to have in 2005 a group of group of teachers from each circuit so that we know people can't say whoo oh my school is here in this area my children can't do that so we have grouped the things so there's at least three different activities per topic like for biodiversity so that you can choose okay this is a nice one. So to save the teachers planning time I have given them the plan you know everything worked out for them.

D: Mmm

S: Even power point presentations. Everything dealing with the content then what the department did eventually now last year they handed out this Thunderbolt books it's a it's a book...

D: Think I saw it , its a workbook?

S: They call it a workbook, cause the children can write in it.

D: Yes yes.

S: It's excellent.

D: Mmm

S: Why it gives you in the teacher's guide all the relevant content knowledge now for that grade and for that topic.

D: Mmm

S: To the point based on CAPS and then the learner books, there are activities building up so so sometimes there's five activities, but in your class we think no I only have to do these two, cause they already here so it's very good it starts from based line all the way to the expectations.

D: But it didn't come for this year?

S: It didn't. So now we go into another arena now. I was explained that the money is in the district and so the district has to find a printer and a publisher and then it would be printed. I was so naïve I was told initially that these books would be here for the next three years. Some schools tell me they did receive a top up for this year, but uh (sighs) it so what did I do? The principles phoned here they say Mr Samson you said this so I said well I was re-iterating a promise made to me.

D: Mmm

S: So what I did was was I than got it electronically so at the moment I'm handling it out electronically to the teachers.

D: Mmm

S: I tell them bring a DVD, because it's enormous files.

D: Mmm

S: You can't for safety reasons with the viruses (giggling). So what I do is I give them on the DVD the electronic copy in English and in Afrikaans for grade four to six. And now here in the pipe line that's there's one for the senior phase as well coming it's going to be roll out next year.

D: Okay

S: So I know I'm really disappointed with this Thunderbolt books were not now given again you know for this year.

D: Mmm

S: You know it's very disappointing and and and a person feels sometimes like a fool, but sometimes I'm naive, I just believe that it is gonna happen and now it didn't happen. One in two schools did tell me they did received about the majority said they receive nothing so I don't became part of the problem I just came part of the solution I hand it out electronically now.

D: Mmm

S: So they can choose which page to print, which activity they going to use.

D: Mmm

S: They don't have to print the whole book.

D: So besides um okay when we come sticking to grade seven besides the file you've prepared for them do you think they need anything else at this stage?

S: I'm a strong to believer in the fact you know I don't know why training was also closed down, because well this is my humble opinion.

D: Mmm

S: I found out that there are young people that come to me, new teachers, young teachers and they want to know the content, but they not equipped in didactics and the pedagogy. They they they struggle like how can I teach this you understand. So (heaving breathing) you know I believe that that we we need to do something, cause I always tell the teachers I will teach you do something with you know if you are novices. So I tried to take them from the base line towards the expected. Ya so they that's how I train them and how I do things it's not just a file by the way the whole year you see my idea is to save teachers time.

D: Mmm

S: That they you don't they don't have to go to libraries or the internet. Here's the file so at least you can do it this way. They are still free to go to on Youtube or Google.

D: Mmm

S: But the thing is that thing is a time saver.

D: Mmm

S: But many of them still need training.

D: Mmm

S: Training in especially Matter and materials, and Energy and change. They skim over that they okay comfortable with Biology, but it's a constant thing.

D: Mmm

S: And luckily you know I have a group of teachers you know I call them NEED (?) teachers, good practise and they give ideas and and sometimes I wonder am I still the subject advisor, because they

phone me the teachers asking me how am I how's your son how's your daughter and then they want a number of the other teacher.

D: Giggling

S: Because rightfully so I'm not in the classroom.

D: Mmm

S: So they want to know how did it work for you you know.

D:Mmm

S: So when they phone these people.

D: Mmm

S: And then I feel left out, but then always report back and show me look here this is what we have done and all of that so I'm not stingy to allow that.

D: Mmm

S: Because it helps me.

D: Mmm mmm

S: Because, if I want to keep my subjects here I would never make it with all these schools. So luckily there are nice people that are sharing ideas they networking they they...

D: Mmm

S: They actually arrange that I do my SBI I make sure before they come to me individually. They sit and show each other's things you now oh that's nice can I have a copy of this thing they come and make a copy.

D: Mmm

S: So I like that.

D: Mmm

S: They have a good working relationship.

D: Mmm

S: So we all trying to help each other.

D: Mmm

S: You know so that is the support base that I have.

D: Mmm

S: I actually enjoy it like that, because...

D: Mmm

S: With the high schools you know the eight and nine it's a bit different. It's totally different from when I talk about the interaction and the support it's very nice from grade four to grade seven, but when you move into the high school there's something else there you know it's a different vibe you know.

D: Mmm

S: It's a more...

D: Competitive?

S: Ya the is some I find two groups in my senior phase I find that competent, enthusiastic ones and then the shy withdrawn ones who don't want to share their work only I can see they not gonna share so that's an indication of something.

D: Mmm

S: You know I ( ) you know you can guess what it can be.

D: Mmm

S: But uh I encourage that.

D: Mmm

S: Because, now you know within a circuit that thing that type of thing where people say "Yinne so you can do that". Remember now it's the same child it's the same.

D: Mmm

S: Geographical area.

D: Mmm mmm

S: So if it's Gelavndale, Parkside you know then you can't say well my child can't do this when my friend down the road can do it.

D: Mmm

S: So that is the nice thing.

D: Yes

S: It's the support...and that helps a great deal.

D: Mmm

S: A great deal.

D: Okay how has the curriculum unit advised teachers to use the CAPS document in relation to teaching biodiversity?

S: Well as I said earlier we know what is the requirement. Ehen you open up the CAPS document on page 17 they see there what they have to do and this is the way I explain to them.

D: Mmm

S: I say we are not here to re write policies.

D: Mmm

S: So what is the expectation? They say here it will take three and a half weeks under normal conditions and biodiversity will take take three and a half weeks. This is what you have to cover one, two, three, four, five, six (referring to the file) goes on all the way till here about twelve bullets are here right. And then what is the activity? Activities are all here given to them okay. So this is how I advise them: Here's the policy this is what you must do, but what you can do now is how do you think you would do it? How did you teach it, because this is the skeleton you know they say they must list the distinguishing characteristics, but that is for me.. cold, but tell me what, how did you jazz it up? you know what did you do? How did you do that?

D: Mmm

S: Then we share ideas.

D: Mmm

S: But now thank goodness we have very good textbook. I won't mention the textbooks names, but there are two very good ones.

D: Mmm

S: Where they looked at the requirement here and they came up very beautiful colourful ways of of teaching the the the the various topics.

D: Mmm

S: Okay I'm just I'm not going to mention the book I'm just gonna look at here (referring to a textbook) at okay. How would they do it here you see here it's one compares, what is the requirement there it's here okay. The the various animals and blah blah what they want us to do it like here, you see, there's those activities

D: Mmm

S: How it is done.

D: Mmm

S: Now here by this stage they've already learned how to sort. They already learned the different characteristics of the various uh vertebrates and invertebrates in this case these are invertebrates okay and vertebrates. So they can then separate them.

D: Mmm

S: Based on what they were taught to look at. Remember the similar things.

D: Mmm so they applying?

S: And then here's a table.

D: Ya

S: So my now you ask me how do I do it? I really re read the requirements, the law.

D: Mmm

S: And then we do this. Another school might do it a different way, but then I said: Finally! Finally! (with great emphasis in his voice) there are textbooks that have worked this out for you so you don't have to take my lessons in that file, remember I've been handing that out since 2005.

D: Mmm

S: But now...? why because we were never there was never one textbook that followed policy you know the teacher had to get five different books.

D: Mmm

S: So we were all in the desert that was my inspiration of drawing up those lessons.

D: Mmm

S: And then giving it to the teachers.

D: Mmm

S: Because, we as teachers I mean when I was a teacher when we were taught at school there was a textbook.

D: Mmm

S: And the textbook was in line with the policy. Now for the first time (With great emphasis in his voice) last year

D: Mmm

S: The teachers can go to this book, forget about specific aims and process skills, because it's worked in here you just going to teach it like this.

D: Mmm

S: It's here.

D: Mmm

S: So by just teaching this they are complying with policy, with SAs and the process of skills.

D: Mmm, but this would, implies that we trust that the teacher. Would have chosen the correct the books that you are mentioning or thinking of.

S: Yes, but then it's... okay it's good that you bring up that point, because what I do I really do this, because the teachers will always phone me like in the past and ask "oh what textbook do I use?" so then I thought this is a need it keeps on coming up so at the CAPS training I told them... let us go when you get confronted by your principle or HOD or deputy that you we must buy books what book is the best.

D: Mmm

S: Soobviously, I can't promote my book it's not it's unethical, but what I can do is I refer them to the planning for the year. Its starts here on page 13 of the CAPS document for the senior phase you see here grade seven right now I tell them you open the index of whatever...

D: Mmm

S: Textbook is put before you, cause you cannot select the book just by name.

D: Mmm

S: You have to do the following. You then go to the contents page of the book of the textbook that you have to choose from and then you read here what, now here it's says grade seven term one, Life and Living, the biosphere I see there the biosphere [comparing the contents page of the textbook to the policy].

D: Mmm

S: Then I see biodiversity biodiversity, sexual reproduction, sexual reproduction; the same. Variation, variation.

D: Mmm

S: But, we can't stop there so this would be a good candidate.

D: Mmm

S: But, now! Is it a hundred per cent candidate so this is how I teach them to select a book it's not my duty, but think it is actually my duty to do this.

D: It's a skill as well.

S: It's a yes, but that's the idea. The more you empower your teachers the less your burden becomes, because you know what if I help one person here then that person helps two others and those help the other that's the nice working relationship here.

D: Mmm

S: So mam then so now that is the starting point, the skill right.

D: Mmm

S: So now I've selected book there according to those big headings.

D: Mmm

S: But, now I must go to that actual content page now...

D: Mmm

S: Of biodiversity on page 17 and biodiversity in this book is page 16. I can't expect the pages to also correspond.

D: Giggling

S: But, anyway than I must see the content depth in coverage you see now we might not have all that time, but now I see they got plants and living things and they talked about biodiversity yes why do we classify organisms yes they will have to classify them okay now I see that this and here sorting out every day materials that's the first thing grouping and selection of every day objects according to... you see...

D: Mmm

S: So now from that I can see now from that... I can see the activity yes they are covering the depth, breadth and they covering my activities. I don't have to work out I can use the activities so I just have to photo stat this cut out the things so the children can then in their groups or individually sort the things.

D: Mmm

S: So this book is now... I can go on and on and on.

D: Mmm

S: And I can see now, yes this book fulfills my requirements and that's the hallelujah moment for me.

D: Mmm

S: Because this we didn't have before: the textbooks are complied with the policy.

D: Mmm

S: And this other part this is where CAPS is so good in NS and NS Tech is now that we know now what is the activity we should be doing to get to there.

D: Mmm

S: So it's only like a didactical book.

D: Mmm

S: It's like a college in the in the book (giggling), because now if I was a novice and I never taught the subject before I can see now there that's my requirement and here's my book.

D: Mmm

S: So this book now becomes the SES in absentia so then I can say this that book is excellent.

D: Mmm mmm

S: I have to look at various books at least four different ones and than at the moment there are only two that are very strong.

D: Mmm

S: That's like this correlation that I took you through now.

D: Mmm

S: So then I can with open heart say yes let's choose those two books with no monetary incentive or anything..

D: Mmm

S: I kept quiet, but people can read.

D: Mmm Mmm

S: But, anyway I'm just saying that is how I let them select the book, because that is their support to implement the CAPS.

D: Mmm

S: But then there is only one thing and I will have to say it. We have spoken from here to there.

D: Mmm

S: This is my biggest problem. If we want hundred per cent CAPS implementations we mustn't shy away from this. For hundred per cent implementation these teachers need to get these resources and that is sorely lacking from the department.

D: Mmm

S: You understand?

D: You are you are pointing to the fourth column?

S: Fourth column saying Equipment and Resources.

D: Ya

S: Now a lot of science is abstract. Life and living, yes, we can always get beautiful pictures of butterflies and stuff, but must understand when we move on there are certain things that are abstract and the children need to see these things.

D: Mmm

S: But, now this teacher will say you know Mr Samson we don't have the money to buy this.

D: Mmm

S: But, why must they buy out of their own pockets? This is not, this is a policy that they are expected to implement.

D: Mmm

S: The... these resources should be coming from the people that devise this. What teachers are doing well. I'm involved with another project the GMSA, but what we do is, we've brought now laptops into the classroom this a uh donghal,unlimited so now against the wall they can see things, because those workbooks that we spoke about earlier.

D: Mmm

S: Those books have sites that you can refer to.

D: Mmm

S: And if you type in those sites then a video comes on for example the diversity of plants.

D: Mmm

S: Then there's a fifteen minute thing that the children can watch and you know you can have like a questionnaire that they have to listen to and then answer you understand?

D: Mmm

S: Or you can have a thing afterwards where you can ask what did you learn now out of this you understand so, but now that's not the real thing of holding a test tube in your hand, but it's at least something.

D: Mmm

S: Because to build a lab will not cost you a few hundreds of thousands so now what's our solution now. We have in most of our township school and in the Northern areas schools where we have laptops with dongals somehow even more where they have a data projector where the whole class can watch at a time and not just around the screen of a laptop.

D: Mmm

S: So that is our solution here.

D: So how did the teachers gain access to obtaining the laptop and the dongal?

S: Okay these laptops are given to the principals. It was given to them by the department.

D: When was this?

S: Well it...

D: And and for what was the laptop given?

S: The laptop was given, because we have SASAMS now and we have that's why for administrative purposes now.

D: Mmm

S: And also it was it wasn't meant by primarily for curriculum only, but that was perhaps my add on, but it was basically there for school administration purposes you know to have a laptop with them and.

D: So it's the same laptop that the teachers are expect to use as well?

S: Well the laptop was donated to the school and not to the principal. The principal is representing the school so if I feel like on Wednesday cause Mr whoever my subject advisor said you know uh like here's something nice you know this here's a nice site so if I know that was my Monday now, but now on Wednesday I can go to the principle and say I need that laptop for Wednesday third period you understand?

D: Mmm

S: That is the idea it's going to be used by the by the teacher.

D: So you say the laptop came with?

S: A dongall?

D: And and that you that's that's.

S: I can't say all the schools received.

D: Okay

S: But, I know many schools did.

D: Okay

S: Because, these laptops are brought the time when I see these laptops is when they come for SA SAMS training here then I see them walking with that laptop.

D: Yes

S: That is the primary use of it.

D: Mmm

S: But, I mean you not gonna use be on SASAMS every day you know it's more like a term thing.

D: Mmm

S: But, you can. The idea is that there's a laptop at my school with a dongal with unlimited access.

D: Mmm

S: I why can't I use it in my one period of fifty minutes you understand?

D: Yes um how has the curriculum how is the curriculum unit advised teachers to use textbooks in relation to teaching biodiversity I think you have touched on it...

S: I've answered that.

D: Extensively.

S: Yes extensively and I also showed you the skill involved in selecting books, because people shouldn't be pressurised you know. Like in the past teachers uh already burned their fingers in the past with the textbooks then nothing, but the budget had to be spent.

D: Mmm

S: You understand so you just got the book and they knew they can't use the entire book.

D: Mmm

S: So now I showed you there are some good textbooks.

D: Mmm

S: And they can select like I explained I showed you how the selection can take place.

D: Mmm

S: From the headings the topics.

D: Mmm

S: To the actual activities.

D: Mmm

S: Ya so.

D: No thank you very much. Our post-apartheid curriculum reforms particularly CAPS, draws on international and national policies which call for the strengthening of the environmental education in particular education for sustainable development. These policies call for education systems that create an awareness and concern about their environment and which develops the knowledge systemic thinking skills, attitudes, values and commitment to solve current problems and prevent new ones. To what extent does CAPS enable teachers to implement environmental education and education for sustainable development?

S: Okay

D: If you want to keep this.

S: No no I got the gist of it.

D: Yes

S: I would perhaps just refer there sometimes

D: Mmm

S: I suppose I get a bit passionate uh what's nice about that, but this is the same as the NCS, but now with the CAPS is different we already showed or explained that that column where things are different.

D: Yes

S: But, what is nice about the NS Tech with NS thing is that we have four strands we have Life and Living, Matter and Material, Energy and Change and Planet Earth and Beyond. Now for me that is our wholistic education if you just look listen to that and when you look at the topics. The children for example will learn in Energy and Change later on in the third term these are the ways how we generate electricity and these are the pro's and the cons of it, but they also learn in the first term about the environment and the importance of the environment and the diversity of the environment and therefore they can relate with Energy and Change that these things the way we are generating electricity in this country as an example has an effect on the environment on the biosphere like air pollution etc. So if again there are no foot notes, but this has to be explained to the child that, did you see now what we learnt there in the first term. If we have coal-generated power stations it is affecting the biosphere with air pollution, animals will die, we will get sick you understand. The wetlands you know are damaged that what you learned in grade six so with this balanced curriculum I believe for me it looks balanced, because they are covering Life and Living and they covering the science and how the science affects the environment and what are the implications of the science. When I say implications it is not always said in the way I'm saying it now, but they they must realise that this line of knowledge in grade seven, grade nine whatever that they learning about the biological importance and then the Physical Science component. Now I believe if you teach the child responsibility regarding environment there should be a reminder like I keep saying a foot note, because if one looks at the content and if one looks at the the requirement here. We see here that in term two for the grades seven with Matter and Material, a very important thing is mentioned and I'm just looking for it here: Here - it says in term two the properties of material and they talk about the impact on the environment you see.

D: Mmm

S: So there is a reminder in some cases.

D: Mmm

S: Okay they also talk about sorting they learned that skill and recycling so you see that in the following chapter that's why I say it's balanced.

D: Mmm

S: We learned about the things and now you see this can be detrimental to the environment, the cause and the effect. So we see that it's balanced.

D: Mmm

S: The child is not learning one thing alone apart from the rest. So if a person looks from this side of grade seven I look at biodiversity we see that there is a flow that there is an impact on the environment the physical properties of certain materials they not bio degradable like plastics you understand? So we must know the impact we can't just throw it in to our water systems understand so there we see it nicely then we see with Energy and Change we talk about renewable and non-renewable energy okay right like you see here there is now no references related to the effect on the environment, because I think they have

covered themselves in Matter and Material. A person looks at Planet Earth and Beyond okay again it's not mentioned again, because I think they've covered it, our effects on the environment is death with under

D: Mmm

S: Matter and Material. So you see the things are not done in isolation. I think the syllabus is then well balanced.

D: Mmm

S: Because, we have learned about these are our living things and non- living things and these are the materials we use and the impact of the environment. So I think the child is well informed.

D: Mmm do you think that there's a focus on the learner or the the human involvement in biodiversity in the topic of biodiversity?

S: Well it.

D: In term one.

S: In term one in term one well again it depends how you doing the in activity. The child The way I feel the child must be a responsible citizen, because the child as an entity as an individual should know his or her impact you understand? Now with biodiversity now the child is learning how to sort and to respect that there are the various animals, plants around us and again there's no nothing to say about the appreciation of nature as a foot note. It's not there.

D: Mmm

S: I would have said you now you know in the next strand or whatever you gonna learn later on you must learn about the effects. You see there's no warning of what's coming.

D: Mmm mmm

S: But at least there by Matter and Material they can look back with hindsight and say yah you know you should...

D: Mmm

S: But here in biodiversity I just see facts you know.

D: Mmm

S: There's nothing about like conservation nature conservation I don't see that and just the child is just taught hard facts about these are the various animals these are the various class of animals this is how they look like and this is how we categorise them .

D: Mmm so do you think that helps for um bringing bout about a conscienceness about sustainable development or.

S: Not in biodiversity you understand there's there's no not even at the end expectations there is nothing mentioning that you saying now.

D: Mmm

S: We only saw it now in the following strand.

D: Do you think it's something that's lacking or do you think the syllabus is fine the way it is?

S: With biodiversity I say they could have done something more as I said earlier really a foot note of making a child realize his or her role individual role in the home environment in the school environment that we have to respect this space the habitat because we co-habitate an area you know there animals sharing area with us.

D: Mmm

S: A home they make nest you know they build nest the insect also has a role in the food chain that is not mentioned it's just facts.

D: Mmm

S: So to answer your question no it doesn't deal with that social awareness that that caring you know it's not there.

D: Mmm

S: It's not the but we do see it in Matter and Material the impact you must look to how deep that goes at least there's a warning. Things that we do there's a cause and effect.

D: Mmm

S: I uh uh the human activity does affect the the environment this environment that we share with other living things.

D: Mmm can can you think um off hand of of what maybe teachers as as individuals or learners as individuals or their parents as individuals could be doing that could be affecting biodiversity which could make it relevant real uh the systemic thinking um about biodiversity.

S: Ya I mean there should be a activity as I mentioned at this school. The school environment where you live in there you can make a difference and that can be taken to the home where children you see the children have to know the effect

D: Mmm

S: Like for example look at some of the school grounds at school we see the grass growing and...

D: Mmm

S: Tall... you see the child is not being taught that we share this work, perhaps it's not coming out so harshly that we share our spaces with animals.

D: Mmm

S: And that there is a food chain.

D: Mmm

S: And if we remove a certain animal from that there will be an effect which ultimately will affect us we cannot us we cannot live in isolation we live as part of nature.

D: Mmm

S: Now how can we do that I say we can have an awareness of the environment and look at the biodiversity at the school.

D: Mmm

S: And then the child can take that skill and apply it at home.

D: Mmm

S: To realize you know it's not always good to spray and kill the spider .

D: Mmm

S: Because, the spider has its niche... it will kill the cockroach that is a nuisance.

D: Mmm

S: In a natural way.

D: Mmm

S: And you know the the the the birds that we see in our garden the hadedahs that make noise they are actually killing the cockroaches maintaining the balance out there.

D: Mmm but you said that's not made it explicit in the...

S: It's not so explicit as I said.

D: Mmm

S: I will reiterate what I said. I said they just learning facts that that social awareness aspect is not there.

D: Mmm

S: It's lacking and when I say lacking it should be there.

D: Mmm

S: If we remember that development outcome I meant critical outcome I mentioned earlier.

D: Mmm mmm

S: Where the child supposed I can't remember the exact wording there the child is supposed to be taught to become a responsible citizen how many the responsible citizen in that banner obviously you know will be awareness of nature.

D: Environment

S: And and my the role in it and and the implication of it is not only me, but...

D: Mmm

S: But, I myself should be responsible so to to make all everyone should be responsible.

D: Mmm

S: So I'd say it's not as explicit but I would you like it to be explicit.

D: Mmm we um I'm just we are done I'm I'm just thinking the the one school that I interviewed one school that is my case study.

S: Okay

D: Opposite the school um is is a wetland, but they don't the learners don't know it's a wetland.

S: Grade six?

D: Okay and then uh uh diagonally across the school uh there's a landfill, but they don't know it's a landfill and they don't know the implications of it um and my second case study that teacher knows the closest wetland they all know the wetland, because they go and baptise in the wetland and they keep it clean, because they need that water to baptise in. Thousands and thousands of them get baptise. So I was just thinking it's interesting and what is your comment on this, because the opportunity for seeing biodiversity is around us oh and then lastly my final point on this matter is the picking of of um traditional medicine to such an extent that you know um, but yet it is needed and and so talking about the maintenance then of that instead of completely removing that biodiversity of traditional plants. What's your comment on that?

S: Clearing throat. Again I did not write the policy, but I feel I would like it to be there you know this this social awareness uh I find it amazing that obviously one school knows and one school doesn't know, cause in grade six they learn the importance, its a short section the importance of the wetlands and PE is surrounded by wetlands you know you see the wetlands as we travel you know and yes you see the people, because of another need we need clean water to baptise so indirectly they looking after nature, but...

D: But

S: They don't realize. If they weren't baptising they wouldn't care about the wetlands. Now you see again that is not as explicit in the curriculum.

D: Mmm

S: That that why why should we be so aware. If we if we know about something about like the animals and diversity and then wetlands and stuff like that it's not explicitly explained that this these things have to be sustained you understand and there's a reason for it, because like people think how's a wetland important to me? During a drought then a wetland can become very important in your life, cause a wetland you know purifies water itself that's the way it's designed like a sponge...

D: Mmm

S: And a wetland is involving water and life and water that we also need to drink.

D: Mmm

S: Eventually that water goes into the ground.

D: Mmm

S: You know there's water cycle you know we so, but the teachers do not are not told to teach it that way.

D: Mmm

S: It might take some environmentalist as a teacher to to now hammer it home.

D: Yes

S: To hammer it home. yes so as on the behalf of the department I plead guilty, because it's not as explicit here, but I don't know what is done in the FET perhaps it's there very explicitly dealt with the with the Life and Living aspect. Perhaps there they are very aware you know of of social demands and and being a responsible environmentalist.

D: Mmm

S: But I I don't want to comment on about the FET.

D: Yes

S: I have read through it, but I'm not gonna comment, but I say here in grade seven: No. No, they do not go to that extent of making people aware now that we are this knowledge I plead this is how it can affect people.

D: But you think that it should be?

S: Definitely definitely yes it should be there.

D: Mmm

S: How can we have this requirement at the child, cause these critical outcomes are still there. How can we expect the child to be a responsible citizen, but we not teaching them how to be responsible citizen (giggling) we just teaching them content and we divorce the social consciousness from the content.

D: Thank you very much um Mr Samson I don't have any more questions, but um.

S: I just hope record button on me and that you did tape me. (Giggling)

D: It says 58 minutes.

S: It's under an hour so you fulfilled your promise.

D: Thank you very much.

S: You may keep that you may need it.