Teaching About Frogs in Grade 7: a Case Study on Integrating Indigenous Knowledge into the Science Curriculum

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Declaration:

I, Jean Elizabeth Minter, hereby declare that this mini-dissertation is my own unaided work and has not been submitted before for any degree or examination in any other University.

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Abstract:

Constructivism and worldview theory were translated into the design of a series of science lessons for Grade 7 learners. Indigenous knowledge about frogs, elicited from the local community, was incorporated into the lessons together with frog myths from other cultures, in order to introduce the curricular topics of conservation and biodiversity. The lessons then focussed on pollution of our natural environments and the loss of biodiversity as evidenced by declining frog populations. The lessons were implemented by the researcher and the participants' activities were assessed using rubrics. Participants' attitudes towards frogs were assessed using pre- and post-test questionnaires. Qualitative analysis of the data revealed that experiences and learning had taken place amongst the participants, and had resulted in a more positive attitude towards frogs. Participants had also developed a better understanding and appreciation of biodiversity and the need for its conservation. Lessons learnt from the research were that information on indigenous knowledge about frogs was not available in the literature and that no guidance was given to teachers regarding the incorporation of indigenous knowledge into the South African Science curriculum, and that some aspects of the assessment had been subjective and needed to be improved. Nevertheless, the researcher has shown that by introducing indigenous knowledge in a series of science lessons, using constructivist principles, and acknowledging the existence of differing worldviews, it is possible to expose learners to positive and effective learning experiences that foster the development of an appreciation of the importance of conservation and the need to maintain biodiversity.

Chapter 1. Introduction

1.1 Background

The Revised National Curriculum Statement (RNCS) Grades R-9 Natural Sciences (Department of Education, 2002) refers to the fact that there are usually different worldviews present in the science classroom. One such worldview is the prevailing one of science, based on empiricism. This worldview holds that observation of nature is objective without the observer influencing or being influenced by the event. It also contends "that if something can be observed and measured in some way, it is real and can be used to explain why events happen in nature" (Department of Education, 2002, p.11), and that those which cannot are of no value in explaining why events happen.

Another worldview present in science classrooms, especially in South Africa, is one held by many people who believe that "people are not separate from the earth and its living things:...all things have come from God or a creative spirit and therefore have spiritual meaning: events happen for spiritual as well as physical reasons" (Department of Education, 2002, p. 11).

The existence of these two different worldviews in South African science classrooms has been acknowledged by the South African Education Department as posing a challenge for curriculum policy, design, materials and assessment, and that the RNCS invites further research and development in this field. (Department of Education, 2002, p. 12).

Also, the last few years have seen a surge of interest in the wake of President Thabo Mbeki's call for an African Renaissance, and indigenous knowledge has

received considerable attention in the developmental, political, scientific, academic and cultural arenas. However, not much that is tangible has materialized and, as yet, little has been translated into curriculum perspectives and learning support materials. In fact, current debate suggests that South Africa's attempt to incorporate indigenous knowledge into the science curriculum is minimal, consisting of no more than "a couple of intentions or premises that indicate a body of knowledge that has existed over time" (Onwu & Mosimege, 2004, p. 3).

A sensitive issue in this debate is the question of how one should incorporate indigenous knowledge into the Science curriculum in South Africa, without one knowledge system becoming the "gate-keeper" (or undermining) of the other? Michie (2002, p. 39) has warned against adopting a tokenistic approach to Indigenous science, noting that such knowledge often exists within a complex web of relationships and tends to be over-simplified by the practitioners of Western Science.

Nowhere in the RNCS is there mention of "how" educators are to go about addressing the issue of the existence of different worldviews in the science classroom nor are any tangible methods suggested for incorporating indigenous knowledge into the science curriculum. This research project sets out to address this deficit in the RNCS by showing how indigenous knowledge can be incorporated into the science curriculum in order to acknowledge the presence of differing worldviews in the science classroom.

One of the assumptions of this research project, based on the researcher's experience from 30 years of teaching biology, is that Grade 7 learners have negative attitudes towards frogs. An attitude may be defined as " an enduring

positive or negative feeling about some person, object, or issue (affective domain)" (Newhouse, in Ballantyne & Packer, 1996, p. 30).

These negative feelings towards frogs, based largely on misconceptions, are widespread in human cultures throughout the world. For example, Carolus Linnaeus (1758), the Father of Modern Taxonomy, had this to say about amphibians:

> "These foul and loathsome animals are abhorrent because of their cold body, pale colour, cartilaginous skeleton, filthy skin, fierce aspect, calculating eye, offensive smell, harsh voice, squalid habitation, and terrible venom: and so their Creator has not exerted his powers to make many of them" (Duellman & Trueb, 1989, p.16).

In the RNCS (Department of Education, 2001) no attempt has been made to incorporate indigenous knowledge about frogs into the school curriculum or to dispel the many widely held myths and beliefs about these animals that exist in many of our diverse cultural groups.

Yet, within the new OBE system, there are opportunities where indigenous knowledge can be introduced to enable outcomes, such as being "able to respect the rights of people to hold personal beliefs and values" (Life Orientation) and "able to demonstrate an understanding of the changing and contested nature of knowledge in the Natural Sciences" (Natural Sciences), to be attained (Department of Education, 2001, p. 52).

Another assumption of this research project, also based on the researcher's teaching experience, is that apart from the negative attitude held by Grade 7 learners towards frogs, they also do not appreciate the value of frogs in the

environment, and are unaware of their conservation needs. For the purposes of this research, this was verified by the responses of the participants during diagnostic interviews.

In view of the alarming declines in frog populations that have been observed in many parts of the world over the last few decades (Wake, 1991), it is important that learners understand the value of these much maligned and poorly understood animals.

In the context of the conservation of South African frogs, Branch and Harrison (2004, p.13), note:

> "Amphibians figure large in folklore and scientific studies, but they fare badly in comparison to the attention lavished on mammals. In the current conservation paradigm that emphasizes sustainable utilisation, frogs are regarded as having limited usefulness in ecotourism or in the upliftment of disadvantaged communities and, as a consequence, are largely neglected. Nevertheless, amphibians are an important component of aquatic and terrestrial ecosystems, playing roles both as predators and as prey and thereby providing links between organisms at either end of food chains".

In order to bring about a change in learners' attitudes towards frogs, a constructivist approach (see 1.3 and 2.1 below) to lesson design was adopted. This approach was chosen due to the positive results obtained from a number of different constructivist teaching projects carried out in the United States of America (Hand, Treagust & Vance, 1997; Yager, 1995). The constructivist approach is based on the contention that new ideas or experiences interact with a learner's existing knowledge and understanding of the phenomenon/a. Accommodation and

assimilation of the new knowledge takes place in the learner resulting in a more detailed and accurate understanding of the phenomena he experiences.

Constructivism was used not only because some projects in the US worked out well. It is presently worldwide the dominant view on how teaching and learning should be organised, and it hard to see how the Learning Outcomes of the RNCS, as well as the envisaged teacher and learner could be understood in another perspective. Yet again there are few concrete guidelines or recipes on how to construct or design constructivist learning, especially in the South African context.

1.2 Research questions

1.2.1 How may constructivism and worldview theory inform the design of science lessons that integrate indigenous knowledge into the Grade 7 Natural Science curriculum?

1.2.2 What experiences and learning result from a lesson series incorporating indigenous knowledge about frogs, designed by using constructivism and worldview theory, that is meant to foster development of an appreciation of conservation and the maintenance of biodiversity?

1.3 Conceptual framework

Constructivism and worldview theory were used as a basis for designing lessons pertinent to the Revised National Curriculum Statement, for Grade 7 Natural Sciences. Indigenous knowledge was incorporated into the framework of the lessons as a constructivist strategy to facilitate more effective teaching and learning.

Chapter 2. Literature Review

This review introduces the reader to the origin, nature, principles and methodologies of the constructivist approach, its application in science education, and the importance of indigenous knowledge in this context. Concepts such as behaviourism, cognitive constructivism and social constructivism are briefly discussed; different models of constructivism are outlined; evaluations of two constructivist teaching projects are discussed and the importance of including indigenous knowledge and environmental education in the science curriculum is stressed.

As this research deals with changing learners' attitudes towards frogs, it is important to refer to the research carried out in the field of cognition, although there are still many unanswered questions as to how knowledge is acquired. As Lawson (1991, p. 487) notes, "no one author has a corner on precisely how knowledge gets into people's heads or what the best words and phrases are to convey the precise nature of this process, or processes. Indeed, there are quite possibly a variety of ways to obtain knowledge".

The constructivist approach to teaching/learning science may provide an effective method for changing learners' attitudes towards frogs, by bridging the gap between western science and indigenous knowledge systems.

2.1 Constructivism

2.1.1 Origin, nature, principles and methodologies of constructivism

Until fairly recently, traditional learning theory in science education followed the behaviourist movement of such authors as Pavlov, in the 1920's, and Watson and Skinner in the 1930's (see review in Yager, 1995), in which it was assumed that the learner enters a learning situation with an empty mind (tabula rasa). Learning was facilitated by presenting learners with stimuli that elicited certain responses, which were reinforced by rewards.

Since the behaviorist model precludes any form of understanding and ignores the influence of outside stimuli such as various forms of media, cultural and social activities, and personal experiences, "it is not surprising that behaviourist training rarely produces the desired behaviours" (Yager, 1995, p.39).
In recent years, research in cognitive psychology, which focuses attention on the way in which new information is assimilated by learners, has revealed new insights into how learning takes place most effectively. Science educators have been looking for a new pedagogy, as science education has become boring and science classrooms have become characterised by "overstuffed curricula, remote and unconnected content, mindless examinations, disengaged learning, unreflective and authoritarian teaching, and much else....." (Mathews, 2000, p. 502).

One such pedagogy is constructivism, which is essentially, a way of teaching and learning, which places the emphasis on the learner and not the teacher, that is, learner based education. Because constructivism shifts the responsibility of learning onto the learner, learning becomes an active process occurring within the learner (Yager, 1995), rather than a passive process as exhibited by the "explain-

practice paradigm" used by behaviourists. This constructivist viewpoint holds that learning results from an interaction between the information presented to the learner, and the way in which it is processed with regard to perceived notions and existing personal knowledge.

Constructivism can thus be defined as "the idea that students, as well as all humans, actively construct their understandings of the world and these constructions are significantly influenced by prior knowledge, beliefs, attitudes, and experiences" (Lederman, Lederman & Bell (2004,p. 40).

It has also become apparent that:

> "most persons have misconceptions; many of the most able students (such as university physics majors and engineering students) have as many misconceptions about science as the average high school student", and "students who score well on standard tests are often unable to successfully integrate or contrast memorized facts and formulae with the experience-based interpretations they have acquired prior to instruction" (Yager, 1991, p. 53).

The constructivist approach may provide a means whereby these misconceptions may be corrected.

It is thought that effective learning is achieved by a process of gradual adjustment characterised by temporary advances, frequent retreats, and periods of indecision (Strike & Posner, in Ballantyne & Packer, 1996, p. 29). Accordingly, to accomplish lasting, meaningful, and effective change, it is necessary to employ a wide range of

teaching strategies that address learners' knowledge, attitudes/values, and behavioural orientations as part of an integrated, long-term program.

Thus, teachers in constructivist classrooms, strive to establish an environment where pupils can gain meaning and are able to restructure ideas at a higher level than that of rote-learning. This can be achieved by using a variety of relevant activities (Wheatley, 1991, p. 18).

In this research project the designed learning activities include class discussions, group work, dramatisation of myths, video clips, exposure to live material, and individual written work. These activities accord with a constructivist approach to learning in that the learner takes a central, active and creative role whereas the researcher/teacher acts as facilitator.

Cognitive Constructivism is based on two principles.

Firstly, knowledge cannot be passively received but must be constructed by the individual (constructions are initial mental representations). In other words, knowledge cannot be transmitted to the learner, rather the learner has his/her own conceptions and knowledge (beliefs) about the way certain things are and how they work through their experiences. Learning may thus be viewed as a product of self-organisation and reorganization (Yager, 1991). During this research project, learners' revealed their existing knowledge base pertaining to frogs by answering questions on a fact sheet. Group discussions of myths and their origins gave rise to debate and a sharing of a variety of viewpoints. Finally, they were exposed to live material and scientific information about frogs to give them the opportunity to restructure their knowledge base.

Secondly, cognition has an adaptive function, enabling the individual to develop his worldview on the basis of actual experiences rather than by the discovery of abstract reality (von Glaserfeld, in Wheatley, 1991). The use of live frogs in the science lessons designed in this research project gave the learners new hands-on experiences with which to adapt their existing knowledge base and attitudes.

Socio-cultural constructivism adds another dimension to constructivist theory. It emphasises the importance, for learning, of social context and interaction with others Yager, 1991). Cognition, language and forms of thought reflect the culture and social history of the learner and are as important as any particular instruction which may be given. This model recognises the needs of learners to construct their own meaningful understandings as well as the importance of the teaching process itself.

A social constructivist view of science education would:

> "support the development of curricula which take the nature and history of science into account and which would also place science within the diverse social realities it operates in today, through the use of richly contextualised practical work and study. This would enhance the relevance of the science learned as well as enable learners to develop a better link between their everyday lives and the desired science interpretation of concepts, thus developing a better ability to effectively and successfully use science in their lives in a variety of ways" (Kuiper, 2000, p. 9).

This research project adopts a social constructivist approach. The lessons (intervention) may result in a positive change in the attitudes of the learners towards frogs, and learners who are more tolerant of frogs in their home

environment may have a positive influence on other family members and their community.

2.1.2 Constructivist Models

This research project was based on the following constructivist models: Wheatley's problem-centered model; Yager's Constructivist Learning Model (CLM); the CLIS Group model and one proposed by Kuiper (2000).

Wheatley (1991, p. 19) proposed a model based on a **problem-centered** perspective. This model has three components: tasks, groups and sharing. The tasks selected by the teacher in preparing for a lesson must pose a problem for the learner. He noted that "selecting the right tasks is a challenging endeavour" and that "good problems are ones which can be solved in a variety of ways by students at different cognitive levels".

The learners work in groups on these tasks, seeking solutions. Collaborative work is a goal during this activity, since problem-centered learning with co-operative groups and class discussions allows learners to develop intellectual autonomy and provides an ideal environment for "students' meaning-making" (Wheatley, 1991, p. 19). Finally, the class comes together for a time of sharing, when learners present their solutions to the other learners for discussion. In this model the teacher is the facilitator, showing encouragement and support without being judgmental.

Co-operative learning is one of the approaches designed to be used in Lessons 1 to 4, in this research project, which gave the learners an opportunity to engage in group work to solve a problem. Sharing took place during the dramatic presentations of the myths.

The remaining three models comprise the following four phases:

1. The Invitation, Orientation or Elicitation phase:

During this phase, questions are asked to elicit the learners' conceptions and understanding of a particular topic. Various methods such as questionnaires, verbal questions and discussion are the tools used to gain the information needed. The surroundings are observed for points of curiosity and unexpected phenomena and variation in learners' perceptions are identified.

In this research project, this phase involved eliciting frog myths from the local community and establishing the level of understanding that existed among the participants, with regard to frogs and their conservation.

2. The Exploration, Theory-making or Challenging phase:

During this phase the learners' existing conceptions are challenged by engaging them in activities such as experiments, discussions and research. During this phase learners are able to re-evaluate their ideas and may develop them in the direction of the accepted school science notion. In this research project, lesson design was informed by the learners' worldview, and relevant activities were selected, which would engage the learners and allow them to re-evaluate their existing conceptions and compare their views with alternative worldviews.

3. The Evaluation, Review, Reflection phase (involving movement toward accepted theory or proposing explanations and solutions):

During this phase learners propose explanations and solutions derived from their activities, communicate their ideas, construct models and finally integrate the solution with existing knowledge and experiences. Both learners and teachers establish whether there has been a conceptual change in understanding and

whether this change has taken place in the direction of the desired school science conception. In this research project, this phase was represented by verbal questions and summaries at the end of each lesson. The researcher/teacher asked the learners what they had learned and consolidated the concepts introduced to them during the lessons.

4. The Application or Action phase:
This phase involves the application and transfer of skills and knowledge, sharing of ideas and development of products in familiar and new situations. In the research project this took the form of group work and the interviews of parents and grandparents, by the participants, regarding frog myths.

2.1.3 Evaluation of the constructivist approach.

The models discussed above, have been implemented in the classroom with varying degrees of success.

The results of a **four-year study** of pupils in constructivist-run classrooms (Hand, Treagust & Vance 1997) showed that the use of co-operative learning strategies helped to improve verbal interactions between pupils. Learners were found to be more mentally active in the learning process; they did not worry about the correctness of their ideas; they became more confident in constructing and understanding scientific concepts and enjoyed the new responsibility given to them.

During this study, teachers often experienced difficulty in adopting the role of facilitator as opposed to the more traditional teacher-centred style of instruction. However, the importance placed on learner-centered learning does not necessarily

imply a lack of control in constructivist classrooms as there is a dynamic relationship between teacher and learner.

Similarly, results of the **Iowa Chautauqua Program** and the **Iowa Scope, Sequence and Co-ordination Project** showed that learners in constructivist classrooms:

> "(a) demonstrate superior understanding of basic science concepts, (b) are better able to use and understand basic processes of science, (c) can apply science concepts and processes in new situations, (d) have more positive attitudes towards science, science study and science teachers, (e) develop better creativity skills including questioning, proposing solutions, and predicting consequences, and (f) have more complete views of the nature of science" (Yager, 1995, p. 57).

2.1.4 Strategies used in Constructivist Classrooms

Many teaching strategies may be employed to change conceptions, remove misconceptions, elaborate and extend conceptions, or make conceptions more internally consistent. Those strategies which maintain student interest are most valuable. The following strategies were used in the design of the science lessons for this research.

One such strategy, ***laboratory work,*** is to promote cognitive skills such as critical thinking, synthesizing, decision-making and creativity. Laboratory work develops attitudes such as curiosity and perseverance, increases motivation and identifies students' misconceptions. "Doing science" will encourage reflection on content which will ultimately encourage conceptual change by bringing cognitive conflict to light. In this research project laboratory work involving exposure to, and handling of, living frogs, in order to dispel the learners' fear of frogs.

Instruction in ***thinking and problem-solving skills*** is a traditional teaching strategy that has long been part of education but needs to be "redefined and audited" (Wallace, 2004, p. 4). Intelligence is sometimes seen as the ability to use thinking and problem solving skills in all aspects of life. Thus, constructivists encourage class discussions in which learners are given the opportunity to express their own meaning through questioning and dialogue resulting in conceptual change learning. The group discussions that took place during this research project gave learners the opportunity to speculate on the origin of frog myths and discuss the role of various characters in a conservation story. During class discussions individual learners had to give verbal answers to questions and complete a fact-sheet questionnaire and assessment questionnaire.

Another important strategy in constructivist teaching is the ***argument***. Argument exposes the distinctive character and nature of science. Focusing on argument provides an opportunity to practice and develop the reflective analytical skills that are so highly prized in contemporary society. By using this as a teaching strategy, science teachers can claim that they are making a significant contribution to students' ability to reason and think critically.

> "Science education without argument is like a book without a plot: in danger of becoming a tale told by an idiot, full of sound and fury but ultimately incomprehensible" (Osborne et al 2001, p. 69).

In this research project, arguments were presented by the learners when preparing the presentations on frog myths, and in the group discussion on the conservation story.

The ***questioning technique*** used by teachers in constructivist classrooms encourages learners to think, draws out their ideas, and encourages them to volunteer points and explore further; thus providing evidence of achievement. In order to achieve this questions should not be closed but open- ended and stimulate debate and creative thinking rather than finding a single correct answer. Emphasis should be placed on questions that evaluate the learner's ability to apply advanced forms of thinking, such as critical thinking skills & reflective awareness. Good questions are those that recognize the wide possibilities of thought and are built upon varying mental operations. Classroom questions can help students to develop more effective and diversified thinking, which should prove valuable throughout their lives and enable them to become independent learners. During this research project the researcher asked verbal questions specifically designed to develop the learners' thinking skills. Learners were challenged in a similar way by the final assessment questionnaire.

In conclusion, constructivist teaching guidelines recommended by Yager (1991) were translated into the science lessons designed for this research, and are summarised below:

- measurement of prior knowledge and understanding, especially with a view to diagnosing existing misconceptions or non-viable constructions. In the present study, a diagnostic pre-test questionnaire was used to ascertain the attitude of the participants towards frogs and their conservation. Questions asked by the researcher/teacher during Lesson 1 also identified misconceptions held by the participants.
- intervention by teachers to mediate the learning of students by means of purposive activity. In the present study, a carefully structured series of five lessons, gradually developing an understanding of the importance of

biodiversity and conservation out of the learners' prior views and feelings pertaining to frogs, by means of an activating, co-operative, learner-centered approach, was designed and implemented.

- establishment of social situations in which students can make sense of experiences in terms of what is already known. By means of a story about frogs (Lesson 3) to which the learners could all relate, the researcher was able to introduce to learners and have them co-operatively explore the moral and ethical aspects of conservation.
- opportunities for students to present their knowledge in a variety of ways, matched by a variety of assessment techniques. In the present study, learners demonstrated the various things they learned in a variety of ways, ranging from cooperative learning activities, drama presentations, written work, extracting information from a Fact Sheet in order to answer questions, and a final assessment questionnaire. These activities were accompanied by instruments to measure each learner's level of understanding.
- constant monitoring of student activity to recognize signs of difficulty, disengagement, and depth of understanding. In this study, each activity was monitored by the researcher both during the activity and by analysing the assessment rubrics.
- reporting that recognizes the learner as a unique individual. In this study, each activity was assessed and the results of the analysis were reported to each learner.

2.2 Indigenous knowledge

This section discusses the reasons for incorporating indigenous knowledge into the science lessons designed by the researcher; the definition of indigenous knowledge; the debate over the conflict between indigenous knowledge systems and Western science, and the incorporation of indigenous knowledge into the science curriculum.

Indigenous knowledge has been included in the lesson design, because:

1. The National Science curriculum states that "it is fitting that traditional and indigenous knowledge systems should be included among the ideas the learner examines when building Learning Outcome 3" (National Curriculum, 2002, p. 11). Also, in the same document (p. 59) one of the suggested assessment standards for Grade 9 states that the learner should be able to: " identify sources and nature of authority in two differing explanations for an event, coming from two differing world views". It is important for the learner (and teacher) to realise that various beliefs are best understood within their particular cultural context, and that in this sense they have equal standing with other world views such as western science (Hodson in Aikenhead & Jegede, 1999, p 277).
2. The researcher was aware that the learners held certain erroneous beliefs about frogs, and were uninformed regarding the need to conserve frogs.
3. In the development of lessons, it is good practice to start with the known and then move to the unknown as this attracts the learners' attention and gives them self-confidence and a sense of security. (A Northern Sotho song about frogs, and frog myths gleaned from the learners during the pre-test interview, were used at the beginning of the lesson).
4. A pilot study undertaken to document frog myths and legends in the local community, revealed the presence of many common misconceptions about frogs and the fact that few people felt there was a need to conserve them.

> Constructivist theory requires that this worldview be acknowledged when presenting an alternative viewpoint.

Indigenous knowledge has been defined in various ways by different authors, for example:

The Inter-Commission Task Force on Indigenous Peoples (Onwu & Mosimege, 2004, p. 2) defines indigenous knowledge systems as:

> "local, community-based systems of knowledge which are unique to a given culture or society and have developed as that culture has evolved over many generations of inhabiting particular ecosystems. "Indigenous knowledge systems" is a general term that refers broadly to the collective knowledge of an Indigenous People about relationships between people, habitat and nature. It encompasses knowledge commonly known within a community or people, as well as knowledge which may be known only to a shaman, tribal elders, a lineage group, or a gender group. It includes technologies and practices that have been and are still used by indigenous and local people for existence, survival and adaptation in a variety of environments".

Le Roux (1999, p. 15), sees indigenous knowledge as "processes of knowledge relevant in certain situations, always changing and open to change, rather than a static body of knowledge which can be unearthed and applied, and held up in comparison to another".

Other authors, O'Donoughue and Neluvhalani (2003, p. 121) use the term "indigenous knowing" rather than "indigenous knowledge", so as to avoid treating

knowledge as "an objective commodity outside the socio-historical contexts of human meaning-making interaction".

While some worldviews may be relatively flexible or open to change, Western science appears to be incompatible with any system of knowing or understanding the world that does not use its methodology. Thus a conflict exists between Western science and Indigenous Knowledge Systems.

For example, Onwu & Mosimege (2004, p. 10) distinguish between Indigenous Knowledge Systems (IKS) and Western Science as follows:

> "Indigenous knowledge systems try to address or understand reality in its deepest or most radical aspect, and seek its ultimate causes, while traditional Western sciences study specific aspects of reality, and seek more immediate or proximate causes…. Indigenous knowledge systems try to provide a rationale for *all* aspects of some reality including its origin, using both material and non-material factors such as spirit, conscience, and freedom to try to discover the ultimate explanation of its very being. Indigenous knowledge systems can contribute a holism missing from Western thought in the process of knowledge creation".

Other differences are mentioned by Kawagley, Norris-Tull & Norris-Tull (1998, p. 140), who characterise Western science as impersonal, formal and elitist in contrast to informal and non-elitist "Indigenous science". In their view, Western science promotes a mechanistic view of the universe, whereas Indigenous science incorporates "spirit".

An example of the conflict between Western and indigenous knowledge is found in Alaskan classrooms where science is portrayed as a discrete body of knowledge distinctly separated from most other subject areas and as a body of knowledge "discovered by European and Euro-American scientists" (Kawagley, Norris-Tull & Norris-Tull, 1998, p. 134).

The question arises whether the interpretation of reality by different worldviews are mutually exclusive. Raine wonders how "other ways of knowing" may be expressed and accepted by those who are immersed in a worldview which is universalistic (the search for absolute totalities) and which excludes the wisdom and traditional knowledge of others (1999, p. 62).

Jones (in Michie, 2002, p.38) has suggested that cultural dissonance created by the conflict between Indigenous knowledge and Western Science might be overcome by a process of reconciling certain inconsistencies that exist between people with different belief systems.

The challenge is therefore to facilitate a sharing of wisdom across worldview boundaries which allows for the validation of differing, and often incommensurable, ways of knowing and experiencing the Earth. The rise of pluralism has encouraged the recognition of other traditions as viable worldviews and has gone some distance in halting prejudice against peoples who hold to their traditional knowledge and refuse to convert to Western modes of thinking.

A closer relationship may be forged between science and traditional wisdom by carrying out more research into everyday life practices in different contexts and circumstances, in order to "see the extent to which these practices were cross-cutting, cross-cultural interactions and/or inter-epistemological challenges" (Onwu, 2004, p. 11).

In spite of the conflict between Western science and other worldviews, it is clear that the science curriculum cannot be effectively implemented without reference to Indigenous Knowledge Systems. From a constructivist viewpoint, new ideas or explanations must be accompanied by those with which the child is already familiar, if one is to be successful, for example, in assisting the child to acquire values and attitudes which will protect and improve the environment.

The acceptance and adoption of differing viewpoints does not seem to be problematic in the case of Indigenous Knowledge Systems, since these appear to be derived from a continuing interaction between communities and their environment. Thus, rather than precluding interaction with other knowledge systems they may, in fact, adapt and evolve as a result of such interaction.

A discussion of how such adaptations take place is provided by Aikenhead & Jegede (1999, p. 271), who recognise transitions from a student's life-world into a science world in the science classroom as "cultural border crossings". The smoothness of this transition determines the degree of science learning achieved by the student. If the transition is smooth (when the culture of science harmonizes with the student's world-view) then science instruction will support the student's world-view, and a process of "enculturation" tends to occur. (Hawkens & Pea, and Wolcott, as quoted by Aikenhead & Jegede, 1999, p. 274). However, if the culture of science and the student's world-view are at odds with one another, science instruction will tend to disrupt the student's world-view by "trying to force that student to abandon or marginalize his or her life-world concepts and reconstruct in their place new (scientific) ways of conceptualizing". This process is called "assimilation". (Aikenhead & Jegede, 1999, p. 274).

Another interpretation of this adaptation process is advanced by Jegede (Aikenhead & Jegede, 1999, p. 277-8). In attempting to describe the "culturally related cognitive dissonance" experienced by both Western and non-Western students in their science classes, they use the concept of collateral learning, in which the degree of interaction and resolution between two conflicting schemas are depicted as points along a spectrum which range from *parallel* collateral learning (compartmentalization), through *secured* and *simultaneous* to *dependent* collateral learning.

Ogawa (in Aikenhead & Jegede, 1999, p. 277) also recognises the phenomenon of collateral learning and claims that the teaching of Western modern science is enhanced when students become aware of the "personal and indigenous sciences" in the classroom.

Ngwane (1999, p. 36) felt that the "education for the environment" component of the curriculum would be enhanced by including indigenous knowledge of the environment. Pupils could then analyse and critically examine subject matter in relation to the knowledge residing in their communities, which was used in their everyday lives (Fien, as quoted by Ngwane, 1999, p. 35).

Indigenous knowledge which has practical application and which stands up to the rigours of scientific investigation (such as knowledge pertaining to medicinal plants) is of great value to Western science, whereas other beliefs, myths or explanations are of more value in the field of social anthropology which seeks to record and understand the structure and function of the various human societies and cultures. Mtshali, (in Ngwane, 1999, p. 35) says that much of this knowledge exists only in the form of oral tradition and needs to be retrieved, documented and disseminated before it disappears.

Whether or not indigenous knowledge is compatible with the explanations offered by Western science it still adds value in the educational context by enriching the discourse and providing a bridge for the learner in crossing from one worldview to the other.

2.3 The importance of Environmental Education in the Science curriculum.

Essentially, the aim of environmental education is to produce citizens who are knowledgeable about the environment and its associated problems and are motivated to work towards solving these problems.

The RNCS (Department of Education, 2002) includes environmental education in the Science curriculum so that the learner will:

- be able and willing to act on knowledge about environmental issues (LO 3, p. 12).
- understand balance and change in environments and the importance of biodiversity (Core Knowledge and Concepts, p. 61).
- be able to interpret simple models of ecosystems in order to predict the effects of change (LO 2, p. 57).
- understand that biodiversity enables ecosystems to sustain life and recover from changes to the environment (Core Knowledge and Concepts in Life and Living, p. 64).
- appreciate that the loss of biodiversity affects the capacity of environments and the earth to sustain life (Core Knowledge and Concepts in Life and Living, p. 64).

- realise that human activities and technologies can lead to extinction of species (Core

Knowledge and Concepts in Life and Living, p. 65).

Environmental education should be brought to the level of the people so that they may acquire the values, attitudes, commitment and skills needed to protect and improve the environment (Wilke, in Ngwane, 1999, p. 36). To present environmental knowledge without reference to the attitudes and values held by learners, would limit the extent to which such knowledge is translated into action. Conversely, to address environmental attitudes and values without providing an accurate and relevant knowledge base, would limit the power and effectiveness with which attitudes/values are applied (Ballantyne & Packer, 1996, p. 27).

Environmental education should create new patterns of behaviour in individuals, groups and society as a whole, with regard to the environment. It should empower people with knowledge and build conceptual bridges between environmentalism and other ways of knowing the world (Wilke, in Ngwane, 1999, p. 36).

The choice of frogs as a subject for introducing the curricular topics of biodiversity and conservation is highly relevant: concern over global amphibian declines have recently received a great deal of publicity and frog populations are now widely used to measure the health of the environment (Channing, 1998; Hartwell and Olivier, 1998).

Chapter 3. Method

The recommendations of Yager (1991), Kuiper (2002) and Driver and Scott (1996), all strong proponents of constructivism, were translated into the design of the science lessons used in this research (see 2.1 above). Although these authors use slightly different terminology, they recognise the same basic stages in their constructivist models, as can be found below. The design of the study itself largely parallels the design of the lesson series. Below, both designs are described and justified in an integrated way.

3.1 Design of the study

Type of research undertaken

Participatory action research (PAR) was chosen for the following reasons (Strydom & Delport, 2002, p 431):

- This method is ideal for research that involves working directly with people: in this case the learners are the participants and the teacher, the researcher. Interactions between researcher and participants included interviews and classroom activities.
- By involving the learners as participants, this type of research has a far greater impact in stimulating and guiding change, than conventional research in which the subjects seldom receive any immediate benefit from the research. The model also provides a bridge between research and practice.
- The research process itself, i.e. the design of constructivist approach involving the incorporation of indigenous knowledge, can effect change or transformation and be part of the solution (a change in learners' attitudes towards frogs).

- This research method is dynamic and flexible, in that the researcher is constantly challenged by events, ideas and arguments raised by the participants, and is able to modify, adjust or improve on the content and structure of future lessons.

The following limitations of PAR listed by Strydom & Delport (2002, p. 433) were addressed, where possible, when designing the series of science lessons:

- Objectivity of the researcher: the analysis of video-recordings of certain lessons, the input of the supervisor who attended the lessons and the assessment reports completed by a colleague, make it possible to establish whether the researcher had lacked objectivity as a result of her close relationship with the participants.
- Extraneous variables are difficult to control, which creates difficulties when interpreting results: the lack of a control and sufficient instruments make it difficult to identify the exact cause of the change in attitude observed in the participants subsequent to the intervention. The researcher controlled extraneous variables to some extent by working with a group of participants that she knew well. The researcher was not interested in exact causes but in the application of global design features and the resulting learning in a broad sense.
- Cross-cultural research is vulnerable to misunderstandings on the part of both researcher and participants: in the case of this research, the participants are mostly of Northern Sotho origin. However, they all speak English fluently, have attended an English-medium school for 5 years and live in a westernised, urban environment. The researcher has taught Northern Sotho learners for the last 11 years and is reasonably sensitive to existing cultural differences. The researcher used a free and open, non-threatening approach during all activities and avoided expressing an opinion as to which viewpoint was "best".

Qualitative methods will be used as this type of research "elicits participant accounts of meaning, experience or perceptions and produces descriptive data in the participant's own written or spoken words. It thus involves identifying the participant's beliefs and values that underlie the phenomena" (Strydom, 2002, p. 70). This will involve the subjective exploration of reality from the perspective of an insider as opposed to the objective outsider perspective that is predominant in the quantitative paradigm.

Reid and Smith (1981) claim that:

> "Qualitative methodology vests on the assumption that valid understanding can be gained through accumulated knowledge acquired first-hand by a single researcher where the unit of analysis is the individual" (Fouche, 2002, p. 105).

3.1.1 Exploration Phase

The researcher established, through verbal questioning of learners of all ages, that they held certain myths pertaining to frogs. She decided to elicit indigenous knowledge about frogs from members of the local community and incorporate these into a series of science lessons. The researcher and an interpreter conducted interviews in the interviewees' homes and recorded the indigenous knowledge on site, on an **interview schedule** (Appendix A1). The interpreter, who was well versed in the goals of the questionnaire/interview, translated the questions and clarified any misunderstandings that arose during the interviews, while the researcher captured the data. The interpreter helped bridge the cultural barrier between the researcher and the interviewees.

The questions on the interview schedule (A1) were designed by the researcher in consultation with an herpetologist, with a view to obtaining as much data from the community as possible: some of the data were relevant to independent studies of frog distribution that were being conducted by the herpetologist in the same area. These questions were modified after a pilot study, involving five interviewees, was conducted. Ambiguities in the questions and language problems that were encountered, were corrected.

The opening six questions (not numbered) enabled the researcher to establish a rapport with the interviewees and record their ages, gender, ethnic group and residential area. Indigenous knowledge about frogs was obtained from the interviewees using simple questions requiring no explanation (Questions 1 to 12). These were designed to relax interviewees and encourage confidence in conversing about frogs, as well as to document knowledge and general beliefs, which members of the local community may hold regarding frogs. The open-ended question (Question 13) at the end of the interview allowed the interviewee to relate any myths and beliefs that they held, pertaining to frogs. These were later used in the science lessons, to allow the participants/learners to pass comfortably from one worldview to another. The interviewees' responses to the questions revealed their attitudes towards frogs as well as their awareness of the role frogs play in the environment, and the need to conserve them.

A chart showing photographs of ten, common, local frog species, was used as an identification guide during interviews (Appendix A2). This was necessary as many of the interviewees did not speak English and reliable identification could not be made without visual representations. This was important in order to determine the species of frogs upon which the myths were based, and in order to provide information for the herpetological data-base.

The data collected in this phase guided aspects of the design of the structure and content of the lessons designed. For example, A Northern Sotho song about frogs was elicited at this stage and used in Lesson 1 as well as establishing the need to introduce live frogs into the lessons.

A structured diagnostic pre-test questionnaire (Appendix B1) was designed to elicit the participants' attitudes towards frogs as well as their level of understanding of biodiversity and the conservation of frogs. Questions were designed by the researcher and an herpetologist in order to:

- establish whether or not the participants were afraid of frogs (Questions 2 and 3)
- establish the reasons for their particular attitude (Questions 3 and 4)
- establish whether or not the participants were aware of the conservation needs of frogs (Questions 5 and 6)
- establish the reasons for the participants' attitude (Question 6)

In order to save time, the questions were structured in such a way that a simple "yes" or "no" answer was required. The reasons for the responses were then elicited by the researcher and recorded during the interviews. The researcher interviewed the participants individually thereby allowing her to clarify the meanings of some of the questions that they struggled to comprehend due to language difficulties.

The participants' reasons for the need to conserve frogs were categorized using Ballantyne and Packers' categorization of concepts (1996, p. 29). This was necessary in order to establish the values, attitudes and content to be incorporated into the lesson design, so as to extend the learners societal role in protecting the environment.

3.1.2 Design and implementation Phase

Constructivism and worldview theory formed the basis of the five science lessons designed for this research. Indigenous knowledge was incorporated into the lesson design in order to foster an appreciation of conservation and biodiversity. The objectives, content and structure of these lessons are detailed in Appendix C. Lessons were conducted over a period of seven days, during which time data were collected by the researcher.

A video recording and transcript was made of Lesson 1 in order to collect data that may have been missed by the researcher/teacher during implementation. Verbal questions were used during the entire lesson to elicit myths and legends and to establish the knowledge base of the participants. **Field notes** were completed at the conclusion of the lesson indicating the success of incorporating indigenous knowledge into this introductory lesson by noting the positive response, enthusiasm and critical questions of the participants. Notes were made concerning the structure, content and implementation of the lesson for future modification.

Group-work and the development of social skills is a constructivist strategy used in the design of the intervention, and the success of its implementation was assessed. During Lesson 2, the researcher moved from one group to the next helping and guiding the participants in the task of preparing the myth presentation . She completed the **Group-work Assessment Sheet** (C2.1) for each group which indicated whether Critical Outcome Two of the RNCS (Department of Education, 2002, p. 7), that is, being able to "work effectively with others as members of a team, group, organisation and community", had been achieved.

Data was collected to assess the constructivist goal of cultivating creative skills and Critical Outcome Five (ability to "communicate effectively using visual, symbolic and/or language skills in various modes" (Department of Education, 2002, p. 7). **The Presentation Assessment Sheet** (C2.2) was completed by the researcher and participants during the presentation of the frog myths. The researcher collected data about the effectiveness of incorporating indigenous knowledge into the science lesson by assessing qualitatively the participants' enjoyment, positive engagement and enthusiasm when dealing with indigenous knowledge during this lesson. These were transcribed in field notes (Appendix D1).

To establish whether "appreciation of conservation" (Research Question 1.2.2) had been achieved by the participants, **paragraphs** written by the participants during Lesson 3, were assessed according to Assessment Sheet (C3.1) and Rubric (C3.2). Evidence of three to four ideas, listed in (C3.1), in the written paragraph was given a score of 3; evidence of only one idea was scored 2, and if participants had missed the point entirely, they were scored 1. Pertinent words for each character in the story, such as "ignorant, selfish and careless" for Nthabi; "wise, advises and responsible" for the frog and "selfish, uneducated and runs away" for the witchdoctor indicated participants' level of understanding of conservation.

Rubric (C3.2) was also used to assess language skills and the ability to follow instructions.

During Lesson 4, participants used a Fact Sheet on Frogs, to help them answer questions relating to biodiversity in **Activity Sheet Using Fact Sheet** (C4.2). To establish whether "appreciation of maintenance of biodiversity" (Research Question 1.2.2) had been achieved, participants' responses to questions in the Activity Sheet, were assessed, using Memorandum C4.3. Participants' responses were scored according to the memorandum and the total number of marks for each question

totaled. These scores were then tabulated (Appendix C4.2) and the number of participants' correct responses analysed. This indicated whether the objectives of the lesson series (of creating an awareness of biodiversity and frogs as endangered species), had been attained. The scores were qualitatively analysed by looking at the class' results as a whole and determining whether the majority of learners had gained anything from the lessons.

3.1.3 Evaluation and reflection Phase

A **structured post-test questionnaire** (Appendix B2), was designed to establish whether there had been a change in attitude towards frogs The participant had to demonstrate whether he/she would pick up a live frog, and answer questions about the role of frogs in the environment and the importance of their conservation.

The participants were interviewed individually by the researcher, *after* the implementation of the intervention (five science lessons). The questions were designed by the researcher and four were identical to those in the pre-test questionnaire, so that any change in attitude could be noted during analysis. There is a design error in the post-test questionnaire in that the data collected would have been easier to analyse if Questions 1, 2 and 3 had corresponded identically to those on the pre-test questionnaire. This only became evident during data analysis.

The response given for Question 1 was compared with those of Questions 2 and 3 on the pre-test questionnaire. The responses given for Questions 2 and 3 were compared with those of Questions 5 and 6, respectively, on questionnaire 3.3.2. Question 5 allowed the participant to verbalise the possible reasons for a change (if any) in his/her beliefs and values. Question 6 allowed the participant freedom to

question the researcher on any aspect of the research thus raising the awareness of equal partnership in the research process.

The participants' present knowledge-base and attitude towards frogs and their conservation was assessed during Lesson 5, by the completion of **Assessment Questionnaire** (C5.1). Memorandum C5.2 was used by the researcher to assess the participants' responses, and their responses to Questions 1, 6, 2 and 4 were tabulated in Table 6 (Appendix D7). Questions 1 and 6 indicated the level of the participants understanding of conservation while Questions 2 and 4 indicated their level of understanding of biodiversity. The reasons given by the participants, for each response was qualitatively analysed by the researcher. If the participant's response to Question 1 indicated that "every organism is as important as the next", or "that all organisms have an equal right to life", they were scored as having a good understanding of the concept of conservation. Similarly, if the participant's response to Question 6 was "all organisms have equal value in the ecosystem" or "there is a balance of nature", this was taken to indicate a high level of understanding. Responses to Question 2 that proposed saving the ocean rather than a city indicated a good level of understanding of biodiversity. Similarly, responses to Question 4 which compared a golf-course to an open field was used to assess the level of understanding of biodiversity. However, this question was inappropriate as many of the participants had no experience of a golf-course. This was brought to the researcher's attention after the research was completed.

3.2 Design of the intervention

The aim of this research was to design a series of science lessons as an intervention to induce a change in the participants' attitudes towards frogs, their understanding of the value of frogs in the environment and the importance of conserving them. The lesson design is based on constructivism and worldview theory incorporating indigenous knowledge.

Motivation for the incorporation of indigenous knowledge arose from several sources: curriculum requirements (Department of Education, 2002. p. 10-12); the call, by political leaders such as Thabo Mbeki, for educators to incorporate IK into school curricula; the desire to design lessons that are more enjoyable and innovative and encourage creativity; and the notion that the learners would relate more easily to the indigenous knowledge, thereby developing a receptive attitude towards science (Odhiambo, 1993, p.2).

The intervention consisted of five science lessons designed to engage the learners in hands-on activities, and to give them the opportunity to re-evaluate and develop their preconceptions in the direction of accepted school science. Various teaching strategies discussed in the literature review, such as laboratory work, thinking and problem-solving skills and questioning techniques, were applied in the lesson structure.

The lessons were based on outcomes from the OBE Grade 7 Natural Sciences curriculum with their corresponding assessment rubrics. Lessons 1 to 4 were 60 minutes in duration while Lesson 5 (Assessment) required 30 minutes.

The constructivist teaching sequence was used as a basis for the design of the lessons and the various phases are discussed below. The sequence is summarised in Table 1, at the end of this discussion.

3.2.1 Elicitation phase

Lesson 1. (See Appendix C1) This introductory lesson introduces the concept of indigenous knowledge to the participants. To build up a rapport with the researcher/teacher, a local Northern Sotho song about frogs was played and the participants encouraged to sing along. Ideas about the interpretation of the song were discussed and terms such as myth and superstition introduced. Frog myths and legends were elicited from the participants as well as a general understanding of the participants' knowledge base. These activities set the stage for the continuation of the lesson.

Live frogs were introduced to determine the participants' reaction to them as well as being used to lead a discussion on the origins of myths and superstitions. The rationale behind superstitions was brainstormed. Homework assignments were issued to the participants. Firstly, they had to plan and prepare frog myth presentations which would be staged during the following lesson. Secondly, to increase the data-base of indigenous myths, legends, beliefs and superstitions regarding frogs, participants documented indigenous knowledge gained through interviewing their parents, grandparents and great-grandparents.

3.2.2 Exploration phase

Lesson 2. (Appendix C2) The activities performed by the participants during this lesson encouraged discussion about myths and their scientific origins in a

comfortable but stimulating atmosphere. This was an enjoyable learning experience which should provide positive motivation in the future, when the participants are exposed to further experiences and knowledge beyond the scope of these research lessons.

During part of this lesson, groups prepared their frog myth presentations, which were then staged in front of the class.

Teacher assessment of co-operative group skills took place during the rehearsals, using Assessment Sheet 1 (Appendix C2.1). This encouraged the participation of group members and enhanced social skills such as listening, praising, encouragement and politeness. These four social skills were chosen to assess the eight groups' co-operative abilities. Five task skills were also assessed. Time constraints did not allow for further assessment.

As a teaching instrument this lesson was successful as the participants were familiar with this type of assessment and responded well, even though there was no time for feedback. As a research instrument the lesson was useful as it indicated whether this type of strategy (group-work) could effectively incorporate indigenous knowledge into the lesson.

Myth presentations were assessed by researcher/teacher, a Grade 7 colleague and by the participants, using Presentation Assessment Sheet 2 (Appendix C2.2). Criterion-referencing was used to establish the level of each group's understanding of the scientific origin of each myth. Presentation/language skills, namely creativity, coherence and organisational skills, speaking skills and audience response, were also assessed. The latter were included in order to assess the participants' language proficiency and organisational skills, and the extent to which

they had been able to exercise their creativity in their myth presentations. Audience response gave an independent indication of the quality of the presentations.

Lesson 3. (Appendix C3) Participants were introduced to the relationships that exist between science, society and the environment. A story set in a traditional, rural environment, describing the effects of scientific and technological development on the environment and man's approach to these effects, was read aloud by the participants. The use of a story-based lesson as a method of instruction is recommended by O'Donoughue and Neluvhalani, who state that:

> "exposure of learners to indigenous knowledge in the form of interpretative texts seemed to enable learners to mobilise and narrate other and wider aspects of common-sense practices, past and present. What appears to have helped these learning activities is how meaning-making was made explicit amidst the interplay of story and interpretation in the text. This "method" seemingly "gave away interpretative tools" for probing aspects of other common-sense wisdom in indigenous and everyday practices" (O'Donoughue and Neluvhalani, 2003, p 131).

Participants each described the role of one of the characters in the story. This activity gave the researcher/teacher insight into how the participants perceived relationships between the characters, the responsibilities of the characters towards their environment and enabled the researcher/teacher to assess their understanding of the concepts underlying the story.

Assessment Sheet 3 (Appendices C3.1 and C3.2) were used to assess the level of understanding reached by the participants, of the concepts illustrated in the story,

as well as their sentence fluency, word choice and ability to follow instructions. The language fluency and comprehension skills of some of the participants limited the expression of their understanding but a general impression could still be obtained from their writings.

3.2.3 Application phase

Lesson 4. (Appendix C4) Participants viewed a video clip of research being conducted on the South African bullfrog by a student of the University of Pretoria. This activity provided, in an engaging way, the information that the issue is locally salient, shows role models with whom the learners can identify, and explicitly demonstrates one way of actively pursuing environmental conservation. A class discussion on the video clip highlighted the reasons for the bullfrog being listed as an endangered species.

A fact and opinion sheet (Appendix C4.1) was used by the participants to provide more information about frogs, threats to their continued existence and strategies adopted by South African authorities with a view to conserving them. The participants completed Activity sheets (Appendix C4.2) that were designed to promote the interpretation, processing and application of this information, so that their learning experience could be consolidated and become meaningful in the long term.

The questions used in this activity were adapted from the worksheet by Bailey (1994, p. 19) which are specifically designed for assessing critical thinking skills. The type of questions on the questionnaire are open-ended, requiring a brief statement or list of concepts. A few are composite questions, revolving around one particular concept, such as Noah, his Principle and how this correlates with the

present drive to protect and conserve our earth's biodiversity. All the answers to the questions on the activity sheet could be found on the fact and opinion sheet. The effectiveness of the activity sheet was, once again, limited by the participants' reading and comprehension skills. A memorandum was used to assess the participants' responses (Appendix C4.3).

This assessment was useful, both as a teaching and as a research instrument, as an indicator of the knowledge-base of the participants as well as the effectiveness of the structure and content of the lessons.

3.2.4 Evaluation phase

This phase comprised activities aimed at establishing whether there had been a conceptual change in understanding and attitudes. Methods aimed at inducing change may include mere exposure to or contact with the object (in this research, a frog), which may in some circumstances be sufficient to enhance the participants' attitudes toward the object; presentation of information to correct attitudinal misconceptions (science lessons administered to participants); demonstration of the relationship between the topic and others valued by the learner (indigenous knowledge); and observation of the attitudes and behaviour of an emotionally positive model (the researcher/teacher) (Adapted from Ballantyne and Packer, 1996, p. 30).

The methods used by the researcher in this phase included questions asked at the end of each lesson by the researcher/teacher, that gave the participants an opportunity to reflect on and consolidate any learning that had taken place during this and previous lessons. This also indicated to the researcher the effectiveness of each of the four lessons designed.

During Lesson 5 (Appendix C5), an assessment questionnaire (Appendix C5.1), was completed by the participants and later analysed by the researcher, to determine whether they had changed their attitudes towards frogs and whether they had a better understanding of conservation and biodiversity.

True/false questions gave participants the opportunity to explain the reasons for their choice of answer, and enabled the researcher/teacher to determine whether they had obtained the desired level of understanding of the concept of conservation. Simple questions often allow the analysis of the participants' reasons and reveal whether their understanding is superficial, or indicative of genuine insight. An example of a superficial answer to the question: "A lion is a more important organism than a frog", is, "A lion is just part of the food-chain and frogs can do more for us". An insightful response is, "All organisms provide a balance in the environment" or "All animals have a right to life".

A memorandum was used to assess the participants' responses to the 10 questions (Appendix C5.2). Questions 2 and 6 were used to evaluate the participants' level of understanding of conservation. From the responses it could be established whether they understood this concept. Questions 1 and 4 indicated whether the participants understood the concept of biodiversity.

Table 1: Design of lessons (Elicitation Phase: Lesson 1; Exploration Phase: Lessons 2 - 3; Application Phase: Lesson 4; Evaluation Phase: Lesson 5)

Lesson	Objectives/Activities/Instruments	Outcomes
1 Elicitation	Introduce concepts of indigenous knowledge and myths (LO 3, p.10)	Use an indigenous song to introduce the topic Class discussion about myths and legends to introduce indigenous knowledge into the science context
	Introduce live frogs	By looking at live frogs, get learners to speculate on the possible origin of the myth that frogs give one warts. Also this gives them an opportunity to handle frogs in a safe environment and so start to dispel their fears
	Compare frog myths of various cultures (LO 1, p.8; LO 3, p.59) To increase the data base of frog myths (LO 3, p.10) *Instrument:*Field notes, video transcript (D1)	Give different groups myths from various cultures to present as drama presentations to allow them to compare indigenous knowledge from other countries
2 Exploration	Learners interact in groups (CO 2, p. 3 and 7) Learners become aware that all cultures have myths about frogs (LO 3, p.59)	This activity creates a fun atmosphere; encourages discussion about myths and their origins in a stimulating environment. Group-work skills assessed to enhance social skills and participation by all learners
	Learners cultivate creative skills through presentations (CO 5, p.7) Enable learners to present scientific knowledge through indigenous knowledge (C) 3, p. 7)	Presentations assessed both by researcher/teacher and learners to establish level of understanding of myth origin as well as learners' creativeness; coherence, organisational skills and speaking skills

	Instrument: Group-work assessment Sheet(C2.1) Myth presentation Assessment (C2.2)	
3 Exploration	Introduce inter-relationships between science and society (LO 3,p.11) Learners describe the role of one of the characters in the story (interpretation of information, LO 2, p.10) Learners identify positive and negative effects of science development and technology on the environment (LO 3, p. 59) Learners share their information with others in small groups (comparing, LO 1, p.8) *Instrument:* Paragraph Assessment (C3.1) and Rubric (C3.2)	Learners read a conservation story aloud (keep focussed) How learners perceive different characters in the story, the responsibilities of the characters towards the environment and the underlying concepts of the story, assessed. Language fluency, comprehension skills also assessed Each learner is a different character and must exchange views with others to induce argument and discussion
4 Application	Show learners a video on South African bullfrog research Learners acquire information about frogs as an endangered species by using a Fact Sheet and Questionnaire (LO 2, p. 10) *Instrument:* Activity Sheet (C4.2) and Memorandum (C4.3)	To motivate learners into wanting to know more about endangered species and the role they can play in protecting the environment Knowledge was acquired and the learning experience consolidated and made meaningful This exercise was assessed using rubrics
5	Evaluation of the learners'	True/False questions with an explanation

Evaluation	understanding of conservation in general *Instrument:* Assessment Questionnaire (C5.1) and Memorandum (C5.2)	(reason) for each answer will give teacher/researcher insight into the level of understanding of learners towards conservation

3.3 Sample

The sample consisted of a class of 34 Grade 7 learners from a local school in the Polokwane area. Permission had been previously obtained from the school administration for this research to be conducted on the school property. Grade 7 was chosen because the content of the syllabus is relevant to this topic, i.e. conservation of biodiversity.

This particular class was chosen to participate in the research as it comprises learners with different ethnic backgrounds, with the majority of learners having a Northern Sotho background. This is important, as the inclusion of indigenous knowledge into the lessons, will mainly be that of the Northern Sotho ethnic group. The learners will also be exposed to indigenous knowledge from other countries, which will allow them to make comparisons of other indigenous knowledge systems.

Another reason for choosing this particular class was that they are very receptive to stories, problem-solving and new ideas, and are at an age where they can be most active in conservation if their energies are channeled in the right direction.

The researcher has had no prior contact with this particular group of learners except for obtaining their permission to be involved in this research project and

the exploratory interviews to establish the learners' attitudes towards frogs and their understanding of the value of their conservation.

The research was conducted at the school where the researcher is an educator thus facilitating access to the participants and their families, as well as being familiar with their backgrounds and the organisation of the school.

3.4 Ethics

The subject matter of this research forms part of the school syllabus and as such neither requires ethical approval from the university nor parental consent. However, the parents were informed about the research to be conducted and assured that the learners' performance would be anonymously used as data. Permission to conduct this research was granted by the school's management and the learners had volunteered to participate. The identity of the participants and the school where the study took place will remain confidential. The results of the investigation will be reported in a Masters mini-thesis and may be used by other educators to help incorporate indigenous knowledge into their classroom teaching.

Chapter 4. Results, Data Analysis and Discussion

4.1 Exploration Phase

4.1.1 Interview Schedule (A1)

A resource of indigenous knowledge myths, stories, beliefs and superstitions (Appendix B2) was compiled through interviews with 26 members of the local Polokwane community (Appendix D4). The sample comprised elders as well as learners from the Pedi ethnic group. Data revealed that 75% of the interviewees held certain beliefs about frogs that resulted in a lack of awareness of the value of frogs in the environment (except as a food source) and the need to conserve them.

4.1.2 Pre-test Questionnaire (B1)

Data pertaining to 33 learners'/participants' attitudes towards frogs and their value in the environment was collected from the pre-test questionnaire (B1). The data were analysed by calculating the % negative responses to four of the questions in the pre-test questionnaire (n=33) and tabulated below (Table 2).

Table 2 Participants' responses to the diagnostic pre-test questionnaire (Appendix B1)

Question	Responses (n=33)		% negative responses
	Yes	No	
Would you pick up frog	16	17	52
Are you afraid of frogs	13	20	39
Are frogs useful	18	15	45
Should frogs be conserved	29	4	12

The analysis of the data in Table 2 shows that a significant percentage of participants were afraid of frogs (39%), and/or would not handle them (52%). Participants gave various reasons for their fear, such as "they are lumpy, slimy and look ugly"; "they jump and scare me", or could offer no explanation, e.g. "I just am, and don't know why". Another factor evident from the results, was that 45% of participants attached no value to frogs in the environment. The data confirm the expectation that learners had a negative attitude towards frogs and are unaware of the value of frogs in the environment. Thus, the intended intervention, with the stated intention, made sense. The setting was therefore, conducive to answering the research questions and an opportunity to "acquire knowledge, values/attitudes, commitment, and skills needed to protect and improve the environment" (UNESCO 1977, as quoted by Ballantyne & Packer, 1996, p.25), was provided to the learners.

Although the results show that 45% of the participants attached no value to frogs, it did not necessarily follow that they saw no reason for conserving them: in fact, 88% of the participants felt that frogs should be conserved. The participants'

reasons for the need to conserve frogs (Question 6) were analysed and categorized according to Ballantyne and Packers' categorisation of conceptions (1996, p. 29).

The categories of conceptions are:

- *The egocentric conception.* Protection of the environment is important to preserve individual health, safety or quality of life. Concerns about environmental problems are immediate and local. The environment is seen as something to be used.

- *The guardianship conception.* Protection of the environment is important for the future of one's children and the survival of the planet. Individuals have a responsibility to ensure that future generations will be able to enjoy the environmental benefits that exist at present. Concerns about the environment are long-term and global. The environment is seen as something to be managed to ensure a sustainable future.

- *The ecocentric conception.* The environment is seen to have inherent worth and a right to exist, not merely because of its necessity for human life. People are not perceived as superior or separate from the environment, but rather harmony and balance in people-environment interactions are emphasized as essential for ensuring the future survival of both people and the environment. Concerns about the environment are complex issues of interrelationship.

82% of learners' responses could be categorised either as egocentric conceptions, for example, "one day they will look after us" and "maybe we can use them for medicines", or as guardianship conceptions, for example, "want our kids to see them" or "what if there are no more frogs around, our kids won't know what a frog is". 18% of the responses had a religious foundation, such as "God made them and so we must protect them', "we are all God's creature and they also deserve to live"

and "the Bible says that we must not kill, so I won't kill a frog". These accounted for the observation that while 45% of learners were unable to conceive of a useful purpose of frogs, 88% still felt that they deserved protection.

The categorization revealed a need to incorporate into the lesson design one of the goals of environmental education, namely: "to enable learners to develop a responsible environmental behaviour" (Howe & Disinger, and Hungerford & Volk, as quoted by Ballantyne and Packer, 1996, p. 25).

4.2 Implementation Phase

4.2.1 Transcript of video recording, field notes, observations (D1)

Analysis of the field notes, the transcript from the video of Lesson 1, lesson assessment sheets and observations made by the researcher, showed that a large proportion of the participants had enjoyed the lesson series and that learning had taken place as indicated by the positive change in attitudes (see 4.4.1).

One of the more successful activities was group work, in which discussion and argument were initiated and led to the formulation of questions. The constructivist approach worked well as the hands-on activities were enjoyable, and thus facilitated learning. These activities led to the acquisition and improvement of a number of skills (see 4.2.2).

However when more abstract concepts such as the definition of the terms "myth" and "legend" in Lesson 1, were introduced, the learners/participants lost interest and their attention waned. This only emphasises the value of learner participation

4.2.2 Group-work (C2.1) and Myth Presentations (C2.2)

The informal group discussions during lessons gave the learner/participants an opportunity to brainstorm various ideas and allowed shy learners to become involved. Assessment of group-work showed that this constructivist teaching strategy also enabled learners to learn social skills while being involved in a task. Science lessons were equated with having "fun" and the positive attitude of learners towards their tasks enhanced the learning process. Indigenous knowledge was positively received as indicated by the type of questions participants asked the researcher during group-work. For example, "where did you find these frog myths?", "how come other cultures have similar stories about frogs?" and "can you prove these myths to be true?".

Incorporation of indigenous knowledge into the lesson series elicited many questions from the participants showing that they were thinking critically about the information presented to them. Enacting the frog myths enabled learners to use their creative skills, language proficiency and their enjoyment of drama.

4.2.3 Written paragraph (C3.1, C3.2)

The participants' written paragraphs concerning the role of the various characters in the conservation story, were assessed by the researcher using assessment ideas (Appendix C3.1) and the rubric (Appendix C3.2). The participants' scores were recorded in Table 3 (Appendix D5). Aspects assessed were: ideas and understanding; sentence fluency; word choice and following of instructions.

The criterion used to differentiate between the different levels of with regard to understanding the concept of conservation, was the number of valid ideas put

forward by participants. Three to four valid ideas scored 3 points. For example, when describing the frog's role, if the participant had written that the frog warned both other characters about the disaster, suggests a more scientific approach to solving the problem and that one should not run away from global problems, he/she would be scored 3 points. On the other hand, if the participant wrote only that the frog warns others of the disaster, he would score 1 point.

The participants' language proficiency (sentence fluency and word choice) was scored by reading the paragraph and allocating a score of 1-3 according to the criteria listed in each level on the rubric (C3.2). This was difficult to quantify and therefore more subjective.

Analysis of participants' scores in Table 3 revealed that only seven participants had a clear conception of conservation indicating the need for further interventions to address this deficiency.

4.3 Application Phase

Activity Sheet Using Fact Sheet (C4.2)

During this phase, participants were given the opportunity to consult a Fact Sheet containing information about frogs, and apply the knowledge gained from the lesson series to answer an Activity Sheet pertaining to conservation (C4.2). The questions were designed to assess critical thinking skills and indicated the level of understanding of conservation, attained by the participants.

Participants' responses to the five questions on the Activity Sheet, were assessed using Memorandum C4.3. In order to establish whether there had been a positive

change in attitude towards the conservation of frogs, the participants' raw scores for this activity were analysed.

The data from this activity are unreliable as the participants' responses were influenced by their competency in skills such as fluency in English, reading, comprehension, applying knowledge and reasoning. Therefore, further analysis of this assessment has not been attempted.

Even though analysis of this Assessment Sheet provided the researcher with little evidence that there had been a positive change in attitudes, the activity itself enabled learners to increase their knowledge-base pertaining to frogs and their conservation. Learners were actively engaged in critical thinking which is one of the goals of constructivism and hence, related to the research question.

4.4 Evaluation Phase

4.4.1 Comparison of Pre- and Post-test Responses (D5)

Participants' responses to four questions on the pre- and post-test questionnaires, relating to their fear of frogs, value of frogs in the environment and the need to conserve frogs, were tabulated in Table 4 (Appendix D6). These responses were analysed and summarised in Table 5 below:

Table 5 Analysis of data from Table 4 (D6)

Questions	Participants response:	Number of participants (n = 33)	Number of participants ÷ n x 100 = %
Would you pick up a frog?	remains positive	15	45
	remains negative	6	18
	changes from positive to negative	1	3
	changes from negative to positive	11	33
Are you afraid of frogs?	still not afraid	14	42
	still afraid	2	
	changes from unafraid to afraid	6	18
	changes from afraid to unafraid	11	33
Are frogs useful?	remains positive	18	54
	remains negative	2	6
	changes from negative to positive	13	39
Should frogs be conserved?	remains positive	29	87
	remains negative	0	0
	changes from negative to positive	4	12

The results indicate a 33% positive change in the participants' willingness to handle live frogs. A small number of participants (18%) still exhibited a negative attitude.

There was also a marked reduction (33%) in the participants' fear of frogs (a positive change). An unexpected result was that six participants (indicated N* and Y* in Table 2), had changed from being initially unafraid to being afraid. The reason for this negative change may have been due to the newly acquired knowledge that "some frogs are poisonous" and that now the participants "were scared of frogs because they are poisonous" (responses to Question 1 on the post-test questionnaire). The participants had been shown one of the few poisonous South African frogs during the science lessons.

There was a significant positive change in attitude (39%) regarding the role frogs play in the environment.

In the post-test interview, participants were asked whether they thought they had changed their attitude towards frogs since the beginning of the lesson series. If their response was yes, they were asked what they thought the reason was for this positive change. Responses such as "I have learnt so much about frogs, touched one and now am not scared", "I know more now", "We saw a video about why we must protect frogs and now I will", indicated that an increase in factual knowledge, exposure to live frogs as well as video clips all played a role in changing attitudes.

It is interesting to note that most of the participants indicated that the lessons they enjoyed most (Question 7 on the post-test questionnaire), were Lesson 1 (indigenous knowledge) and Lesson 2 (presentation of indigenous myths).

4.4.2 Final Assessment Questionnaire (C5.1)

The final assessment of the participants' level of understanding of the conservation of frogs and biodiversity, took the form of an analysis of the responses to four out of the ten true/false questions on the Assessment questionnaire (Appendix C5.1), using a memorandum (Appendix C5.2). The results are recorded in Table 6 (Appendix D7).

The responses to Question 1 (A lion is more important than a frog) and to Question 6 (Humans should protect only those organisms that are useful to mankind) were qualitatively analysed to assess the participants' understanding of conservation. Responses such as "False, they are all equal", "False, without frogs we won't know when our water is polluted", "False, every organism is as equal as the next" and "False, all organisms are useful, we just don't know what some of them are useful for!" indicated a relatively high level of understanding of conservation.

The responses to Question 2 (Given the choice between saving a city or an ocean, it is preferable to save a city), such as: "False, we can build cities but if we destroy the ocean we will kill all the sea creatures"; "False, the ocean gives us oxygen and we would die if we didn't save it"; "Cities are full of people but the ocean has many, many different animals which need to live as they are part of a food chain", indicated a fairly high level of understanding of the concept of biodiversity.

Similarly, answers to Question 4 (A golf course is more beautiful than an open field), such as "False, a golf course has no animals only mowed grass", "False, in a field there are many more animals than just grass and some trees" and "False, a golf course destroys habitats and has few natural things in it" were taken to indicate a fairly high level of understanding of the concept of biodiversity.

These analyses show that the participants had improved their understanding of the concepts of conservation and biodiversity: in other words, significant experience and learning had resulted from the lessons designed for this research.

4.5 Limitations

PAR is labour intensive and takes a long time to complete: the research was restricted to a single school term and it was thus not possible to monitor long-term changes in the participants; also it was not possible to include a control group, due to insufficient time and the labour-intensive nature of the research.

One of the limitations of participation observation research, is validity. The fact that the observer (researcher) is forced to rely almost exclusively on his / her own perceptions, means that the approach is to some extent subjective. It is difficult for the researcher to remain objective as she becomes part of the total situation and forms a close relationship with the participants.

Another limitation is that of reliability, as it is difficult for the researcher to ensure that his/her findings are valid and not merely the effects of chance i.e. the findings can be too generalised and this can be an obstacle in participation-observation research.

Chapter 5. Conclusion

A number of lessons were learnt from designing the intervention for this research project. Firstly, there is a dearth of information on indigenous knowledge in South Africa. Therefore the onus is on the teacher to source the raw data. This is time consuming, but can be achieved by conducting interviews with members of the relevant communities, as this knowledge is passed on orally rather than being recorded in a written form.

Secondly, the curriculum offers no guidance as to how IK should be incorporated into the lessons. There is a danger, as was the case in this study, that the perspective of Western science is so far removed from the mythological perspective of the indigenous peoples that the two are completely incompatible. The lessons therefore had to be designed in such a way that the Western scientific perspective did not dominate at the expense, or to the detriment of the other worldview. This problem was overcome by the researcher, by incorporating examples of beliefs and mythological explanations relating to frogs from many different cultures, including Western cultures, many of which have survived to the present day. This focused the learners' attention on the origin and function of myths and beliefs, rather than on the cultures in which they were found.

During the implementation process, it was difficult to make objective observations because the researcher who designed the lessons was also the teacher who implemented them. However, it was clear to the researcher that learners responded to the indigenous knowledge content of the lessons and remained enthusiastic throughout the lesson series. This impression was supported by the grade-7 colleague who attended some of the lessons and by the responses of the learners to questions in the post-test questionnaire.

The constructivist approach lent itself to the use of a variety of teaching and learning strategies which encouraged the learners to be creative, think critically, apply their knowledge and communicate effectively. The various assessments showed that the use of strategies and instruments such as dramatization, the use of live material in practicals, group work, video clips and story telling, provided the learners with additional experiences, created a more stimulating environment, and facilitated the learning process.

These findings relate to the first objective of this research project, viz: "How may constructivism and worldview theory inform the design of science lessons that integrate indigenous knowledge into the Grade 7 Natural Science curriculum?"

The lessons learnt from evaluating the ensuing learning, pertained mainly to the effectiveness of the assessment instruments. Errors in the design of these instruments became apparent only after implementation of the intervention had taken place. The assessments of group work, presentations and the learners' application of knowledge which assessed social and communication skills, were adequate. However, the assessment of essay-type questions aimed at gaining insight into the level of understanding of conservation attained by learners, was subjective and language dependent. In the case of the final assessment sheet the researcher experienced difficulty in assessing the responses to the questions as some of them were not well structured and unambiguous and did not lend themselves to qualitative analysis.

The post-test questionnaire showed that experiences and learning relating to the importance of conservation and the need to maintain biodiversity, had resulted from the series of lessons designed by the researcher. There had been a positive

change in their attitudes towards frogs and they had increased their knowledge of frogs, the role they play in the environment and the importance of conserving them. Therefore it appears that the use of indigenous knowledge in science lessons and of constructivist principles in their design, achieved the second objective of this research project.

The researcher found that hands-on strategies were more effective than those in which the learners played a passive role, and that the introduction of indigenous knowledge was useful in bridging the gap between differing worldviews. With regard to assessment, she found that data collected from individual pre- and post-test interviews were more reliable than other forms of data capture, but interviews are more time consuming to execute. Assessing an emotive feeling, such as "appreciation", appearing in the research question requires a specialised assessment instrument and further research is required in this area.

The researcher has shown that by introducing indigenous knowledge in a series of science lessons, using constructivist principles, and acknowledging the existence of differing worldviews, it is possible to expose learners to positive and effective learning experiences that foster the development of an appreciation of the importance of conservation and the need to maintain biodiversity.

Areas that require further research include a database of local indigenous knowledge that teachers could use when designing science lessons and the development of effective assessment instruments for measuring the extent to which learning has taken place.

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INDIGENOUS KNOWLEDGE QUESTIONNAIRE ABOUT FROGS **A1**

Name: …… M / F Age Group: ……

Ethnic group: …… Place of birth: ……

Where have you lived most of your life? …… R / U

Present place of residence: ……

Frog recognition	Recognize	Name	Information
1. Olive toad	Y / N	……Y / N	
2. Red toad	Y / N	……Y / N	
3. Bullfrog	Y / N	……Y / N	
4. Rain frog	Y / N	……Y / N	
5. Tremolo Sand Frog	Y / N	……Y / N	
6. Banded Rubber frog	Y / N	……Y / N	
7. Common River frog	Y / N	……Y / N	
8. Platanna	Y / N	……Y / N	
9. Common Caco	Y / N	……Y / N	
10. Chiromantis nest	Y / N	……Y / N	
11. Chiromantis	Y / N	……Y / N	
12. Tadpole	Y / N	……Y / N	

Frogs as food

1. Do you eat frogs? Y / N
2. If not, why not? ……
3. Do you know of anyone who eats frogs? Y / N Who? ……

Fear of frogs

4. Are you afraid of frogs? Y / N. If so, why? ……
……

5. Would you pick up a frog in your hand? Y/N If not, why not?
……

6. Are frogs poisonous or dangerous in any way? Y/N Explain:
……

7. Are frogs used in witchcraft? Y/N Explain: ……
……
8. They say that frogs attract snakes to the house – is this true? Y/N

9. Why do frogs call at night or after rain? ……
……
10. How do frogs breed (reproduce)? ……
……

11. What are tadpoles? ……

12. Are frogs of any use to us? ……

13. Are you aware of any stories (myths or superstitions) about frogs, eg. did your parents or grandparents teach you anything about frogs when you were young?

……
……
……
……
……
……
……

CHART OF FROGS **B2**

INTERVIEW TO ASCERTAIN THE LEARNER'S ATTITUDE TO FROGS. **B1**

Name:……**M / F** Age group:……

Ethnic group:……Place of birth:……

Where have you lived most of your life?……**R / U**

1. Have you ever touched a frog? **Y / N**
2. Would you pick up a frog? **Y / N**
3. Are you afraid of frogs? **Y / N** If so, why?……

……

4. Do you think frogs are poisonous or dangerous in any way? **Y / N**
   If so, how?

   ……

   ……

5. Do you think frogs are of any use to us? **Y / N**

   If so, in what way?……

   ……

6. Do you think frogs should be conserved or protected? **Y / N**

   If so, why?……

   ……

7. Do you think elephants should be conserved or protected? **Y / N**

   Why?……

   ……

8. (Depending on response to 6. & 7.) Why should elephants be protected and not frogs? OR Why did you immediately say 'yes' to 7. but had to think about 6.?

   ……

INTERVIEW TO ASCERTAIN THE CHANGE, IF ANY, IN ATTITUDE TO FROGS **B2**

1. Do you think frogs are animals to be afraid of? **Y / N**

If **yes**, why?……

Pick up the frog **Y / N**……..……

2. Do you think frogs are of any use to us? **Y / N How?**……..

……

3. Do you think frogs should be conserved or protected? **Y / N Why?**……..

……

4. Do you think you have changed your attitude since the beginning of these lessons?
Y / N Explain……

……

……

5. If **yes**, what do you think was the reason of your change in attitude? (What caused you to change your attitude?

……..

……

6. Is there anything you would like to ask me?……..

……

7. Which of the five lessons did you enjoy the most?……

……..

LESSON 1: Introduce the concept of endangered species using indigenous knowledge. **C1**

Class organization: Eight groups of four learners in each.

Resources needed: Song sheet; questions relating to the song; live frogs in plastic bags; overhead transparency of definitions of myths & superstitions; homework activity sheets.

What are the outcomes for this activity?

1. Introducing indigenous knowledge into the science context.
2. Enable learners to interpret and compare information.
3. Understand through physical contact with live material, the origin of a frog myth.
4. Enable the learner to become aware that all cultures have myths / superstitions.

What will be done to achieve this learning?

1. Learners will listen to a Northern Sotho song about frogs.
2. Learners will analyze the poem by answering two questions and compare their answers to a linguist's interpretation.
3. Learners will be exposed to different definitions of myths / superstitions.
4. Learners will observe a live frog in a plastic bag to try and work out the origin of a frog myth.
5. Learner's will be given one of eight frog myths to plan and prepare a presentation (story, poem, rap song, play or dance).
6. Learners will interview parents, grandparents & elders to document any frog myths, superstitions or beliefs that they may have at their disposal.

Teacher's notes:

1. Type N. Sotho song and the interpretation by a linguist.
2. Record Gr. 11's singing the N. Sotho song.
3. Type the activity sheet.
4. Collect 8 live, non-jumping Breviceps (frogs) in plastic bags.
5. Make overhead transparency of definitions of myths and superstitions.
6. Type eight myths with instructions on separate sheets.

How will the learner achievements be assessed?

1. Oral assessment of learner's ability to answer questions on myths.
2. Assessment of learner's interpretation of N. Sotho song.
3. Observe if learners can engage in discussion.
4. Collection of local myths, superstitions, or beliefs will be printed as a booklet to be used in classroom practice.

Lesson procedure:

Turn over the paper on your desks. Here is a Sotho song about frogs, which was probably taught to you by your grandparents or parents or you might have learnt it at Nursery School. Do any of you know this song? *Response* Who learnt it at Nursery School? *Response* Whose grandparents or parents taught it to them? *Response*
I will play this song sung by the Grade 11's and I want you to sing along. It is sung twice and therefore those who don't know it can pick it up and join in. *Play tape. Sing*
Northern Sotho Song:
Segwagwa ! Segwagwa ! Segwagwa !
Sa re go nna! sa re go nna! sa re go nna!
Sa re mpepu ! mpepu ! mpepu !
Nna ka gana ! ka gana ! ka gana !
Sona sa lla ! sa lla ! sa lla !
Sare gwaa ! gwaa ! gwaa !

Do any of you know what it means? *Response*
Can someone interpret it for me? *Response*
Here is the interpretation of the song. *Overhead projector*

Segwagwa
The song is about a frog asking a child to carry it on the child's back.
The child immediately refuses causing the frog to feel sad.
The frog cries, cries and cries.
In your groups discuss the meaning of this song.
Here are a few questions to guide you in your discussion. *Hand out activity sheet*

Segwagwa Activity Sheet:
The song is about a frog asking a child to carry it on the child's back.
The child immediately refuses causing the frog to feel sad.
The frog cries, cries and cries.

1. Why do you think the frog wants to be carried on the child's back?……

…….

…….

2. Why do you think the child refuses?……

…….

…….

Now here is a detailed interpretation of this poem by Mr. Mphalehle, a linguist (a person who studies languages). *Hand out interpretation or put on overhead transparency. Read it to the class*

Interpretation of song: (Overhead transparency)
The frog is seen as a very hospitable creature and it wants to live together with human beings. It appears that humans are afraid of this creature although the reason is unknown. The frog is always seeing the child being carried on the back of the elderly or the parents. Therefore, the frog wants to emulate the actions of the child's parents.
The overall meaning of the song is that the frog is depicted as a friendly creature willing to live with the young child.

Did any of you interpret the song in the same way? *Response*
Why do you think the writer wrote this song? What inspired him to write these words? *Response* Frogs enter houses to catch insects, for water and protection. Perhaps they are killed by the owners or thrown out and the author wanted to protect frogs in some way.

Well, we are exposed to frogs from a very early age, even as early as Nursery School or before. When I was a child, my mother told me not to touch a frog. Have your parents told you not to touch frogs? *Response*
What could be the reason for that? *Response*
Well, my mother, who had not studied biology at school, believed that if you touched a frog you would get warts on your hands.
Do you know what warts are? *Response*
Warts are hard little bumps which usually occur on your fingers.

I'm going to give each group a live frog in a plastic bag. This is the best way to observe a frog as it cannot jump away and you don't have to be afraid of it. *Hand out frogs*
Look at the frog closely and tell me from your observations, how my mother came to believe that frogs cause warts. *Response*
(If necessary, show learners the bullfrog with the very lumpy skin).

Frogs have very lumpy skins and this is possibly why the myth or belief that warts are caused from touching a frog's skin, arose. Frogs skins have sometimes been described as warty looking as the skin has the same appearance as warts. Actually, warts are caused by a virus. Colds, flu and Aids are a few diseases caused by viruses.
Collect frogs put them in coldbox

So you see, my mother was not stupid, but **uninformed**. She was not aware of the latest medical knowledge about warts and probably heard this myth from **her** mother. In such a way, many myths, beliefs, legends and superstitions are passed on from one generation to the next. Many myths and beliefs arose from a happening or event that was explained to the community using the knowledge that was available at that point in time. It's not to say that the myth or legend is now incorrect, only that more knowledge has been gained and perhaps can be used to come to a better understanding of the myth.

For interest, I looked up on the internet and found these interesting definitions of myth and superstition: *Place on Overhead projector*

Definitions:

Myth: 1. Myth is the earliest form of science. It gives speculation on how the world came into being.
2. A myth is something that only begins to work where our own senses end.
3. Myths are the earliest forms of literature, which began as literature by word of mouth i.e. orally
4. Myth is the "glue" that holds societies together; it is the basis of identity for communities, tribes and nations.
5. The patterns, stories, even details, contained in myth is a shared heritage of ancestral memories, related consciously from generation to generation.

Superstition:

1. Superstitions are culturally based.
2. They define growth and evolution within our cultural framework. Almost every culture is driven in some sense by superstitions and beliefs held by the group.
3. Superstitions say a lot about who we are, how we feel and think about the world.

Superstitions, beliefs and myths must have had some origin. What I mean is, they must have originated due to a certain circumstance, action, event or even been created by elders of the community to safeguard the people. For instance, a common Western superstition is that it is **unlucky** to walk under a ladder.
Do you think this is true? *Response*
It might be true, because if someone is painting on the ladder and you walk beneath it, you might get splashed with paint. Therefore, this might be just a common sense superstition to safeguard you from being hurt or suffer some kind of inconvenience.

Homework:

1. During the holidays, you are to interview your parents, grandparents and adult friends to find out if they know any frog myths, legends or superstitions. Write them down and hand them in after the holidays to be bound into a booklet.

2. I am going to give each one of you a myth or superstition about frogs from different cultures from all over the world. Read the myth given to you and try and work out what the possible scientific origin of the myth could be. Think about how you could present this myth in such a way as to inform the rest of the class the meaning and origin of your myth.

Hand out a myth / legend to each group.
Frog Myth presentation:

Instruction:

- Read the following myth.
- Think about its meaning.
- Think about the possible scientific origin of the myth.
- Think about how you could convey the meaning and scientific origin to the rest of the class.
- Tomorrow you will discuss and prepare a story, play, poem, rap song or dance to present to the class.

INDIA: In India tales refer to the secret of immortality as being a fungus growing from the forehead of a toad.

CHINA: Many legends involve a wandering man called Liu Hai and his 3-legged toad, Ch"an Chu. The toad knows the secret of eternal life and for his friendship, reveals the secret to the wise man. Liu Hai is the God of Wealth. The frog would convey him to any place he wanted to go. Occasionally the frog would escape down a well, and Liu Hai would lure it out with gold coins. The toad is a symbol for riches, and is most often pictured with a gold coin in its mouth.

JAPAN: It is told that there is a hunchback called Gama-Sennin. He has a warty face and has a toad for a companion. He wanders over the land with his warty companion, who teaches him the secret powers of herbs and immortality.

BOLIVIA: Frogs and toads were seen as spirits of rain, used in many rituals intended to bring rain. The Aymara tribe of Peru and Bolivia made small frog images and placed them on hill tops to call down the rain. If no rain came, some tribes blamed the toads and lashed them in punishment.

MEDIEVAL EUROPE: Toads were believed to be evil creatures whose blood was a potent poison and whose body parts had strange powers. Ancient Greek writers believed that a toad in a room will silence a room full of people. they also believed that a small bone from a toad's right side will keep water from boiling; a bone from the left side will repel the attack of dogs.

SOTHO: If you hear loud frog calls at night, it means good rains are going to fall. Also, if a bed-wetter takes a frog and boils it and then drinks the liquid in which it was boiled, he/she will be cured and no longer wet the bed .

LESSON 2: Preparation and presentation of frog myths. **C2**

Class organization: Eight groups. Groups may go outside to prepare and practice. Clear a stage in front of the class.

Resources needed: Myth for each group.

What are the outcomes for this activity?

1. Learner's become aware that all cultures have myths.
2. Learners are able to present scientific knowledge through indigenous knowledge.
3. Learners cultivate creative skills through presentations.

What will be done to achieve this learning?

1. Groups will plan and prepare their myth presentations.
2. Groups will present their myths to the class.
3. The class will watch and assess presentations.
4. Learners will report back using their assessment rubrics.

Teacher's notes:

1. Prepare assessment rubrics for teacher and learners.
2. Assist each group in their planning.
3. Plan a rubric for assessment of group skills.
4. Assess groups.
5. Assess presentations.

How will the learner achievements be assessed?

1. Group-work skills will be assessed by the teacher using rubrics.
2. The presentations will be assessed by the teacher using rubrics.
3. The presentations will be assessed by the learners using rubrics.

CO-OPERATIVE GROUP SKILLS ASSESSMENT SHEET				
GROUP NUMBER:				
TASK SKILLS:	Learner	Learner	Learner	Learner
Gives ideas				
Asks questions				
Stays on the task				
Follows directions				
Gets group back on task				
SOCIAL SKILLS:				
Encourages others				
Discusses				
Listens well				
Praises others				

PRESENTATION ASSESSMENT SHEET				
GROUP NUMBER: NAMES:				
MYTH:				
TYPE OF PRESENTATION:				
Assessment criteria	1	2	3	4
Understanding of possible scientific origin of myth	Little understanding. No indication of scientific origin	Slight understanding. Weak scientific origin	Understands. Well thought out idea of origin	Complete understanding. Plausible origin. Research done
Creativity	Repetitive. Little or no variety	Little variety. Presentation lacks originality	Good variety. Some originality	Very original. Uses unusual ideas. Great variety
Coherence & Organization	No organization. Does not flow. Not rehearsed	Little organization. Seldom flows. Some indication of practice	Well organizes but not rehearsed enough. Break in flow	Very good logical organization. Flows due to lots of practice
Speaking skills	Too soft/loud. No eye contact. Too fast or slow	Some mumbling. Little eye contact. Uneven rate. Little or no expression	Well spoken. Eye contact. Expression but not polished	Well spoken. Eye contact. Expression, enthusiasm & confidence
Audience response	Lost interest. Restless. Bored	Listened for a while then lost interest	Audience attention held most of the time. Participated or listened quietly	Captive audience throughout. Enjoyed & participated

LESSON 3: Societal view of endangered species. ***C3***

Class organization: Learners at individual desks.

Resources needed: Story, folio paper.

What are the outcomes for this activity?

1. Learners understand inter-relationships between science and society and the environment.
2. Learners identify the positive and negative effects of science development and technology on the environment.

What will be done to achieve this learning?

1. Learners read a story about the destruction of the environment (three groups: each taking the part of one of the characters in the story) - this will keep the learners focussed.
2. Learners write a paragraph on their role in the story (either the frog, the girl or the witchdoctor).
3. Learners share their information with others of the same character.
4. Three learners i.e. one of each character, discuss the impact of science development and technology on endangered species.

Teacher's notes:

1. Prepare the story worksheet with instructions for the paragraph to be written.
2. Assist the three groups to keep them on track.

How will the learner achievements be assessed?

The paragraph will be assessed on a scale of 1 - 3 relating to the level of understanding the learner has of endangered species.

STORY INTRODUCING ENDANGERED SPECIES: **NAME:**…….

Whither the Frog.

A young woman was busy in the garden one afternoon when a frog hopped upon a rock nearby. The woman, whose name was Nthabi, had a beautiful face and wore colourful clothing. While she worked she sang.

"What a beautiful song, dear lady," said the frog.

"Indeed," said Nthabi, reaching down to pick some wild flowers. "Take these flowers and be off with you. I have no time for frogs today".

"That's a pity," said the frog. "I have need of your time. Surely you know me."

"Don't tell me," said Nthabi, " I've read some books. If I kiss you on the mouth, you will change from your present hideous form into a handsome prince."

"What an imagination!" said the frog. "I'm a choir frog from the east valley."

The young lady touched the frog's nose with the flowers. "Kwa kwa," she said.

"Do you know there is a giant living in the west valley?" asked the frog. "A greedy giant. He has machinery and is using the latest technology to cut down all the trees in the forest in order to build storerooms for his wealth."

"I know the creature you speak of, Rampo is his name and he is quite decent. He sends me cakes once a month and has promised to leave me alone."

The frog hopped into Nthabi's hand. "You are foolish to listen to him. When the forests are all gone, the jackals and hyenas will pay you a visit. What will you say to them?"

"I will say, 'I have no time for jackals and hyenas today.' Just as I have no time for you." With that, Nthabi tossed the frog across the garden and laughed.

The frog, whose nose was bruised and bleeding, wagged his finger at Nthabi and said, "When wisdom comes in the evening, dear lady, it comes to nothing."

The frog set off down the road in an easterly direction, muttering to himself, "Hideous. Indeed!"

Soon he met a witchdoctor, dressed in ragged clothes and standing by the side of the road. The witchdoctor whistled like a bird and juggled beef bones in his hands, and as he did so, he jumped up and down on one foot, causing the seeds and shells around his ankles to jingle. The frog sat down and watched.

"You're going the wrong way," said the witchdoctor. There's a disaster up the road."

"I've got family up the road," said the frog. "And I sing in the east valley choir."

"Not any more, you don't," said the witchdoctor. "A disaster!"

"You don't say," said the frog. "Then why do you sing for joy like a bird?"

"That's a warning. This is joy." The witchdoctor hopped on his other foot and whistled another tune.

"I knew that," said the frog. "Tell me about this disaster."

The witchdoctor folded his legs beneath him and sat. "It's like this," he said. "For weeks now, every night, a sticky red rain has fallen. It sticks to the birds' feathers, the grasses, and the leaves on the trees. It is driving the cattle crazy. So what's a tribe to do? Move on down the road. It's either that or die. What would you do?"

The frog thought for a minute. "Wait… investigate… consider… and adapt."

"You frogs," said the witchdoctor, "you're so territorial. Your golden ball won't save you this time." The witchdoctor held up one of the bones. "See this? One of these days, this is all there'll be left of you. Why rush it? I'd turn around, if I were you."

"Things aren't quite as simple as you imagine," said the frog.

The witchdoctor had stood up and began walking west, flipping his bones in the air.
"Witchdoctor, have you ever entertained a giant?"

"Giants don't scare me," said the witchdoctor. "All I need is enough wood for a house."
In the witchdoctor's footprints, the frog noticed blobs of sticky red earth.
"Witchdoctor," the frog said, "sometimes there is wisdom in standing still and facing one's problems. You will learn this eventually, but I'm afraid it will be too late."
"A nice thing about giants," said the witchdoctor, "is that they don't talk much. Kwa kwa."
Once again the witchdoctor walked west. Nthabi continued to work in her garden while she sang. The giant ravaged the forest and the red rain clouds gathered.
"I tried to tell them," said the frog. "People just don't listen."
The frog strode away, in the direction of home, humming to himself and thinking of his choir. "Who knows if I shall ever meet them again," he said to himself.

INSTRUCTION:
Select one of the characters in the story, either the frog, Nthabi or the witchdoctor. Write a paragraph on **your role** in the story.

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Assessment of paragraph: **C3.1**

The following are the main ideas which the learner should have grasped from the story:

Nthabi: She is like an ostrich with its head in the sand.
She is not interested in what the frog has to say.
She cannot see the long-term effects of the giant's actions.
Does not heed his warning.

Witchdoctor: He warns others of the disaster.
He describes the environmental happening.
He is very nearsighted and only worries about his personal needs
eg. wood for a house.
Does not see the giant as the destructive force that led to the
environmental disaster.
He is the type of person who runs away from problems and does not
stay to help solve them.

Frog: He warns both Nthabi and the witchdoctor about the giant's activities.
He suggests a more scientific approach to dealing with the environmental
disaster.
He feels that one should not run away from a problem but stay and deal with
it.

The following rubric will be used to assess the learners' paragraph: **C3.2**

Criteria	Level 1	Level 2	Level 3
1 Ideas and understanding	Little understanding; missed the point; few ideas	Understands to a certain degree; errors ideas; on the right track	Complete understanding of all roles; good ideas
2 Sentence fluency	Difficult to read; does not flow	Some sentences are smooth, others halting	Easy to read; varied beginnings to sentences
3 Word choice	Confusing and misused words abound	Correct but not striking	Extremely clear and visual
4 Follows instructions	Did not follow instructions at all	Followed instructions with some errors	Evidence of instructions being followed completely

LESSON 4: Facts and opinions about FROGS as an endangered species. ***C4***

Class organization: Learners at individual desks.

Resources needed: Video - 50/50 research on bullfrogs, fact sheets, questionnaire about frogs.

What are the outcomes for this activity?

1. Learners are able to contribute to a class list of interesting aspects of a given situation.
2. Learners acquire information on the frog as an endangered species.

What will be done to achieve this learning?

1. Learners watch a video clip of bullfrogs and research (50/50).
2. Learners give reasons why the bullfrog is endangered. (Learners' Ideas written on the board).
3. Learners use fact sheet to help them answer questions on the frog as an endangered species.

Teacher's notes:

1. Organize video machine and video.
2. Prepare and type fact sheet and questionnaire.

How will the learner achievements be assessed?

Learners' questionnaires will be assessed using a memorandum.

FACTS: **Frogs and the Environment** **C4.1**

There are 5,130 species of frogs.

There are 115 species in South Africa.

Amphibians are among the oldest creatures on earth, dating back to the times of the great dinosaurs, perhaps 350 million years. To survive this long frogs have been extremely adaptable.

On six out of seven continents on earth, frog populations have dropped considerably in the last 20 years. Researchers call these "massive dips and die-offs."

Among endangered or extinct species are the giant bullfrog in South Africa; common leopard frog in the USA; the golden toad in Costa Rica; rice paddy frog in Japan.

The frog is a unique organism in that it lives in a dual habitat - both land and water. It comes into contact with air, water and soil. Its skin is thin and permeable (water and air pass through it).

Frogs have no hair or feathers to screen them from the sun's ultraviolet rays.

Scientists think frog die-offs may signal environmental distress.

Miners used to take canaries into the mines with them because the birds were sensitive to gases. If a canary showed distress, the miners knew they were in trouble. Scientists think of amphibians as the 'canaries' of the global environment.

In the Red Data Book of endangered species (2000) it is said that 'we are in an extinction crisis' & frogs in S.A are extremely threatened.

Possible declines of frog populations are habitat destruction resulting from logging, agriculture, and drained wetlands

Acid rain may also explain declines. Acid affects egg formation, deforms tadpoles, slows growth rates.

Intense droughts have disturbed mating, individual development, and respiration, all of which are dependant upon water.

Ozone depletion has allowed higher levels of ultraviolet rays into the environment.

In some places amphibians are thriving. In the West Indies two new species have been added to the 28 known species. In Borneo no declines have been reported.

The French consume 3 000 to 4 000 metric tons of frog legs a year (22 000 frogs make a metric ton).

A "herpetologist" is a biologist who studies frogs.

Scientists agree that the way to save the greatest number of species is to save the places that house the richest biological diversity.

Many amphibians are falling prey to viruses, fungi, and infectious diseases.

Taxol, a substance extracted from the bark of yew trees, is described by one scientist as 'one of the most important anticancer agents discov-

S.A. is member of RAMSAR (an international group set out to save wetlands) & 17 wetlands have been proclaimed in S.A since 1975.

Mondi Wetlands Project raises awareness of wetlands to landowners & advise on wetland rehabilitation.

S.A. Dept. of Water Affairs & Forestry provides funds for rehabilitation & for addressing getting rid of alien species.

In the next decade, scientists warn that as many as 50,000 species a year may become extinct.

As many as 100 million species may exist on the earth; thus far, about 1.4 million have been named.

The Endangered Species Act requires that we treat all species alike - whales, eagles, elephants, as well as organisms most people step on without thinking twice.

Living creatures provide people with almost all their food & medicine; allowing an insignificant mould to become extinct could result in the loss of a cancer cure.

On the spaceship *Earth*, humans are both passengers & pilots. Human choices affect other passengers.

ered in the past decade'.

Yews are presently being farmed in USA by drug companies working together.

Once Taxol can be manufactured in laboratories, rather than from yew bark, the yew will be abandoned by drug & lumbar companies & allowed to become endangered, possibly extinct.

Some people argue that we cannot save every species on earth. Our task should be to save those that are scientifically & economically useful.

Others answer that to choose whether a species lives or dies is to play God; to assign a price or value to a species is immoral.

Still others say that we are allowing species to become extinct whose use or value to humankind is unknown.

According to the 'Noah Principle', a bug has the same tight to exist as a hippopotamus.

ACTIVITY SHEET USING FACT SHEET: **NAME:**…… **C4.2.**

Review the fact sheet on frogs and the environment and provide answers for the following questions:

1. List the possible causes of depleted frog populations.

……
……
……

2. What is it about the frog that makes it especially vulnerable in its changing environment? In what sense it is also a miraculous survivor?

……
……
……

3. How is a frog useful to mankind?

……
……
……

4. Who was Noah? What did he do? What is the 'Noah Principle' and how does it apply to endangered species?

……
……
……

5. What is South Africa doing to protect its amphibian populations?

……
……
……

MEMORANDUM USED TO ASSESS ACTIVITY SHEET: **C4.3**

Possible correct responses	Marks
Question 1	
Habitat destruction (logging, agriculture, wetlands drained	1
Acid rain (affects egg formation, tadpoles deformed, slow growth	1
Droughts (mating disturbed, individual development affected, respiration	1
Ozone depleted (UV rays dangerous)	1 (4)
Question 2	
Skin - thin, permeable; no feathers for protection; in contact with soil, air and water (affected by pollution)	1
Adaptable - 350 million years; survived since the dinosaurs	1 (2)
Question 3	
Indicate pollution	1
Forms part of the food web OR balance of nature	1
Used as food in some cultures	1 (3)
Question 4	
Bible character; built Ark & took two of every animal species to save them from the flood	correct or
Every species has the same right to exist	incorrect
Question 5	
Save the wetlands OR save the frog's habitat	1
Rehabilitate wetlands (Mondi & Dept of Water Affairs)	1
Getting rid of aliens (Dept of water of Affairs	1 (3)

LESSON 5: Assessment of learners' attitude towards conservation. **C5**

Class organization: Learners at individual desks.

Resources needed: Questionnaire.

What are the outcomes for this activity?
To assess whether learners have changed their attitudes towards the role frogs play in the environment as well as the need to conserve them.

What will be done to achieve this learning?
Learners will answer a questionnaire.

Teacher's notes:
Prepare questionnaire.
Assess learners answers.

How will the learner achievements be assessed?
Questionnaire using a memorandum.

Assessment questionnaire. **NAME:**……. **C5.1**

Indicate whether the following statements are true or false giving an explanation for your answer:

1. A lion is a more important organism than a frog.

……

2. Given the choice between saving a city and saving an ocean, it is preferable to save the city.

……

3. Science, if used properly, can make nature better.

……..

4. A golf course is more beautiful than an open field.

……

5. When a person buys land and owns it, he or she also buys and owns the animals that live on it.

……..

6. Humans should protect only those organisms that are useful to mankind.

……

7. If some organisms become extinct, do not worry; new organisms will be discovered.

……

8. Given the choice between providing food and employment for a people and saving the lives of elephants, it is better to think of people.

……

9. Medicines come from laboratories, not jungles.

……..

10. According to Darwin, it is natural for some organisms (such as the frog) to die off. We need not be alarmed when nature takes its course.

……

MEMORANDUM USED TO ASSESS QUESTIONNAIRE **C5.2**

Quest-ion	True or False	Possible reason
1	F	Every organism is as important as the next; equal right to life
2	F	Ocean has grater biodiversity; supplies most of the earth's oxygen supply
3	T	Science prevent pollution; save the planet; sustain resources
4	F	Golf course has little biodiversity; sterile
5	T	Should treat the animals with respect
6	F	All should be protected ; balance of nature
7	F	Disturb the balance of nature; decrease biodiversity; sterile planet
8	F/T	Man is important but a compromise could be reached; global view
9	F	Originally from nature; many still do
10	F	Usually not nature that kills of species but man

FIELD NOTES, TRANSCRIPT OF VIDEO RECORDING, OBSERVATIONS **D1**

Lesson 1.
At the beginning the learners were quite and polite and listened intently. Some answered the questions asked by the researcher/teacher but they were very shy of the new researcher/teacher. Learners did not know the reactions of the researcher to their responses. Took a while for them to get warmed up. The song was fun and they started giggling and sang the song. Could see they were wondering what was going on….made them immediately interested in what was coming next.

As soon as live frogs were introduced, there was a lot of moving away, interest, lots of very scared learners. Some were terrified and jumped up and moved back from the frogs.

There was noticeable difference in the classroom atmosphere once the frogs had been collected. Learners seemed more receptive to what was going to be introduced next. They should enthusiasm and now started to respond to the questions the researcher/teacher put to them.

They enjoyed the myths, superstitions and legend theory. Were excited about the presentations.

Lesson 2.
Groups outside. Easier for them to practice without disturbing one another. Lots of fun. All participated with enthusiasm. Worked well together. Danced, rapped and sang. Very talented and creative.

Presentations were well done. Everyone enjoyed themselves. Origins of myths were not dealt with…..perhaps too difficult for them to do or the instructions were not clear eneough.

Lesson 3.
The conservation story was read out loud. There were three groups (frog, witchdoctor, Nthabi). They read it well and considered what was being said. Settled down to write their thoughts about the role of the characters in the story. Asked for help when necessary.

Lesson 4.
The video on research on the bullfrog stimulated lots of questions and interest . The fact sheet and Activity sheet was tackled well. Learners asked for help. The word vulnerable was unknown to most of them but once explained they could carry on.

Lesson 5.
They answered the Assessment sheet in silence and certainly thought about their answers. It seems this age group experience difficulty when asked to give reasons for true or false questions.

1. If you see a dead frog in the garden, it means that someone is trying to bewitch you and the only way to prevent this happening, is to burn it without touching it.

2. A teacher teaching at a rural school happened to leave her shoes at a friend's house. There was a frog in the packet when the shoes were returned to her. After wearing them for a few months, she found her legs started to turn green and she had to retire and became bedridden.

3. A frog releases a white milky substance from it skin (poisonous) when a snake approaches it. As the snake opens its mouth to swallow the frog, the frog sticks its legs out sideways and this prevents the frog from being swallowed.

4. If you find a frog in a hole that has a little water in it, you must leave it there as it will bring the rains and fill up the hole.

5. If you see a frog calling loudly, something bad is going to happen to you in the near future.

6. There a story once that people saw frogs falling from the sky as though it was "raining frogs" but the source of the myth did not believe it.

7. If bedwetters boil a frog and then drink the liquid that it was boiled in, the bedwetter will be cured of this ailment.

8. Witchcraft makes use of the slime removed from a frog's skin.

9. After rains, the frogs appear in celebration of this event.

10. If a frog passes you by when you are walking in the opposite direction, you are going to receive bad luck in the future.

11. If you touch a frog with a lumpy skin, you will get sores on your hands.

12. If you find a frog in the house, it means good luck and you must not kill it.

13. If the grey tree frog jumps onto your face, it will suck out all the mucous from your nose in order to build a nest.

Table 3 Assessment of participants' paragraph on the role of either Nthabi, the witchdoctor or the frog in the story **D5**

Participants' assigned number	Criteria 1=ideas & understanding; 2=sentence fluency; 3=word choice; 4=follows instructions (levels 1-3)				Words used
	1	2	3	4	
1	2	3	3	3	not care / ignorant / selfish
2	1	2	2	3	not listen / ignorant / selfish
3	2	2	2	3	wise, responsible / not run away from problems
4	1	2	2	3	not listen
5	2	2	2	3	not listen/not understand about giant / selfish
6	2	2	2	3	did not know much / thought about herself
7	1	2	2	2	Ignorant
8	2	2	2	2	not listen / uneducated
9	1	2	2	3	warned about disaster & giant
10	2	2	2	2	wanted to share knowledge / warn them
11	2	2	2	2	warn village about disaster & giant
12	2	2	2	2	wise, responsible / advise to do right decision
13	1	2	2	3	not care / ignorant
14	1	2	2	3	not educated / selfish
15	2	2	2	2	not listen / not understand about giant/selfish
16	2	2	2	2	warn people about disaster & giant
17	3	3	3	3	careless / thoughtless / ignorant / selfish
18	3	3	2	3	not care / ignorant/ / not listen/ selfish
19	2	2	2	3	not care / warn people / selfish
20	2	2	2	3	wise, responsible/selfless/ advise
21	3	3	2	3	tells frog about disaster / selfish
22	2	3	2	3	warns frog / selfish
23	3	3	2	3	warns about disaster & giant/selfish/ignorant
24	3	3	2	3	warns about giant / face up to problems
25	2	2	2	3	wise, responsible, selfless' advises right thing
26	1	2	2	1	not care
27	3	2	3	3	not care / not listen/ ignorant
28	1	2	2	3	not care / selfish
29	2	2	2	3	wise, responsible / do not run from problems
30	2	2	1	3	uneducated / not listen to frog
31	3	2	2	3	not care / ignores
32	1	2	2	1	wise / warn of disaster
33	2	2	2	3	wise, responsible / concerned of environment

Table 4 Participants' responses to certain questions on the pre-test and post-test questionnaires **D6**

Participants' assigned number	Pick up frog		Afraid of frog		Usefulness		Conservation	
	Pre Y/N	Post Y/N	Pre Y/N	Post Y/N	Pre Y/N	Post Y/N	Pre Y/N	Post Y/N
	Q2	Q1	Q3	Q1	Q5	Q2	Q6	Q3
1	N	N	Y	N	N	Y	Y	Y
2	Y	Y	Y	N	Y	Y	Y	Y
3	Y	Y	N	N	Y	Y	Y	Y
4	N	Y	N	N	N	Y	Y	Y
5	N	N	Y	N	Y	Y	Y	Y
6	Y	Y	N	N	N	N	Y	Y
7	Y	Y	N*	Y*	Y	Y	Y	Y
8	Y	Y	N	N	Y	Y	Y	Y
9	N	Y	N	N	N	Y	Y	Y
10	Y	Y	N	N	N	Y	N	Y
11	Y	Y	N*	Y*	N	Y	N	Y
12	N	Y	Y	N	N	Y	Y	Y
13	Y	Y	N	N	Y	Y	N	Y
14	Y	N	N*	Y*	Y	Y	Y	Y
15	N	Y	Y	N	Y	Y	Y	Y
16	Y	Y	N	N	N	Y	Y	Y
17	N	N	N*	Y*	Y	Y	Y	Y
18	N	N	Y	Y	Y	Y	Y	Y
19	N	Y	Y	N	N	Y	Y	Y
20	N	N	Y	Y	Y	Y	Y	Y
21	N	Y	Y	N	Y	Y	Y	Y
22	N	Y	N	N	Y	Y	Y	Y
23	N	Y	Y	N	N	Y	N	Y
24	Y	Y	N	N	Y	Y	Y	Y
25	Y	Y	N	N	N	Y	Y	Y
26	N	Y	Y	N	N	N	Y	Y
27	Y	Y	N	N	N	Y	Y	Y
28	N	Y	Y	N	Y	Y	Y	Y
29	N	Y	N	N	Y	Y	Y	Y
30	Y	Y	N	N	N	Y	Y	Y
31	Y	Y	N*	Y*	Y	Y	Y	Y
32	N	N	N*	Y*	Y	Y	Y	Y
33	Y	Y	Y	N	N	Y	Y	Y

Table 6 Participants' responses to Questions 1 & 6 (Uses of Frogs / Conservation) and Questions 2 and 4 (Biodiversity) on Assessment Questionnaire (Appendix C5.1) **D7**

Participants' assigned number	Uses of frogs, Conservation		Biodiversity		General level of understanding
	Q 1	Q 6	Q 2	Q 4	
1	F	F	F	F	fairly good idea of both
2	F	F	F	T	fairly good idea of both
3	F	F	F	F	definitely understands both
4	F	F	T	T	no idea of either / confused
5	F	F	F	F	good idea of both
6	F	F	F	T	conservation yes; biodiversity not
7	F	T	T	T	no idea of either
8	T	F	F	T	no idea of either
9	F	F	T	T	conservation yes; biodiversity not
10	F	F	F	F	has good understanding of both
11	F	F	T	F	conservation yes; biodiversity not
12	F	F	F	F	conservation yes; biodiversity not
13	F	T	T	T	no idea of either
14	F	F	F	F	conservation yes; biodiversity little
15	F	F	F	F	superficial understanding of both
16	F	F	F	F	conservation yes; biodiversity not
17	T	F	T	F	conservation little; biodiversity not
18	F	F	F	F	good idea of both
19	F	F	F	F	very good understanding
20	F	F	F	F	very good understanding
21	F	F	F	F	very good understanding
22	T	F	F	T	conservation yes; biodiversity not
23	F	F	F	F	conservation yes; biodiversity not
24	F	F	F	F	conservation yes; biodiversity little
25	F	F	F	F	fairly good of both
26	F	F	F	F	conservation yes; biodiversity not
27	F	F	T	F	conservation yes; biodiversity little
28	F	F	F	F	conservation yes; biodiversity not
29	F	F	T	T	conservation yes; biodiversity not
30	F	F	F	F	very good understanding
31	F	F	F	T	no understanding of either
32	F	F	F	F	conservation yes; biodiversity little
33	F	F		F	conservation yes; biodiversity not