Revised National Curriculum Statement For Grades R-9 (Schools)

Natural Sciences

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This document must be read as part of the
Revised National Curriculum Statement Grades R-9 (Schools).

This Revised National Curriculum Statement Grades R-9 (Schools) includes:

1. An Overview
2. Eight Learning Area Statements:
   - Languages
   - Mathematics
   - Natural Sciences
   - Social Sciences
   - Arts and Culture
   - Life Orientation
   - Economic and Management Sciences
   - Technology

HOW TO USE THIS BOOK

- For general information see:
  - *Introducing the National Curriculum Statement in Chapter 1* - This will provide information on Outcomes-based Education, the Revised Curriculum Statement for Grades R-9 (Schools), and Learning Programmes.
  - *Introducing the Learning Area in Chapter 1* - This will provide an introduction to the Learning Area Statement including its features, scope and Learning Outcomes.
  - *Learner Assessment* - This Chapter provides guidelines to assessment principles in Outcomes-based Education, discusses continuous assessment, and provides examples of record-keeping.
  - The *Reference Lists* provide both a general Curriculum and Assessment Glossary and a specific Learning Area Glossary.

- The body of this book is divided into several chapters. There is one chapter for each of the Phases of the General Education and Training Band - Foundation Phase, Intermediate Phase, Senior Phase. Each of these chapters has a brief introductory section, followed by the Assessment Standards for the Phase. There is also a chapter on Learner Assessment.

- The Assessment Standards are presented first in an overview, found in tables at the end of Chapter 1. The tables allow the reader to see the intended progression in the Assessment Standards and Learning Outcomes.

- Certain symbols are used throughout this book to guide the reader in finding the information she or he is looking for. These symbols are:

 Assessment Standard

 Grade

 Learning Outcome

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WORKING TOGETHER

CHAPTER 1
INTRODUCTION

INTRODUCING THE NATIONAL CURRICULUM STATEMENT

The Constitution of the Republic of South Africa (Act 108 of 1996) provides the basis for curriculum transformation and development in South Africa. The Preamble to the Constitution states that the aims of the Constitution are to:

- heal the divisions of the past and establish a society based on democratic values, social justice and fundamental human rights;
- improve the quality of life of all citizens and free the potential of each person;
- lay the foundations for a democratic and open society in which government is based on the will of the people and every citizen is equally protected by law; and
- build a united and democratic South Africa able to take its rightful place as a sovereign state in the family of nations.

Education and the curriculum have an important role to play in realising these aims. The curriculum aims to develop the full potential of each learner as a citizen of a democratic South Africa.

Outcomes-based Education

Outcomes-based education forms the foundation of the curriculum in South Africa. It strives to enable all learners to achieve to their maximum ability. This it does by setting the outcomes to be achieved at the end of the process. The outcomes encourage a learner-centred and activity-based approach to education. The Revised National Curriculum Statement builds its Learning Outcomes for the General Education and Training Band for Grades R-9 (for schools) on the critical and developmental outcomes that were inspired by the Constitution and developed in a democratic process.

The critical outcomes envisage learners who are able to:

- identify and solve problems and make decisions using critical and creative thinking;
- work effectively with others as members of a team, group, organisation and community;
- organise and manage themselves and their activities responsibly and effectively;
- collect, analyse, organise and critically evaluate information;
- communicate effectively using visual, symbolic and/or language skills in various modes;
- use science and technology effectively and critically showing responsibility towards the environment and the health of others; and
- demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation.

The developmental outcomes envisage learners who are also able to:

- reflect on and explore a variety of strategies to learn more effectively;
- participate as responsible citizens in the life of local, national, and global communities;
- be culturally and aesthetically sensitive across a range of social contexts;

- explore education and career opportunities; and
- develop entrepreneurial opportunities.

Issues such as poverty, inequality, race, gender, age, disability and challenges such as HIV/AIDS all influence the degree and way in which learners can participate in schooling. The Revised National Curriculum Statement for Grades R-9 (Schools) adopts an inclusive approach by specifying the minimum requirements for all learners. All the Learning Area Statements try to create an awareness of the relationship between social justice, human rights, a healthy environment and inclusivity. Learners are also encouraged to develop knowledge and understanding of the rich diversity of this country, including the cultural, religious and ethnic components of this diversity.

Revised National Curriculum Statement: Learning Area Statements

The Revised National Curriculum Statement for Grades R-9 (Schools) consists of an Overview and eight Learning Area Statements for:

- Languages;
- Mathematics;
- Natural Sciences;
- Social Sciences;
- Arts and Culture;
- Life Orientation;
- Economic and Management Sciences; and
- Technology.

Each Learning Area Statement identifies the main Learning Outcomes to be achieved by the end of Grade 9. Each Learning Area Statement also specifies the Assessment Standards that will enable the Learning Outcomes to be achieved. Assessment Standards are defined for each grade and describe the depth and breadth of what learners should know and be able to do. Each Learning Area Statement's Assessment Standards show how conceptual and skill development can take place over time. Assessment Standards can be integrated within grades as well as across grades. The achievement of an optimal relationship between integration across Learning Areas (where necessary and educationally sound), and conceptual progression from grade to grade, are central to this curriculum.

Revised National Curriculum Statement: Learning Programmes

The Revised National Curriculum Statement is aimed at promoting commitment as well as competence among teachers, who will be responsible for the development of their own Learning Programmes. In order to support this process, the Department of Education will provide policy guidelines based on each Learning Area Statement. Provinces will develop further guidelines where necessary in order to accommodate diversity.

The underlying principles and values of the Revised National Curriculum Statement Learning Area Statements underpin the Learning Programmes. Whereas the Learning Areas stipulate the concepts, skills and values to be achieved on a grade by grade basis, Learning Programmes specify the scope of learning and assessment activities for each phase. Learning Programmes also contain work schedules that provide the pace and sequence of these activities each year, as well as exemplars of lesson plans to be implemented in any given period.

In the Foundation Phase, there are three Learning Programmes: Literacy, Numeracy and Life Skills. In the Intermediate Phase, Languages and Mathematics are distinct Learning Programmes. Learning Programmes must ensure that the prescribed outcomes for each learning area are covered effectively and comprehensively. Schools may decide on the number and nature of other Learning Programmes in the Intermediate Phase based on the organisational imperatives of the school, provided that the national priorities and developmental needs of learners in a phase are taken into account. In the Senior Phase, there are eight Learning Programmes based on the Learning Area Statements. Time allocations for each Learning Area are prescribed for all Grades and Phases.

Time Allocations

In terms of Section 4 of the Employment of Educators Act, (1998), the formal school day for teachers will be seven hours. In terms of the National Education Policy Act, (1996), the formal teaching time per school week is 35 hours. This is set out in:
(i) Overview Document ISBN 1-919917-08-X, pages 17 & 18.
(ii) Government Gazette No. 23406, Vol. 443, May 2002, pages 26 & 27

Assessment

Each Learning Area Statement includes a detailed section on assessment. An outcomes-based framework uses assessment methods that are able to accommodate divergent contextual factors. Assessment should provide indications of learner achievement in the most effective and efficient manner, and ensure that learners integrate and apply skills. Assessment should also help students to make judgments about their own performance, set goals for progress and provoke further learning.

The Kind of Teacher that is Envisaged

All teachers and other educators are key contributors to the transformation of education in South Africa. This Revised National Curriculum Statement for Grades R-9 (Schools) envisions teachers who are qualified, competent, dedicated and caring. They will be able to fulfil the various roles outlined in the Norms and Standards for Educators. These include being mediators of learning, interpreters and designers of Learning Programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors and Learning Area or Phase specialists.

The Kind of Learner that is Envisaged

The promotion of values is important not only for the sake of personal development, but also to ensure that a national South African identity is built on values very different from those that underpinned apartheid education. The kind of learner that is envisaged is one who will be inspired by these values, and who will act in the interests of a society based on respect for democracy, equality, human dignity, life and social justice. The curriculum seeks to create a lifelong learner who is confident and independent, literate, numerate, multi-skilled, compassionate, with a respect for the environment and the ability to participate in society as a critical and active citizen.

INTRODUCING THE NATURAL SCIENCES LEARNING AREA

Definition

What is today known as 'science' has roots in African, Arabic, Asian, American and European cultures. It has been shaped by the search to understand the natural world through observation, codifying and testing ideas, and has evolved to become part of the cultural heritage of all nations. It is usually 'characterised by the possibility of making precise statements which are susceptible to some sort of check or proof' (*McGraw-Hill Concise Encyclopaedia of Science and Technology*, Second Edition, p.1647).

To be accepted as science, certain methods of inquiry are generally used. They promote reproducibility, attempts at objectivity, and a systematic approach to scientific inquiry. These methods include formulating hypotheses, and designing and carrying out experiments to test the hypotheses. Repeated investigations are undertaken, and the resulting methods and results are carefully examined and debated before they are accepted as valid. Knowledge production in science is an ongoing process that usually happens gradually, but occasionally knowledge leaps forward as a new theory replaces the dominant view. As with all other knowledge, scientific knowledge changes over time as people acquire new information and change their ways of viewing the world.

Purpose

The Natural Sciences Learning Area deals with the promotion of scientific literacy. It does this by:

- the development and use of science process skills in a variety of settings;
- the development and application of scientific knowledge and understanding; and
- appreciation of the relationships and responsibilities between science, society and the environment.

Development of science process skills

The teaching and learning of science involves the development of a range of process skills that may be used in everyday life, in the community and in the workplace. Learners can gain these skills in an environment that supports creativity, responsibility and growing confidence. Learners develop the ability to think objectively and use a variety of forms of reasoning while they use process skills to investigate, reflect, analyse, synthesise and communicate.

Development of scientific knowledge and understanding

Scientific knowledge and understanding is a cultural heritage that can be used to:

- answer questions about the nature of the physical world;
- prepare learners for economic activity and self-expression;
- lay the basis for further studies in science; and
- prepare learners for active participation in a democratic society that values human rights and promotes environmental responsibility.

Science and society

Science and technology have made a major impact, both positive and negative, on our world. Careful selection of scientific content, and use of a variety of ways of teaching and learning science, should promote understanding of:

- science as a human activity;
- the history of science;
- the relationship between Natural Sciences and other Learning Areas;
- the contribution of science to social justice and societal development;
- responsibility to ourselves, society and the environment; and
- the consequences of decisions that involve ethical issues.

Unique Features and Scope

The Natural Sciences Learning Area Statement envisages a teaching and learning milieu which recognises that the people of South Africa operate with a variety of learning styles as well as with culturally-influenced perspectives. It starts from the premise that all learners should have access to a meaningful science education, and that arbitrary selection and rejection based on various kinds of biases should be avoided. Meaningful education has to be learning-centred and help learners to understand not only scientific knowledge and how it is produced, but also the contextual environmental and global issues that are intertwined within the Learning Area. The Natural Sciences Learning Area must be able to provide a foundation on which learners can build throughout life.

The Natural Sciences offer us a particular way of understanding the world we live in. The Natural Sciences Learning Area differs from other Learning Areas because of:

- the way in which information is gathered and interpreted;
- the way in which information is verified before general acceptance;
- the acknowledgement of the limitations of scientific enquiry; and
- the domain of knowledge that is covered.

The first three of these features have been discussed above. The domain of science knowledge is discussed here.

The Natural Sciences Learning Area comprises a wide variety of fields of inquiry, ranging from the study of how stars form to how microscopically small animals live, and from the study of crystals to understanding how the climate of the earth is changing. These fields of inquiry need very different data and use very different methods of investigation. So, while there are similarities in the ways scientists work, it is not possible to put all science knowledge and activity together under a single heading. In this Revised National Curriculum Statement the fields which scientists study have been grouped into four main content areas or knowledge strands:

- *Life and Living* focuses on life processes and healthy living, on understanding balance and change in environments, and on the importance of biodiversity.

- *Energy and Change* focuses on how energy is transferred in physical and biological systems, and on the consequences that human needs and wants have for energy resources.
- *Planet Earth and Beyond* focuses on the structure of the planet and how the earth changes over time, on understanding why and how the weather changes, and on the earth as a small planet in a vast universe.
- *Matter and Materials* focuses on the properties and uses of materials, and on understanding their structure, changes and reactions in order to promote desired changes.

These broad statements of the four content areas are spelled out in more detail in Chapter 5, Core Knowledge and Concepts.

Natural Sciences Learning Outcomes

Learning Outcome 1: Scientific Investigations

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

Learning Outcome 2: Constructing Science Knowledge

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

Learning Outcome 3: Science, Society and the Environment

The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.

The three Learning Outcomes address different competencies and ideally should not overlap, so as to avoid being confused during assessment. However, they do come together when extended tasks are designed for learners, and it is normal for two or three of the Learning Outcomes to be seen in the same extended task.

Some Assessment Standards show links between the Learning Outcomes. For example, in Learning Outcome 2 learners might evaluate an investigation design to demonstrate their grasp of principles of investigations, and in Learning Outcome 3 learners might compare reports of investigations to show how well they understand that results are reported in different ways.

The relationship of the content areas to the Learning Outcomes

The Revised National Curriculum Statement has chosen Learning Outcomes which stress the learner's ability to use science knowledge, not just to acquire it. Using knowledge refers to the learner's ability to operate and work with knowledge, to recognise when an idea is relevant to a problem, and to combine relevant ideas.

So, in the Revised National Curriculum Statement, progression is reflected not solely in terms of the amount of knowledge a learner can recall. Rather, Learning Outcomes 1, 2 and 3 are used to assess progress in the learner's ability to plan and carry out investigations involving knowledge, and the ability to interpret and apply that knowledge in classroom situations as well as in situations affecting the learner as a member of a changing society.

To restate the point, *the Learning Outcomes are the operations which the learner must be able to do on a certain range of scientific knowledge*. The Assessment Standards define the levels at which the learner operates in an Outcome, while the content areas (knowledge strands) define the breadth over which the learner can operate at any particular level.

In order to ensure sufficient breadth in a Learning Outcome, this Revised National Curriculum Statement requires that Natural Sciences teachers provide learning opportunities from all four content areas. A learning programme which omits one of the content areas would offer the learner an inadequate range of learning opportunities.

The core knowledge statements in Chapter 5 represent a time allocation of 70% of the time for the Natural Sciences Learning Area in a Phase. Teachers are encouraged to view the remaining 30% of the time as available for extending the core and for curriculum development around contexts which are significant to learners and the local community. These may be economic, environmental, social or health contexts. This policy creates an opportunity for curriculum development and teacher professional development at school and district levels, and enables learners to demonstrate outcomes in issues which have relevance to their lives.

The relationship of the Learning Outcomes to the Critical and Developmental Outcomes

For the convenience of the reader, the seven Critical Outcomes and the five Developmental Outcomes discussed in the first section of this chapter are reproduced here:

- Critical Outcomes:
  1. Identify and solve problems and make decisions using critical and creative thinking.
  2. Work effectively with others as members of a team, group, organisation and community.
  3. Organise and manage themselves and their activities responsibly and effectively.
  4. Collect, analyse, organise and critically evaluate information.
  5. Communicate effectively using visual, symbolic and/or language skills in various modes.
  6. Use science and technology effectively and critically, showing responsibility towards the environment and the health of others.
  7. Demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation.

- Developmental Outcomes:
  1. Reflect on and explore a variety of strategies to learn more effectively.
  2. Participate as responsible citizens in the life of local, national, and global communities.
  3. Be culturally and aesthetically sensitive across a range of social contexts.
  4. Explore education and career opportunities.
  5. Develop entrepreneurial opportunities.

Learning Outcome 1 most clearly represents Critical Outcome 6. It also gives meaning to Critical Outcome 1 by emphasising that learners should increasingly formulate questions and problems for themselves. Furthermore, when learners do investigations they build Critical Outcomes 2, 3, 4, and 5.

Learning Outcome 2 most clearly represents Critical Outcomes 4 and 5. The activities required to build Learning Outcome 2 also reflect Developmental Outcome 1.

Learning Outcome 3 most clearly represents Critical Outcomes 6 and 7. It also contributes to building Developmental Outcomes 2 and 3.

The meaning of the Learning Outcomes and their relationship to the Assessment Standards

In this section, each Learning Outcome is examined, first in terms of its meaning, and second in terms of its relationship to progression in the Assessment Standards.

Learning Outcome 1: Scientific Investigations

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

Meaning

Competence in this Learning Outcome can be seen as the learner searches for information from books and resource people, generates products and questionnaires, collects data and materials from nature or industry, creates testable questions and fair tests, and explains conclusions. The learner shows initiative and puts his or her mind to practical problems of at least four kinds:

- *problems of making:* e.g. 'How can we make a very sensitive thermometer?' or 'How can we make our own magnetic compass?' or 'How can we make a system that will give water to a plant automatically?' or 'How can we make a solar-energy oven?'

- *problems of observing, surveying and measuring:* e.g. 'How can we find out what nocturnal animals do at night?' or 'How could we find out which kinds of fuel people in this area use?' or 'What do successful gardeners do to get a good crop?' or 'How can we measure the volume of a drop of water?' or 'How much water does a plant lose in a day?' or 'How can we show the change in the position of Venus each morning?

- *problems of comparing:* e.g. 'Which liquid soap is the best?' or 'Which cloth will keep you warmest on a cold day?' or 'Which glue is the strongest?' or 'Which batteries are the most economical?'

- *problems of determining the effect of certain factors*: e.g. 'What is the effect of increased dropping height on how high a ball bounces?' or 'What is the effect of making the water hotter when you dissolve sugar?' or 'Which conditions make seeds germinate fastest?' or 'Do the roots of seedlings grow downward because the water is down below?'

Each kind of problem calls for conceptual knowledge of science, as well as creative thought and systematic testing of ideas. The four kinds of problem listed here overlap, of course. For example, to determine the effect of changing one factor, the learner needs to set up a fair way of comparing the effects as that factor is varied. The four kinds of problems represent a range of the kinds of intellectual demands that Learning Outcome 1 makes on learners.

Relationship to Assessment Standards

Progress in this Learning Outcome is seen in terms of increasing competence in perceiving, describing and testing relationships between variables. The Assessment Standards reflect this increasing growth in competence. By the end of Grade 9, the learner will have a good understanding of a variable as a factor which might influence a situation, and be able to describe how a change in one variable may cause a change in another variable. The learner will also be able to apply that knowledge to simple problem solving. The learner's imagination, curiosity and ability to ask good questions will increase and broaden. The learner's skill at doing practical work and evaluating investigations, or judging whether an investigation was a fair test of an idea, will also increase. The section on 'Process Skills across the three Learning Outcomes' later in this chapter gives more detail on the kind of activities which build competence in this Learning Outcome.

Learning Outcome 2: Constructing Science Knowledge

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

Meaning

The learner's competence in this Learning Outcome can be seen in the ability to collect or extract information from various sources, and then to organise and analyse that information. The learner is building a framework of knowledge by using science concepts repeatedly in a widening range of situations. The learner sees the usefulness of concepts which explain a range of phenomena and link a range of ideas. Building this competence involves process skills such as interpreting information by interrogating pictures and diagrams, transforming information from one form to another (e.g. from text to a graph or vice versa), looking for patterns in data, or expressing a relationship between two variables. (The section on 'Process Skills across the three Learning Outcomes' later in this chapter gives more detail on the kind of activities which build competence in this Learning Outcome.)

Relationship to Assessment Standards

The Assessment Standards for Learning Outcome 2 appear later in this chapter, and in more detail in Chapters 3 and 4. Note that this Learning Outcome is not assessed in the Foundation Phase.

- The simplest expression of this Learning Outcome, but an essential one, is that *the learner can recall meaningful information when it is needed*. All learners from Grades 4 to 9 must be able to do this. This Revised National Curriculum Statement does not want learners to memorise material which has no meaning or connections for them; however, this Learning Outcome recognises that the ability to retrieve connected ideas is still a valuable intellectual skill.

- The next expression of this outcome is *categorisation*. Categorisation is used extensively in science because it is an effective intellectual tool for reducing the great complexity which scientists find in nature. Categorisation is a general term encompassing the more well-known terms 'sorting', 'grouping' and 'classifying'.

- A more advanced ability is comprehension, shown in the *interpretation of information*. The learner must be able to change the information from one form to another (e.g. from words to numbers or graphs), explain it in her or his own words, find appropriate examples of it, make inferences and predictions from it, and relate it to other information.

- The next higher level of ability is *application of knowledge*. Application means the ability to select and use knowledge in new and unfamiliar situations. This often means selecting and correctly using concepts, rules, methods, formulae and theories to produce an answer or product.

These are minimum expectations, of course. At any grade, teachers can call for higher levels of understanding, such as analysis, synthesis and evaluation.

Learning Outcome 3: Science, Society and the Environment

The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.

Meaning

This is a challenging Learning Outcome, with potential to broaden the curriculum and make it distinctively South African. Its meaning is examined under four headings:

- *Education should help people to become problem solvers*: Whereas Learning Outcome 1 calls for problem solving of closely-defined problems, Learning Outcome 3 calls for the learner to become a scientific problem solver in the context of South African society. The learner will be an adult in a society which faces many problems; the society needs creative thinking to find new solutions, as well as steady application of old solutions that are still effective. Whereas traditional education places a high value on the learner knowing answers to standard questions, this Revised National Curriculum Statement also places value on the learner being able to solve problems and think of ethical alternatives. Alternatives can come from completely new ideas, from adaptations of current ideas and practices in other societies, or by revisiting traditional practices and technologies.

- *Traditional technologies may reflect people's wisdom and experience*: Indigenous or traditional technologies and practices in South Africa were not just ways of working; they were ways of knowing and thinking. Traditional technologies and practices often reflect the wisdom of people who have lived a long time in one place and have a great deal of knowledge about their environment. Wisdom means that they can predict the long-tem results of decisions, and that they can recognise ideas which offer only short-term benefits. Much valuable wisdom has been lost in South Africa in the past 300 years, and effort is needed now to rediscover it and to examine its value for the present day.

Knowledge and wisdom can be lost as new technologies become popular, or as people move away from their well-known environments. In the past, in South Africa and in Africa as a whole, people were moved off their land or pressed to take up other kinds of work or to farm unfamiliar crops for export. Established practices were changed, stable societies were broken up, and knowledge was no longer taught in the context where it applied. In this way, much knowledge was lost.

The movement of people nowadays and the impact of new technologies still results in knowledge being fragmented and lost. Sometimes it is passed on but it is abstract, without the context for understanding and applying it. (For example, detailed traditional knowledge about the soil is hard to teach to people who no longer depend on the soil.) Perhaps people who have that knowledge are no longer respected because their knowledge does not seem to be relevant to the modern world.

Given this history, it is fitting that traditional and indigenous knowledge systems should be included among the ideas the learner examines when building Learning Outcome 3.

- *The scientific and technological choices people make reflect their values*: The values of people are seen in the ways they choose to deal with problems, and even in the choice of issues which they define as problems. For example, in our society not long ago, disabled people were not recognised as having a full right to participate in society - their difficulties were simply not seen as problems which needed solutions. Learning Outcome 3 requires that the learner acquires increased understanding of the way values influence people's choices of technological and scientific solutions.

- *Different world-views are usually present in the science classroom*: One of the underlying differences between modern science and technology on the one hand, and traditional and indigenous knowledge systems on the other hand, is the existence of different world-views. The prevailing world-view of science is based on empiricism. Very briefly, empiricism believes that a scientist can observe things objectively, without influencing the event being observed or being influenced by it. Empiricism believes 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. On the other hand, empiricism believes that those things which cannot be observed and measured are of no value in explaining why events happen.

  Empiricism fuelled the growth of modern science over the past 400 years and has been remarkably effective in generating accurate and reliable knowledge about the natural world. As an approach to understanding nature, it is used in research and science education in all countries of the world. It is challenged by those who argue that pure empirical science does not concern itself with questions of meaning and value, and is therefore too limited a way of understanding the world.

  There are other world-views. For example, in South Africa many people hold a strong world-view which says that people are not separate from the earth and its living things; they believe that all things have come from God or a creative spirit and therefore have spiritual meaning; events happen for spiritual as well as physical reasons. Traditional and indigenous knowledge systems and technologies developed within this system of thought. They were closely connected to the physical and social environment in which people lived and were thus sensitive to impacts on that environment. Nowadays, many commentators see this as a strength of indigenous knowledge systems and argue that there is much to learn from these ways of knowing.

This description of the two world-views is more clear-cut than it is in reality. People tend to use different ways of thinking for different situations, and even scientists in their private lives may have religious frameworks or other ways of giving values to life and making choices.

However, the existence of different world-views is important for the Natural Sciences curriculum. One can assume that learners in the Natural Sciences Learning Area think in terms of more than one world-view. Several times a week they cross from the culture of home, over the border into the culture of science, and then back again. How does this fact influence their understanding of science and their progress in the Learning Area? Is it a hindrance to teaching or is it an opportunity for more meaningful learning and a curriculum which tries to understand both the culture of science and the cultures of home?

These South African issues create interesting challenges for curriculum policy, design, materials and assessment. Science curriculum development which takes account of world-views and indigenous knowledge systems is in its early stages and will be addressed with enthusiasm by many educators. This Revised National Curriculum Statement creates an invitation for such research and development, and in this way it is an enabling document rather than a prescriptive one.

The Assessment Standards for Learning Outcome 3 can be used to assess progress in a variety of issues such as human rights, environmental justice, traditional and indigenous knowledge, and also knowledge about careers which involve science, technology, environmental management and engineering. The Assessment Standards could be used as starting points from which to broaden the curriculum under the general heading of this Learning Outcome.

Relationship to Assessment Standards

The Assessment Standards for Learning Outcome 3 appear later in this chapter, and in more detail in Chapters 3 and 4. Note that this Learning Outcome is not assessed in the Foundation Phase.

In the Intermediate Phase, progression lies in understanding that all societies have some basic needs in common, and they choose varying ways of meeting those needs. It is possible to learn from the ways that societies in the past dealt with their needs. There is also progression in understanding that people make choices when accepting solutions to a problem, and that their choices reflect their wisdom (or lack of it) and their values (good or bad). Their choices result in good or bad effects on the environment, and in sensitive or insensitive application of technology which affects people's lives.

In the Senior Phase, progression lies in increasing understanding that science seeks the most reliable and authoritative ways of explaining events in nature, and that people choose to accept explanations coming from the source of authority they prefer in each situation. Also in the Senior Phase, progression lies in the increasing ability and willingness to act on knowledge about environmental issues.

Process Skills across the Three Learning Outcomes

The meaning of the term 'process skills'

The term 'process skills' refers to the learner's cognitive activity of creating meaning and structure from new information and experiences. Examples of process skills include observing, making measurements, classifying data, making inferences and formulating questions for investigation. The term should not be understood as referring to the manipulative skills which are a small subset of process skills.

The process skills listed below are applicable to all three Learning Outcomes, and do not refer only to the investigative activities in Learning Outcome 1.

The role of process skills in the teaching and learning of science

From the teaching point of view, process skills can be seen as building blocks from which suitable science tasks are constructed. A framework of process skills enables teachers to design questions which promote the kinds of thinking required by the Learning Outcomes. From the learning point of view, process skills are an important and necessary means by which the learner engages with the world and gains intellectual control of it through the formation of concepts.

A framework of process skills is also valuable to teachers in assessment, when they are designing rating scales, marking memos and instruments to record the day-to-day participation of learners.

The following should be noted with regard to the process skills:

- Not all the process skills will be suitable for assessment of every Assessment Standard.
- Other skills, over and above these process skills, may also be used to assess each Assessment Standard.

A set of process skills which are essential in creating outcomes-based science tasks

- *Observing and comparing* may involve the learner in noting detail about objects, organisms and events with and without prompting by the teacher, noting similarities and differences, describing them in general terms, or describing them numerically.

- *Measuring* may involve the learner in using instruments accurately, reading scales and using intermediate points between divisions on scales, choosing appropriate instruments or appropriate scales on instruments, knowing when it is appropriate to measure, and choosing to do so without prompting by the teacher.

- *Recording information* may involve the learner in recording on a form which is prescribed (sentences, lists, tables, labelled diagram), selecting a suitable form in which to record the information when asked to do so, knowing when it is important to record, and doing so without being prompted by the teacher.

- *Sorting and classifying* may involve the learner in using a given rule to sort items into a table, mind map, list or other system, deciding on own rules for classifying, or choosing a suitable system such as a table, dichotomous key, or mind map.

- *Interpreting information* may involve the learner in a large number of ways of creating meaning and structure. Among these, two are particularly important in Natural Sciences - knowing how to get information from a book, and learning from the printed page. Skills include cross-referencing information in books, finding information from knowing how a book is structured, and organising information using summaries or concept maps. Other aspects of interpreting include changing the form of information to other forms in order to reveal its meaning, looking for patterns in recorded information, predicting, interpolating for missing data, making an inference from given information, perceiving and stating a relationship between two variables, and constructing a statement to describe a relationship between two variables.

- *Predicting* involves the learner in using knowledge to decide what will happen if something is changed in a situation. This skill includes predicting from patterns in information, or interpreting a model of a system to predict how a change in one variable will cause a change in another variable.

- *Hypothesising* may involve the learner in naming possible factors which could have an effect on a situation, giving reasons why something has happened, stating a reason or cause for something, or using prior knowledge as well as information given in the task.

- *Raising questions about a situation* involves thinking of questions which could be asked about a situation, recognising a question which can be answered by scientific investigation (as opposed to a question which science cannot answer), or rewording the question to make it scientifically testable.

- *Planning science investigations* is a composite of many of the skills above and is in fact an Assessment Standard in its own right. The learner will be involved in rewording a vague question to make it into a testable prediction, deciding which variables matter in the problem or question, planning how to change one variable and keep the other variables constant (controlling variables), planning what variables to measure and how to measure them, knowing how to improve the accuracy and validity of the measurements, making inferences from results (their own results or someone else's results), and evaluating someone else's plan for a fair test.

- *Conducting investigations* is also an Assessment Standard, in which the learner sets up a situation in which the change in the dependent variable can be observed, while controlling interfering variables, measuring the variables, recording data, interpreting data to make findings, and reporting in qualitative and quantitative terms.

- *Communicating science information*: This skill links directly with Critical Outcome 5 and is important both in helping the learner reflect on own learning and in building confidence as a person. Competence in communicating involves knowing when it is important to make extra effort to communicate one's ideas or results, and choosing an appropriate means to communicate with the specified audience. In the science classroom, this skill may involve learners in forms of communicating such as giving oral reports in English or other languages, writing prose text, using an art form such as poetry or drama or comic strip, and using graphic forms such posters, diagrams, pie-charts. Communicating also involves more conventional science forms such as tables, concept maps, word-webs, graphs, making physical, constructed models, or enacted models such as using people to show the motion of the planets around the Sun.

INTRODUCING THE NATURAL SCIENCES ASSESSMENT STANDARDS

Progression in the Learning Outcomes

The Natural Sciences Learning Area Statement addresses the **Critical and Developmental Outcomes** through three **Learning Outcomes**, which were introduced on page 6. The **Assessment Standards** are ways in which learners demonstrate the achievement of the Natural Sciences Learning Outcomes.

There are **ten Assessment Standards** covering the three Learning Outcomes. On pages 16-21, each of the Assessment Standards appears in a blue bar across the page. Under each blue bar there are ways in which that Assessment Standard might be demonstrated at increasing levels of complexity, arranged from left to right as Grade R level, Grade 1 level, Grade 2 level and so on, continuing to Grade 9 level. Learners' progress on each Assessment Standard is seen in their increasing ability to perform at higher levels. **These ways of demonstrating the Assessment Standards are policy and learners are to be assessed against these standards**.

In Chapters 2, 3 and 4, the Assessment Standards are set out Phase by Phase with supporting detail and illustrative examples (which are *not* policy). In the tables of this section, the illustrative examples have been omitted in order to provide a summarised overview of progression. Not all the Assessment Standards apply to every grade.

Learning Outcome: 1 Scientific Investigation

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and enviromental contexts.

Grade R Level	Grade 1 Level	Grade 2 Level	Grade 3 Level	Grade 4 Level
Planning investigations				
Learner contributes towards planning an investigative activity.	Learner plans an investigation independently.	Learner plans an investigation as part of group.	Learner uses materials selected by the group in order to communicate the group's plan.	Learner contributes ideas of familiar situations, needs or materials, and identifies interesting aspects which could lead to investigations.
Conducting investigations and collecting data				
Learner participates in planned activity.	Learner independently participates in planned activity.	Learner participates in planned activity independently or as part of a group.	Learner participates constructively in the activity with understanding of its purpose.	Learner explores the possibilities in available materials, finding out how they can be used.
Evaluating data and communicating findings				
Learner thinks and talks about what has been done.	Learner thinks about what has been done and says what has been found out.	Learner shows and explains what was intended and how it was done.	Learner explains and reflects on what action was intended, and whether it was possible to carry out the plan.	Learner talks about observations and suggests possible connections to other situations.

Grade 5 Level	Grade 6 Level	Grade 7 Level	Grade 8 Level	Grade 9 Level
Planning investigations				
Learner lists, with support, what is known about familiar situations and materials, and suggests questions for investigation.	Learner helps to clarify focus questions for investigation and describes the kind of information which would be needed to answer the question.	Learner plans simple tests and comparisons, and considers how to make them fair.	Learner identifies factors to be considered in investigations and plans ways to collect data on them, across a range of values.	Learner plans a procedure to test predictions or hypotheses, with control of an interfering variable.
Conducting investigations and collecting data				
Learner carries out instructions and procedures involving a small number of steps.	Learner conducts simple tests or surveys and records observations or responses.	Learner organises and uses equipment or sources to gather and record information.	Learner collects and records information as accurately as equipment permits and investigation purposes require.	Learner contributes to systematic data collection, with regard to accuracy, reliability and the need to control a variable.
Evaluating data and communicating findings				
Learner reports on the group's procedure and the results obtained.	Learner relates observations and responses to the focus question.	Learner generalises in terms of a relevant aspect and describes how the data supports the generalisation.	Learner considers the extent to which the conclusions reached are reasonable answers to the focus question of the investigation.	Learner seeks patterns and trends in the data collected and generalises in terms of simple principles.

Learning Outcome 2: Constructing Science Knowledge

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

Grade 4 Level	Grade 5 Level	Grade 6 Level
Recalling meaningful information when needed		
Learner, at the minimum, uses own most fluent language to name and describe objects, materials and organisms.	Learner, at the minimum, uses own most fluent language to name and describe features and properties of objects, materials and organisms.	Learner, at the minimum, describes the features which distinguish one category of thing from another.
Categorising information to reduce complexity and look for patterns		
Learner sorts objects and organisms by a visible property.	Learner creates own categories of objects and organisms, and explains own rule for categorising.	Learner categorises objects and organisms by two variables.
Interpreting information		
(There are no further Assessment Standards for this Learning Outcome in Grade 4.)	(There are no further Assessment Standards for this Learning Outcome in Grade 5.)	Learner, at the minimum, interprets information by using alternative forms of the same information.
Applying knowledge to problems that are not taught explicitly		
(There are no further Assessment Standards for this Learning Outcome in Grade 4.)	(There are no further Assessment Standards for this Learning Outcome in Grade 5.)	(There are no further Assessment Standards for this Learning Outcome in Grade 4.)

Grade 7 Level	Grade 8 Level	Grade 9 Level
Recalling meaningful information when needed		
Learner, at the minimum, recalls definitions and complex facts.	Learner, at the minimum, recalls procedures, processes and complex facts.	Learner, at the minimum, recalls principles, processes and models.
Categorising information to reduce complexity and look for patterns		
Learner compares features of different categories of objects, organisms and events.	Learner applies classification systems to familiar and unfamiliar objects, events, organisms and materials.	Learner applies multiple classifications to familiar and unfamiliar objects, events, organisms and materials.
Interpreting information		
Learner interprets information by identifying key ideas in text, finding patterns in recorded data, and making inferences from information in various forms such as pictures, diagrams and text.	Learner interprets information by translating tabulated data into graphs, by reading data off graphs, and by making predictions from patterns.	Learner interprets information by translating line graphs into text descriptions and vice versa, by extrapolating from patterns in tables and graphs to predict how one variable will change, and by identifying relationships between variables from tables and graphs of data, and by hypothesising possible relationships between variables.
Applying knowledge to problems that are not taught explicitly		
Learner applies conceptual knowledge by linking a taught concept to a variation of a familiar situation.	Learner applies conceptual knowledge to somewhat unfamiliar situations by referring to appropriate concepts and processes.	Learner applies principles and links relevant concepts to generate solutions to somewhat unfamiliar problems.

Learning Outcome 3: Science, Society and the Environment

The learner will be able to demonstrate an understading of the interrelationships between science and technology, society and the environment

Grade 4 Level	Grade 5 Level	Grade 6 Level
Understanding science and technology in the context of history and indigenous knowledge		
Learner describes how local indigenous cultures have used scientific principles and technological products for specific purposes.	Learner identifies ways in which products and technologies have been adapted from other times and cultures.	Learner describes similarities in problems and solutions in own and other societies in the present, the past and the possible future.
Understanding the impact of science and technology on the environment and on people's lives		
Learner identifies features of technological devices around him or her, and tells about their purpose and usefulness.	Learner identifies the positive and negative effects of scientific developments or technological products on the quality of people's lives and/or the environment.	Learner suggests ways to improve technological products or processes and to minimise negative effects on the environment.
Recognising bias in science and technology which impacts on people's lives		
Learner identifies difficulties some people may have in using technological devices.	Learner describes the impact that lack of access to technological products and services has on people.	Learner suggests how technological products and services can be made accessible to those presently excluded.

Grade 7 Level	Grade 8 Level	Grade 9 Level
Understanding science as a human endeavour in cultural contexts		
Learner compares differing interpretations of events.	Learner identifies ways in which people build confidence in their knowledge systems.	Learner recognises differences in explanations offered by the natural sciences and other systems of explanation.
Understanding sustainable use of the Earth's resources		
Learner analyses information about sustainable and unsustainable use of resources.	Learner identifies information required to make a judgement about resource use.	Learner responds appropriately to knowledge about the use of resources and environmental impacts.

TIRISANO
WORKING TOGETHER

CHAPTER 2
FOUNDATION PHASE
(GRADES R-3)

INTRODUCTION

The natural sense of curiosity of the Foundation Phase learner leads to an exploration of the world by observing and manipulating common objects and materials in the environment. The learner in this Phase achieves by exploring, and these abilities are displayed if the curriculum is rich in objects and materials with which to work. The learner finds it hard to plan, because the approach to learning is one of 'action first and then see what happens', rather than to spend time thinking through what will happen before action is undertaken. The learner is mostly interested in his or her own viewpoint on any matter; thus events or objects are described without reference to how they might appear to another person. In this sense, what the learner knows is the same as what is seen or felt.

Science in the Foundation Phase should build on the learner's curiosity and ways of knowing, and encourage investigation of the natural world with a sense of wonderment. Learning science as investigation provides the learner with the opportunity to develop the process skills so fundamental to scientific inquiry, and creates essential opportunities for language development as the learner talks about experiences.

Process skills and learner-talk are fundamental to concept development. Classroom methodologies should encourage the learners to use their most fluent language in order to express their own ideas in discussion with classmates. This makes the learners participants in the intellectual activity of the lesson and lowers the barrier to participation created by unfamiliar language.

It is important for the Foundation Phase learner to describe and manipulate objects by pushing, pulling, throwing, dropping, and rolling, so that the position and movement of objects receive attention. The learner should develop the vocabulary in his or her most fluent language to describe location as up, down, in front of or behind. This can be done by involving the learner in playing games and participating in physical actions and activities through which the meaning of these descriptions can be experienced. The Foundation Phase learner should recognise names for different properties like size, shape, texture and colour, and be able to sort and categorise objects accordingly. The learner should be able to describe, from investigation, the properties of different kinds of materials (e.g. paper, wood, metal, water). The learner should be guided to observe and describe changes, including cyclical changes that occur in the natural environment.

LEARNING OUTCOMES

Note:
- In this Phase, only Learning Outcome 1 is taught and assessed.

Learning Outcome 1: Scientific Investigations

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

ASSESSMENT STANDARDS

For this Learning Outcome, the Assessment Standards are:
- planning investigations;
- conducting investigations and collecting data; and
- evaluating data and communicating findings.

These three Assessment Standards are expressed, in terms appropriate to the Foundation Phase, as:
- plan;
- do; and
- review.

On the following pages, each Assessment Standard appears in **bold type** for Grades R to 3. These statements in bold type are **policy** and they provide a common national framework for assessing the learner's progress.

Under the **bold** statements of the Assessment Standards, there are illustrative examples, headed by the phrase *'Achievement is evident when the learner, for example*,'. These examples *are not policy*. Their purpose is to show how the learner gets better at achieving the Assessment Standard across the Grades.

Note:
- Teachers need to remember that not all learners will have attended Grade R. Concepts, skills and strategies for Grade R need to be taught and consolidated in Grade 1.

Grade R

Learning Outcome 1

SCIENTIFIC INVESTIGATIONS

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

Assessment Standards

We know this when the learner:

- **Plans: Contributes towards planning an investigative activity.**

Achievement is evident when the learner, for example,

- asks and answers questions about the investigation, using 'show and tell' or stories to say what action is planned.

- **Does: Participates in planned activity.**

Achievement is evident when the learner, for example,

- follows simple instructions with assistance;
- explains what is being done or played (e.g. games according to the rules).

- **Reviews: Thinks and talks about what has been done.**

Achievement is evident when the learner, for example,

- uses simple words, pictures or other items with assistance to explain what has been done.

Grade 1

Learning Outcome 1

SCIENTIFIC INVESTIGATIONS

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

Assessment Standards

We know this when the learner:

- **Plans: Plans an investigation independently.**

Achievement is evident when the learner, for example,

- shows how self plans to find out about things which are found to be curious;
- uses pictures, drawings or other markings of choice to explain what is going to be done.

- **Does: Independently participates in planned activity.**

Achievement is evident when the learner, for example,

- carries out instructions independently and shows or tells what is being done.

- **Reviews: Thinks about what has been done and says what has been found out.**

Achievement is evident when the learner, for example,

- individually or with assistance, 'shows and tells' what was done using own ideas and objects to explain what aroused curiosity.

Grade 2

Assessment Standards

We know this when the learner:

- **Plans: Plans an investigation as part of a group.**

Achievement is evident when the learner, for example,

- discusses and plans with others;
- negotiates joint understanding of who does what;
- decides on what materials or modes will be used to communicate the plan.

- **Does: Participates in planned activity independently or as part of a group.**

Achievement is evident when the learner, for example,

- plays a role in a group and carries out instructions independently;
- explains what is being done, and answers the question, 'What are you trying to find out?'.

- **Reviews: Shows and explains what was intended and how it was done.**

Achievement is evident when the learner, for example,

- explains own contribution to the investigation;
- uses several different ways to communicate own ideas;
- is curious about what might happen if the situation was changed in some way.

Grade 3

Assessment Standards

We know this when the learner:

- **Plans: Uses materials selected by the group in order to communicate the group's plan.**

Achievement is evident when the learner, for example,

- lays out materials the group intends to use;
- tells who will use the materials and the purpose.

- **Does: Participates constructively in the activity with understanding of its purpose.**

Achievement is evident when the learner, for example,

- explains the purpose of the activity;
- answers the questions, 'Why are you doing this?' and 'How are you trying to find that out?' and 'Is your plan working?';
- agrees or disagrees with other opinions, giving reasons.

- **Reviews: Explains and reflects on what action was intended and whether it was possible to carry out the plan.**

Achievement is evident when the learner, for example,

- reviews how actions of members in the group contributed to the purpose;
- reviews what is needed to do better next time;
- uses a number of different ways of presenting information;
- reflects on what other topics might be investigated.

TIRISANO
WORKING TOGETHER

CHAPTER 3
INTERMEDIATE PHASE
(GRADES 4-6)

INTRODUCTION

In the Intermediate Phase, the learner begins a major advance in thinking, compared to the Foundation Phase. The advance is in the increasing ability to do things in thought before doing them in action. The learner can think through a series of steps mentally, and thus is better able to plan a procedure for an investigation. The growing ability to consider a connected series of events allows the learner to see and describe simple associations between events - provided that the task involves materials or events which have already been worked with or experienced. By Grade 6, the learner can recall the steps that occur when a situation changes. For example, the learner can reconstruct, by memory and reasoning, the way shadows will change length and direction between sunrise and sunset.

The learner has command of more language and can use it more accurately, which allows greater refinement of concepts. For example, the Intermediate Phase learner may have the words to distinguish between 'melting' and 'dissolving', or between a towel 'becoming dry' and the water 'evaporating'.

The learner is more able to think in terms of how others might see things or experience situations, and thus is more able to deal with issues of bias and the impact of technology on society.

LEARNING OUTCOMES

Learning Outcome 1: Scientific Investigations

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

For this Learning Outcome, the Assessment Standards are:

- planning investigations;
- conducting investigations and collecting data; and
- evaluating data and communicating findings.

Learning Outcome 2: Constructing Science Knowledge

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

For this Learning Outcome, the Assessment Standards are:
- recalling meaningful information when needed;
- categorising information to reduce complexity and look for patterns;
- interpreting information, and
- applying knowledge to problems that are not taught explicitly.

Learning Outcome 3: Science, Society and the Environment

The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.

For this Learning Outcome, the Assessment Standards are
- understanding science and technology in the context of history and indigenous knowledge;
- understanding the impact of science and technology on the environment and on people's lives; and
- recognising the bias in science and technology which impacts on people's lives.

ASSESSMENT STANDARDS

On the following pages, each Assessment Standard appears in **bold** type for Grades 4 to 6. These statements in bold type are **policy** and they provide a common national framework for assessing the learner's progress.

Under the **bold** statements of the Assessment Standards, there are illustrative examples, headed by the phrase *'Achievement is evident when the learner, for example,'.* These examples *are not policy*. Their purpose is to show how the learner gets better at achieving the Assessment Standard across the Grades.

TIRISANO
WORKING TOGETHER

Grade 4

Learning Outcome 1

SCIENTIFIC INVESTIGATIONS

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

Assessment Standards

We know this when the learner:

- **Plans investigations: Contributes ideas of familiar situations, needs or materials, and identifies interesting aspects which could lead to investigations.**

Achievement is evident when the learner, for example,

- suggests actions to try with the materials;
- talks about personal experiences, highlighting aspects which relate to science or technology;
- responds to suggestions like: 'Some people say ... What do you think?'

- **Conducts investigations and collects data: Explores the possibilities in available materials, finding out how they can be used.**

Achievement is evident when the learner, for example,

- notes and remarks on obvious changes or interesting details;
- tries own idea of how the materials might respond;
- perseveres or repeats the activity in different ways, experiencing the phenomenon in other ways.

Grade 5

Assessment Standards

We know this when the learner:

- **Plans investigations: Lists, with support, what is known about familiar situations and materials, and suggests questions for investigation.**

Achievement is evident when the learner, for example,

- contributes to a class list of interesting aspects of the situation;
- helps build a list of questions which self or classmates consider important;
- responds to teacher's suggestions of 'what would happen if...?'

- **Conducts investigations and collects data: Carries out instructions and procedures involving a small number of steps.**

Achievement is evident when the learner, for example,

- follows a simple worksheet to set up equipment and obtain observations;
- records observations by drawing and labelling;
- perseveres until the phenomenon happens or can be observed over a longer period of time (e.g. plants grow toward light from a mirror).

Grade 6

Assessment Standards

.We know this when the learner:

- **Plans investigations: Helps to clarify focus questions for investigation and describes the kind of information which would be needed to answer the question.**

Achievement is evident when the learner, for example,

- expresses focus questions in own words;
- considers classmates' ideas about kinds of information which could be relevant;
- suggests ways that the information could be gathered;
- clarifies task for other learners (e.g. 'What we need to find out is...').

- **Conducts investigations and collects data: Conducts simple tests or surveys and records observations or responses.**

Achievement is evident when the learner, for example,

- interviews people about their preferences on a particular matter or product;
- records new notes and measurements if teacher gives format for recording (e.g. lists, tables with headings);
- contributes entries to the class logbook (e.g. about changes in a growing plant or a caterpillar).

Grade 4

Learning Outcome 1 Continued

SCIENTIFIC INVESTIGATIONS

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

Assessment Standards

We know this when the learner:

- **Evaluates data and communicates findings: Talks about observations and suggests possible connections to other situations.**

Achievement is evident when the learner, for example,

- describes own perceptions of the event, relating to the purpose of the investigation;
- tells of related situations in which own ideas would be relevant.

Grade 5

Assessment Standards

We know this when the learner:

- **Evaluates data and communicates findings: Reports on the group's procedure and the results obtained.**

Achievement is evident when the learner, for example,

- offers observation data which have a connection to the focus question;
- describes before-and-after situations when they varied some factor in the situation.

Grade 6

Assessment Standards

We know this when the learner:

- **Evaluates data and communicates findings: Relates observations and responses to the focus question.**

Achievement is evident when the learner, for example,

- points to examples of data which confirm the finding;
- describes the data-collection methods and how data were recorded.

Grade 4

Learning Outcome 2

CONSTRUCTING SCIENCE KNOWLEDGE

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

Assessment Standards

We know this when the learner:

- **Recalls meaningful information: At the minimum, uses own most fluent language to name and describe objects, materials and organisms.**

Achievement is evident when the learner, for example,

- gives the names of animals in a picture, using own most fluent language;
- names and describes materials used in making a kite, using own most fluent language;
- names or describes functional parts of structures (e.g. 'beam' or 'strut'), using own most fluent language.

- **Categorises information: Sorts objects and organisms by a visible property.**

Achievement is evident when the learner, for example,

- follows instructions to sort animals into groups of those with two legs, with four legs, and with more than four legs.

Grade 5

Assessment Standards

We know this when the learner:

- **Recalls meaningful information: At the minimum, uses own most fluent language to name and describe features and properties of objects, materials and organisms.**

Achievement is evident when the learner, for example,

- identifies external parts of animals (e.g. noses, ears, tails, fur, gills, fins, scales, feathers) in own most fluent language;
- appropriately describes observable features of objects in the environment, animals, plants or features in the sky, in own most fluent language;
- matches moving mechanical systems to the definition of their motions (e.g. oscillation, rotation, movement in straight lines).

- **Categorises information: Creates own categories of objects and organisms, and explains own rule for categorising.**

Achievement is evident when the learner, for example,

- explains the grouping of a set of organisms with sentences such as: 'All these animals can get into trees, and these ones can't.'

Grade 6

Assessment Standards

We know this when the learner:

- **Recalls meaningful information: At the minimum, describes the features which distinguish one category of thing from another.**

Achievement is evident when the learner, for example,

- explains the definitions that distinguish mammals (which suckle their young) and reptiles (which do not);
- describes and names different cloud formations and links them to coming weather;
- recalls the difference between planets and stars.

- **Categorises information: Categorises objects and organisms by two variables.**

Achievement is evident when the learner, for example,

- categorises animals as mammals or reptiles, and then as carnivorous and herbivorous mammals, or carnivorous and herbivorous reptiles;
- categorises leaves by the type of vein patterns, and then each class of leaf by the type of margin.

Grade 4

Learning Outcome 2 Continued

CONSTRUCTING SCIENCE KNOWLEDGE

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

Assessment Standards

We know this when the learner:

(There are no further Assessment Standards for this Learning Outcome in Grade 4.)

Grade 5

Assessment Standards

We know this when the learner:

(There are no further Assessment Standards for this Learning Outcome in Grade 5.)

Grade 6

Assessment Standards

We know this when the learner:

- **Interprets information: At the minimum, interprets information by using alternative forms of the same information.**

Achievement is evident when the learner, for example,

- finds information in science texts by using glossaries, indexes and tables of contents;
- extracts information from bar graphs;
- puts in order pictures of the stages in the life cycle of fruit flies, when observing real fruit flies reproducing;
- identifies external parts of animals (e.g. noses, ears, tails, fur, gills, fins, scales, feathers), and tells as much as possible about their function in the animal's way of living.

Grade 4

Learning Outcome 3

SCIENCE, SOCIETY AND THE ENVIRONMENT

The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.

Assessment Standards

We know this when the learner:

- **Understands science and technology in the context of history and indigenous knowledge: Describes how local indigenous cultures have used scientific principles and technological products for specific purposes.**

Achievement is evident when the learner, for example,

- describes how own cultural group has, through history, found safe ways to collect and use water to drink;
- describes methods of sending messages over short and long distances.

- **Understands the impact of science and technology: Identifies features of technological devices around him or her, and tells about their purpose and usefulness.**

Achievement is evident when the learner, for example,

- suggests why having running water in a home might make people's lives easier;
- dismantles a tap or uses cross-section diagrams of a tap to explain why a closed tap may drip and waste water.

Grade 5

Assessment Standards

We know this when the learner:

- **Understands science and technology in the context of history and indigenous knowledge: Identifies ways in which products and technologies have been adapted from other times and cultures.**

Achievement is evident when the learner, for example,

- describes traditional shelters and relates some of their features to modern dwellings;
- listens and responds to stories about people who invented known devices (e.g. the telephone was invented by Alexander Graham Bell, who also taught deaf people to speak).

- **Understands the impact of science and technology: Identifies the positive and negative effects of scientific developments or technological products on the quality of people's lives and/or the environment.**

Achievement is evident when the learner, for example,

- expresses possible advantages and disadvantages of living in a modern city, and explains why some people might prefer to live in traditional dwellings in a rural area;
- compares results of an audit of water use in own home with results of other learners, noting differences in amounts used and for what purposes, as well as costs of getting the water.

Grade 6

Assessment Standards

We know this when the learner:

- **Understands science and technology in the context of history and indigenous knowledge: Describes similarities in problems and solutions in own and other societies in the present, the past and the possible future.**

Achievement is evident when the learner, for example,

- describes different ways that people in the past might have produced light at night;
- generates a list of basic human needs that are common to all societies, now and in the past.

- **Understands the impact of science and technology: Suggests ways to improve technological products or processes and to minimise negative effects on the environment.**

Achievement is evident when the learner, for example,

- describes how technology can be used to save energy by switching lights off automatically when not needed;
- uses personal observation or information from the local authority to flow-chart the water supply system from the taps (or water tank) back to the source, noting points of potential contamination.

Grade 4

Learning Outcome 3 Continued

SCIENCE, SOCIETY AND THE ENVIRONMENT

The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.

Assessment Standards

We know this when the learner:

- **Recognises bias in science and technology: Identifies difficulties some people may have in using technological devices.**

Achievement is evident when the learner, for example,

- identifies possible reasons why a disabled, older or younger person may find it difficult to open a tap.

Grade 5

Assessment Standards

We know this when the learner:

- **Recognises bias in science and technology: Describes the impact that lack of access to technological products and services has on people.**

Achievement is evident when the learner, for example,

- explains how poor or unemployed people might end up homeless through changes in technology.

Grade 6

Assessment Standards

We know this when the learner:

- **Recognises bias in science and technology: Suggests how technological products and services can be made accessible to those presently excluded.**

Achievement is evident when the learner, for example,

- suggests ways that light could be made available to remote rural areas.

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CHAPTER 4
SENIOR PHASE
(GRADES 7-9)

INTRODUCTION

The learner in the Senior Phase shows an extension and consolidation of Intermediate Phase types of reasoning, rather than a major change in the character of thinking. That is, the learner still achieves best when there is a personal experience of objects, materials and situations. There is an increasing ability to generalise and construct principles which the learner applies to a variety of situations. By Grade 9, most learners are able to see that certain quantities are constant even when change takes place. For example, the learner understands that the mass of an amount of substance remains the same even if the shape of the substance changes or it is broken up.

The learner can think through more complex problems without actually doing them, provided pictures or models are available to work with. When doing investigations, the learner is interested in questions like: 'Does it happen in other instances?' and 'Does it always happen?' and 'Is there a pattern?' The learner is interested in making and checking cause-and-effect predictions.

The language of the learner has developed so that an increasing number of relational concepts can be used and understood. This enables the learner to investigate things like structure and function, adaptation, and energy transfers by conduction and convection. Examples of these relational concepts are: 'all animals have structures which enable them to take in the food they need' and 'different substances conduct heat at different rates'. The learner can now use language to make finer distinctions, which demonstrates a better grasp of reality. For example, the learner can distinguish 'air' from 'steam', and 'steam' from 'smoke', and 'water vapour' from 'air' and the learner can also explain how the concepts 'air' and 'the atmosphere' relate to each other.

Although the learner's thinking is still dependent on personal experience of objects and situations, by Grade 9 some abstract thinking is taking place. The learner begins to reason about situations which have never been experienced, and to apply principles to consider the possibilities in such situations. The Natural Sciences curriculum of the school needs to plan for this, and to provide tasks which elicit this type of thinking.

The older Senior Phase learner enjoys considering principles of authority and ethics, and the curriculum should provide opportunities to examine and debate these issues in the scientific, technological and environmental context.

LEARNING OUTCOMES

Learning Outcome 1: Scientific Investigations

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

For this Learning Outcome, the Assessment Standards are
- planning investigations;
- conducting investigations and collecting data; and
- evaluating data and communicating findings.

Learning Outcome 2: Constructing Science Knowledge

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

For this Learning Outcome, the Assessment Standards are
- recalling meaningful information when needed;
- categorising information to reduce complexity and look for patterns;
- interpreting information; and
- applying knowledge to problems that are not taught explicitly.

Learning Outcome 3: Science, Society and the Environment

The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.

For this Learning Outcome, the Assessment Standards are
- understanding science as a human endeavour in cultural contexts; and
- understanding sustainable use of the earth's resources.

ASSESSMENT STANDARDS

On the following pages, each Assessment Standard appears in **bold type** for Grades 7 to 9. These statements in bold type are **policy** and they provide a common national framework for assessing the learner's progress.

Under the **bold** statements of the Assessment Standards, there are illustrative examples, headed by the phrase *'Achievement is evident when the learner, for example,'.* These examples *are not policy*. Their purpose is to show how the learner gets better at achieving the Assessment Standard across the Grades.

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Grade 7

Learning Outcome 1

SCIENTIFIC INVESTIGATIONS

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

Assessment Standards

We know this when the learner:

- **Plans investigations: Plans simple tests and comparisons, and considers how to make them fair.**

Achievement is evident when the learner, for example,

- identifies a testable question among a set of possible questions;
- contributes in ways that aid the investigation (e.g. asks: 'How could we measure X?' or 'Are we treating these two things in the same way?');
- gives reasons why a particular test is or is not fair.

- **Conducts investigations and collects data: Organises and uses equipment or sources to gather and record information**.

Achievement is evident when the learner, for example,

- systematically tests two or more items in order to compare them on the same common property;
- modifies procedure to obtain better observations or readings;
- uses indexes and glossaries to find useful data in books and catalogues.

Grade 8

Assessment Standards

We know this when the learner:

- **Plans investigations: Identifies factors to be considered in investigations and plans ways to collect data on them, across a range of values.**

Achievement is evident when the learner, for example,

- modifies a vague question to make it testable;
- discusses suitable headings of instruments (e.g. tables, interview schedules) which will be needed to record data while working;
- identifies factors which may be important to the investigation.

- **Conducts investigations and collects data: Collects and records information as accurately as equipment permits and investigation purposes require.**

Achievement is evident when the learner, for example,

- reviews data-collecting procedures during the investigation (e.g. varies the independent variable systematically while collecting data on the dependent variable);
- sees the need to use measuring instruments, and does so with reasonable accuracy.

Grade 9

Assessment Standards

We know this when the learner:

- **Plans investigations: Plans a procedure to test predictions or hypotheses, with control of an interfering variable.**

Achievement is evident when the learner, for example,

- expresses a question in a testable form (e.g. 'if we do X, then Y will happen' or 'X and Y are always related');
- identifies an interfering variable and explains how it will be taken into account;
- suggests sources of information which would provide suitable data;
- pilot-tests an interview schedule before doing a survey.

- **Conducts investigations and collects data: Contributes to systematic data collection, with regard to accuracy, reliability and the need to control a variable.**

Achievement is evident when the learner, for example,

- takes sufficient measurements or responses to gauge reliability;
- effectively controls at least one variable during data collection;
- compares information from other sources when different views are likely or important;
- discusses the meaning of the data being collected, comparing them with the focus question.

Grade 7

Learning Outcome 1 Continued

SCIENTIFIC INVESTIGATIONS

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

Assessment Standards

We know this when the learner:

- **Evaluates data and communicates findings: Generalises in terms of a relevant aspect and describes how the data supports the generalisation.**

Achievement is evident when the learner, for example,

- offers a strong example of evidence that supports the finding;
- considers what further work would be needed to decide whether the findings apply to other, similar situations.

Grade 8

Assessment Standards

We know this when the learner:

- **Evaluates data and communicates findings: Considers the extent to which the conclusions reached are reasonable answers to the focus question of the investigation.**

Achievement is evident when the learner, for example,

- lists items of evidence supporting the finding;
- describes how the plan and data collection procedure was checked against the focus question;
- considers factors in the group which might have affected their data.

Grade 9

Assessment Standards

We know this when the learner:

- **Evaluates data and communicates findings: Seeks patterns and trends in the data collected and generalises in terms of simple principles.**

Achievement is evident when the learner, for example,

- shows how items of evidence support each other;
- presents data in suitable forms in order to show trends and patterns;
- considers possible bias in sources of information that are used;
- suggests further investigations which would help to confirm the generalisation.

Grade 7

Learning Outcome 2

CONSTRUCTING SCIENCE KNOWLEDGE

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

Assessment Standards

We know this when the learner:

- **Recalls meaningful information: At the minimum, recalls definitions and complex facts.**

Achievement is evident when the learner, for example,

- distinguishes vertebrates from invertebrates;
- lists the planets in our solar system, in their correct order and relations of size;
- tells how electric and magnetic forces affect materials differently;
- explains what is meant by a variable in an investigation.

- **Categorises information: Compares features of different categories of objects, organisms and events.**

Achievement is evident when the learner, for example,

- uses a simple classification system to group root types of familiar plants;
- compiles a list of uses of household acids, based on common properties, and compares them with a list of household bases;
- takes the role of a zookeeper who needs to build animal enclosures in suitable groups, based on the particular needs of the animals.

Grade 8

Assessment Standards

We know this when the learner:

- **Recalls meaningful information: At the minimum, recalls procedures, processes and complex facts.**

Achievement is evident when the learner, for example,

- describes some symbiotic relationships among living things;
- describes the steps in separating alcohol and water;
- makes and uses a model of a flower to explain how the parts (e.g. petals, sepals, anthers, stigma) enable the functions of pollination and fertilisation.

- **Categorises information: Applies classification systems to familiar and unfamiliar objects, events, organisms and materials.**

Achievement is evident when the learner, for example,

- uses a simple classification system to group root types of plants, including unfamiliar species, and link them to dicotyledon vs. monocotyledon classification;
- recalls and correctly applies classifications (e.g. mammals vs. birds, fish, reptiles and amphibians; metals vs. non-metals; insulators vs. conductors; planets vs. stars).

Grade 9

Assessment Standards

We know this when the learner:

- **Recalls meaningful information: At the minimum, recalls principles, processes and models.**

Achievement is evident when the learner, for example,

- describes how heart, lungs and stomach work together to provide a human with energy;
- describes separation of alcohol and water in terms of the relevant principle;
- describes the key statements of the particle kinetic model of matter;
- describes the difference between a dependent and an independent variable.

- **Categorises information: Applies multiple classifications to familiar and unfamiliar objects, events, organisms and materials.**

Achievement is evident when the learner, for example,

- uses alternative classifications for the same thing (e.g. uses information to construct three classifications of copper):
  - copper is a solid (rather than a liquid or gas),
  - copper is also a metal (rather than a non-metal),
  - copper is also an element (rather than a compound);
- considers the implications of categorising humans by physical characteristics.

Grade 7

Learning Outcome 2 Continued

CONSTRUCTING SCIENCE KNOWLEDGE

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

Assessment Standards

We know this when the learner:

- **Interprets information: Interprets information by identifying key ideas in text, finding patterns in recorded data, and making inferences from information in various forms (e.g. pictures, diagrams, text).**

Achievement is evident when the learner, for example,

- creates headings for paragraphs in some passages from a textbook;
- reconstructs jumbled or partly-deleted text by reference to photos or diagrams;
- identifies properties of materials from reading a story about the Wright brothers choosing materials to make the first aeroplane;
- generates own sentences about relationships of the type 'when X happens, then Y also happens'.

Grade 8

Assessment Standards

We know this when the learner:

- **Interprets information: Interprets information by translating tabulated data into graphs, by reading data off graphs, and by making predictions from patterns.**

Achievement is evident when the learner, for example,

- annotates diagrams by interpreting text passages about the topic;
- draws graphs of population growth over time, from data provided in a table;
- studies photographs of fossil animals and makes inferences about their ways of feeding and moving;
- generates own sentences about relationships (e.g. of the type 'if you change X, then Y changes also').

Grade 9

Assessment Standards

We know this when the learner:

- **Interprets information: Interprets information by translating line graphs into text descriptions and vice versa, by extrapolating from patterns in tables and graphs to predict how one variable will change, by identifying relationships between variables from tables and graphs of data, and by hypothesising possible relationships between variables.**

Achievement is evident when the learner, for example,

- creates word-webs and mind maps by previewing chapters of text;
- estimates the doubling time of a population from graph data of an increasing population;
- reads off, from a line graph, the range of temperatures at which yeast is most active;
- relates melting and freezing, evaporation and condensation to a particle kinetic model of changes of state;
- generates own sentences such as 'we think that X is the cause of Y, because Y happens only if X happens'.

Grade 7

Learning Outcome 2 Continued

CONSTRUCTING SCIENCE KNOWLEDGE

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

Assessment Standards

We know this when the learner:

- **Applies knowledge: Applies conceptual knowledge by linking a taught concept to a variation of a familiar situation.**

Achievement is evident when the learner, for example,

- identifies which processes of energy transfer were involved as a hot car engine cooled down;
- applies the concept of reproduction to debate the question of whether rivers and fires are living or non-living things;
- evaluates the 'fair test' aspect of simple investigations carried out by other people.

Grade 8

Assessment Standards

We know this when the learner:

- **Applies knowledge: Applies conceptual knowledge to somewhat unfamiliar situations by referring to appropriate concepts and processes.**

Achievement is evident when the learner, for example,

- explains why a thermal insulator keeps cold objects cold as well as keeping hot objects hot;
- applies the concept of saturation to explain why a crystal growing in solutions begins to shrink if the water is warmed;
- writes a story about survival from the point of view of an animal in the middle of a food chain in a natural habitat, a garden or a farm.

Grade 9

Assessment Standards

We know this when the learner:

- **Applies knowledge: Applies principles and links relevant concepts to generate solutions to somewhat unfamiliar problems.**

Achievement is evident when the learner, for example,

- interprets simple models of ecosystems in order to make predictions of the effects when one factor changes;
- uses molecule models to hypothesise possible products in a simple chemical reaction;
- uses provided data and concepts of life processes to list and describe the problems explorers would have in surviving on Mars.

Grade 7

Learning Outcome 3

SCIENCE, SOCIETY AND THE ENVIRONMENT

The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.

Assessment Standards

We know this when the learner:

- **Understands science as a human endeavour: Compares differing interpretations of events.**

Achievement is evident when the learner, for example,

- identifies and explains differences in two reports of the same event or investigation;
- describes difficulties in observing certain phenomena (e.g. behaviour of nocturnal animals), and suggests ways of gaining better information.

- **Understands sustainable use of the earth's resources: Analyses information about sustainable and unsustainable use of resources**.

Achievement is evident when the learner, for example,

- analyses data provided about water use in South Africa, comparing the amounts used in various production processes and noting amounts released as effluent;
- presents the analysis as a report to a policy-making body such as Parliament, with recommendations;
- prepares several devices for cooking on, using different types of fuel and finding out the costs and sources of the fuels.

Grade 8

Assessment Standards

We know this when the learner:

- **Understands science as a human endeavour: Identifies ways in which people build confidence in their knowledge systems.**

Achievement is evident when the learner, for example,

- replicates an interesting investigation and findings of a learner at another school;
- reports on difficulties that scientists have had in clarifying ideas and dealing with doubts;
- describes ways in which traditional wisdom is accumulated and passed on.

- **Understands sustainable use of the earth's resources: Identifies information required to make a judgement about resource use.**

Achievement is evident when the learner, for example,

- plans and carries out an audit of all uses of water around the school premises (including gardening, car-washing and drinking), and develops an implementation plan to improve water management in the school;
- conducts a waste-production audit at the school, analysing types of waste, their sources, potential health hazards, and whether or not the waste is biodegradable.

Grade 9

Assessment Standards

We know this when the learner:

- **Understands science as a human endeavour: Recognises differences in explanations offered by the Natural Sciences Learning Area and other systems of explanation.**

Achievement is evident when the learner, for example,

- identifies sources and nature of authority in two differing explanations for an event, coming from two differing world-views;
- compares ways that knowledge is held in an oral tradition and in a written, public tradition;
- traces the way a theory about nature has changed over the centuries.

- **Understands sustainable use of the earth's resources: Responds appropriately to knowledge about the use of resources and environmental impacts.**

Achievement is evident when the learner, for example,

- organises an audit of water use in sections of the community, analyses the data and prepares it for presentation in a local newspaper or radio talk show;
- contributes to formulating a school environment policy, including constructive ways to deal with waste material and to improve water management.

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CHAPTER 5
CORE KNOWLEDGE AND CONCEPTS

INTRODUCTION

As stated in Chapter 1, the Natural Sciences Learning Area comprises a wide variety of fields of inquiry. Because of this diversity, it is not possible to list all science knowledge under one heading. In this Revised National Curriculum Statement, the fields which scientists study have been grouped into four main content areas:

- *Life and Living* focuses on life processes and healthy living, on understanding balance and change in environments, and on the importance of biodiversity.
- *Energy and Change* focuses on how energy is transferred in physical and biological systems, and on the consequences that human needs and wants have for energy resources.
- *Planet Earth and Beyond* focuses on the structure of the planet and how the earth changes over time, on understanding why and how the weather changes, and on the earth as a small planet in a vast universe.
- *Matter and Materials* focuses on the properties and uses of materials, and on understanding their structure, changes and reactions in order to promote desired changes.

Several points should be noted about the core knowledge statements which comprise this Chapter.

- These core knowledge statements are neither Learning Outcome statements nor Assessment Standards.
- The statements are core, minimum knowledge for Learning Programmes in the Natural Sciences Learning Area. Learning Programmes must draw content from all four strands over a Phase.
- This core knowledge is applicable when doing all three Learning Outcomes. By Grade 9, every learner should be able to interpret and apply these concepts in both familiar and somewhat unfamiliar situations.
- The core knowledge statements may be clustered and taught in various sequences.
- The knowledge statements for the Intermediate and Senior Phases represent a notional 70% of the time in a Phase's Learning Programme. The other 30% of the time should be used to extend these minimum knowledge statements; alternatively, science content from contexts which are significant to the learners and the local community may be used. These contexts may be economic, environmental, social or health matters, for example.
- The core knowledge statements represent four major fields of scientific study, and these have been refined into sub-strands. Each sub-strand is summarised by a general proposition or unifying statement; the unifying statement could be explored at increasing depth in the General Education and Training Band of schooling, in Further Education and Training, and in Higher Education. The unifying statement also provides a broad statement under which further content which may be added in terms of the 30% time for local options.

CORE KNOWLEDGE AND CONCEPTS IN LIFE AND LIVING

Life Processes and Healthy Living	Interactions in Environments	Biodiversity, Change and Continuity
Unifying statement: Living things, including humans and invisibly small organisms, can be understood in terms of life processes, functional units and systems.	*Unifying statement: Organisms in ecosystems are dependent for their survival on the presence of abiotic factors and on their relationship with other organisms.*	*Unifying statement: The huge diversity of forms of life can be understood in terms of a history of change in environments and in characteristics of plants and animals throughout the world over millions of years.*
Foundation Phase		
❖ Many of our body parts correspond to parts of animals, such as limbs, heads, eyes, ears, feet, and in many cases animals use them for the same purposes we do. ❖ Animals and plants have needs similar needs to ours, for food, water and air.	❖ We depend on plants and animals for food, and we breed certain animals and grow certain plants as crops. ❖ We see cultural diversity in the kinds of food people like to eat. ❖ Some animals, like flies and ticks, carry germs which can make people sick.	❖ There is a large variety of plants and animals, which have interesting visible differences but also similarities, and they can be grouped by their similarities. ❖ Plants and animals change as they grow, and as the years pass, and as the seasons change.
Intermediate Phase		
❖ Green plants produce their own food and grow by using water and substances from the air and soil. Energy from light is needed to change these simple substances into food and plant material. Green plants are the only organisms that can produce food in their own bodies.	❖ Animals cannot make their own food, and so some animals eat plants for food while some animals eat other animals. All animals ultimately depend on green plants for their food. ❖ Ecosystems are self-contained areas where a wide variety of plant and animal species live and reproduce. They depend on each other and on the non-	❖ New plants can grow from certain parts of a parent plant. This is called vegetative reproduction and does not need seeds. The new plants have all the characteristics of the parent plant.

Life Processes and Healthy Living	Interactions in Environments	Biodiversity, Change and Continuity
❖ Living things need food for energy, to move, grow and to repair damage to their bodies ('tissues'). Animals including humans have digestive systems for getting nutrients from food. Humans need a balanced diet from certain groups of food to be healthy. ❖ All living things can respond to their environment in various ways; animals, including humans, have specialised sense organs. ❖ Living things can move themselves; animals, including humans, can move themselves from place to place. Many species of animals move themselves by means of muscles attached to some kind of skeleton, which is either inside or on the surface of the body.	living environment. The life and reproduction of all the organisms in an ecosystem depend on the continuing growth and reproduction of plants. ❖ Organisms' habitats are the places where they feed, hide, produce young and, in many cases, shelter the young until the young have a better chance of survival. Animal species live in their habitats in a variety of social patterns (such as being solitary, pairing for life, or living in packs, prides, herds, troops or colonies). ❖ Ecosystems depend on soil. Soil forms by natural processes from rock and dead plant and animal material, but it takes an extremely long time to form. Substances which plants take from the soil must be replaced to maintain fertility of the soil. *(Links with soil in Planet Earth and Beyond)* ❖ Water plays an important role in ecosystems, sustaining both plant and animal life. Industrial, agricultural and domestic activities may have a serious impact on the quality and quantity of water available in an area. *(Links with Planet Earth and Beyond)*	❖ Sexual reproduction is the process by which two individual plants or animals produce another generation of individuals. The next generation's individuals look like the parents but always have slight differences ('variation') from their parents and from each other. ❖ South Africa has a rich fossil record of animals and plants which lived many millions of years ago. Many of those animals and plants were different from the ones we see nowadays. Some plants and animals nowadays have strong similarities to fossils of ancient plants and animals. We infer from the fossil record and other geological observations that the diversity of living things, natural environments and climates were different in those long-ago times. *(Links with fossils in Planet Earth and Beyond)*

Life Processes and Healthy Living	Interactions in Environment	Biodiversity, Change and Continuity
Senior Phase		
❖ Humans go through physical changes as they age; puberty means that the body is ready for sexual reproduction. ❖ Human reproduction begins with the fusion of sex cells from mother and father, carrying the patterns for some characteristics of each. ❖ Conception is followed by a sequence of changes in the mother's body, and during this period the future health of the unborn child can be affected. ❖ Knowledge of how to prevent the transmission of sexually transmitted diseases, including the HIVirus, must be followed by behaviour choices. ❖ Green plants use energy from the sun, water and carbon dioxide from the air to make food by photosynthesis. This chemical reaction is central to the survival of all organisms living on earth. ❖ Animals, including humans, require protein, fat, carbohydrates, minerals, vitamins and water. Food taken in is absorbed into the body via the intestine. Surplus food is stored as fat or carbohydrate. ❖ Animals, including humans, have a circulatory system which includes the heart, veins, arteries and capillaries, and	❖ Human reproduction is more than conception and birth; it involves adults raising children, which requires judgement and values and usually depends on the behaviour of other people in a community and environment. ❖ Each species of animal has characteristic behaviours which enable it to feed, find a mate, breed, raise young, live in a population of the same species, or escape threats in its particular environment. These behaviours have arisen over long periods of time that the species population has been living in the same environment. ❖ All organisms have adaptations for survival in their habitats (such as adaptations for maintaining their water balance, obtaining and eating the kind of food they need, reproduction, protection or escape from predators.) ❖ An ecosystem maintains numerous food webs and competition for food among different individuals and populations. South Africa has certain ecosystems which have exceptional biodiversity. All uses of these areas must be based on principles of sustainable development	❖ Offspring of organisms differ in small ways from their parents and generally from each other. This is called variation in a species. ❖ Natural selection kills those individuals of a species which lack the characteristics that would have enabled them to survive and reproduce successfully in their environment. Individuals which have characteristics suited to the environment reproduce successfully and some of their offspring carry the successful characteristics. Natural selection is accelerated when the environment changes; this can lead to the extinction of species. ❖ Variations in human biological characteristics such as skin colour, height, and so on. have been used to categorise groups of people. These biological differences do not indicate differences in innate abilities of the groups concerned. Therefore, such categorisation of groups by biological differences is neither scientifically valid nor exact; it is a social construct. ❖ Biodiversity enables ecosystems to sustain life and recover from changes to the environment. Loss of

Life Processes and Healthy Living	Interactions in Environments	Biodiversity, Change and Continuity
which carries nutrients and oxygen to all parts of the body and removes waste products. Oxygen, which is provided by the breathing system, reacts with food substances to release energy. *(Links with Energy and Change)* ❖ All living things, including humans, have means of eliminating waste products which are produced during life processes. Water plays an important role in this process. ❖ Water makes up a large proportion of all living things, and their health depends on water passing through them in various ways, using structures (such as kidneys, skin or stomata) which can fulfil this function.	❖ Pollution interferes with natural processes that maintain the interdependencies and diversity of an ecosystem. ❖ Many biological changes, including decomposition and recycling of matter in ecosystems and human diseases, are caused by invisibly small, quickly-reproducing organisms.	biodiversity seriously affects the capacity of ecosystems and the earth, to sustain life. Classification is a means to organise the great diversity of organisms and make them easier to study. The two main categories of animals are the vertebrates and invertebrates, and among vertebrates the five classes are amphibians, birds, fish, reptiles and mammals. ❖ Human activities, such as the introduction of alien species, habitat destruction, population growth, pollution and over-consumption, result in the loss of biodiversity. This becomes evident when more species become endangered, or, ultimately, extinct. ❖ Extinctions also occur through natural events. Mass extinctions have occurred in the past, suggesting that huge changes to environments have occurred. However, these changes occurred very slowly, compared to the fast rate at which humans can destroy plant and animal species. *(Links with Planet Earth and Beyond)* ❖ The cell is the basic unit of most living things, and an organism may be formed from one or many cells. Cells themselves carry on life processes such as nutrition, respiration, excretion and reproduction, which sustain the life of the organism as a whole.

CORE KNOWLEDGE AND CONCEPTS IN ENERGY AND CHANGE

Energy Transfers and Systems	Energy and Development in South Africa
Unifying statement: Energy is transferred through biological or physical systems, from energy sources. With each energy transfer, some of the energy becomes less available for our use, and therefore we need to know how to control energy transfers.	*Unifying statement: Energy is available from a limited number of sources, and the sustainable development of countries in our region depends on the wise use of energy sources.*
Foundation Phase	
❖ When we say we feel 'full of energy', we mean we feel ready to move fast or do a lot of work.	❖ People who do not have enough food or the right kind food to eat, feel tired and lack energy.
Intermediate Phase	
❖ There are sources of energy in nature which can be used for doing useful work; examples are wind, the sun, fire, animals' muscles and falling water. Energy sources can be dangerous but can also be used in systems which people design, such as boats, windmills, carts, cookers and turbines. ❖ A system is made of two or more parts that work together or affect each other. Systems may be as simple as two grindstones that crush grain between them, or have several parts, like an electrical circuit, or have many parts, like an ecosystem. Systems transfer energy from one part of the system to other parts. ❖ We can design and make systems which store energy. Electric cells, stretched springs, food and chemicals which can react are examples of such systems. ❖ An electrical circuit is a system. It is a path of electrical components and conductors with no breaks in it, and an energy source to make electric charges flow around the conducting path. The energy source may be cells or the 'mains' electricity supply. The circuit transfers energy from the source to resistors such as bulbs, heating-wires, solenoids or motors in the circuit. *(Links with the Technology Learning Area)*	❖ Humans and animals get energy from eating plants and from eating animals that ate plants. The sun provides energy for plants to grow and produce food. *(Links with Life and Living)* ❖ Energy from electrical sources can be dangerous and so we need safety rules for using electricity.

Energy Transfers and Systems	Energy and Development in South Africa
❖ Whenever a substance changes by expanding, contracting, melting evaporating, condensing or solidifying, it means that the substance has gained or given away some energy. *(Links with Matter and Materials)* ❖ Sound transfers energy from a vibrating body to our ears. Vibrations travel through a medium, which may be a solid, a liquid or a gas. We hear a change in the rate of vibration as a change in pitch.	*(There are no further core knowledge statements for Energy and Development in South Africa in this Phase.)*

Senior Phase

❖ Energy can be stored in a system as potential energy, either by the positions of the bulk parts of the system or by its particles (atoms and molecules) which have the potential to react with each other and release energy. Examples of potential energy are the stored energy of a compressed spring or the stored energy of particles which could react in a fuel-and-air mixture, or in the food and body of a living thing. ❖ Potential energy can be released as kinetic energy in the motion of parts of the system, either in the motion of bulk parts of the system or in the motion of particles of the system. Examples of the release of kinetic energy are the motion of a released spring or the faster motion of the particles of hot gases when a fuel-air mixture burns, or the body movement of humans and animals. Kinetic energy is transferred to parts within the system and energy is also transferred to the system's surroundings. When energy is transferred, it causes changes in the system and the system's surroundings. ❖ There is an unlimited number of systems which can be made to store or transfer energy. The possible systems include electrical, mechanical (including spring and friction systems), chemical, gravitational, nuclear, solar, biomass, optical (light), acoustical (sound) and thermal (heat) systems as well as human bodies and ecosystems.	❖ Energy sources such as wind, sun, and water in high dams are renewable. Fuels such as coal, gas and oil are not renewable energy sources, because they cannot be replaced. *(Links with Planet Earth and Beyond)* ❖ Development and relief of poverty depends on energy supplies, particularly electrical energy, and the systems to deliver the energy to where it is needed. ❖ Large-scale electricity supply depends on generation systems which use a few energy sources such as burning coal, nuclear reactions, burning gas and falling water. Use of any of these sources has environmental implications. For example, when coal is burned to generate electricity, gases are produced that affect the atmosphere and local and global environments. *(Links with Planet Earth and Beyond)*

Energy Transfers and Systems	Energy and development in South Africa
❖ All physical systems that people use (for example, appliances, vehicles and human bodies) waste some of the energy they receive, and the wasted energy goes to heat up the surroundings. When the energy has gone into heating the surroundings, we can no longer use that energy to do work for us. ❖ Hot objects transfer energy to colder objects, until the objects reach the same temperature. Hot objects transfer their energy, as heat, in three ways: by conduction, by convection and by radiation. These transfers may be useful or wasteful. Wasteful heat transfer can be controlled by reducing conduction, convection and radiation in a system. Similarly, useful heat transfer can be increased by improving conduction, convection and radiation in a system. ❖ All organisms in an ecosystem need energy from other parts of the ecosystem. Energy is transferred from part to part of an ecosystem and each part retains only a fraction of the energy it received. *(Links with Life and Living)* ❖ Light travels away from a light-giving body until it strikes an object. The object may then absorb the light, or refract it or reflect it. Light transfers energy to other objects. *(Links with Life and Living)* ❖ Objects can exert forces on each other, thereby forming a system which can store or transfer energy. They may do so by physical contact or by forces which act through a field. Field forces are the magnetic, electric and gravitational forces. All forces act in pairs, so that if body A exerts a force on body B, B exerts an equal and opposite force on A.	❖ Other electricity-generation systems have smaller environmental impact but may cost more in the short term. Better design of buildings and appliances, and better practices in using energy, can save costs to consumers and lessen the environmental impact of exploiting energy sources ❖ Many people in South Africa use wood for heating and cooking. Plants such as trees can be a renewable energy source if more trees are planted and the soil is managed well. *(Links with Planet Earth and Beyond)*

CORE KNOWLEDGE AND CONCEPTS IN THE PLANET EARTH AND BEYOND

Our Place in Space	Atmosphere and Weather	The Changing Earth
Unifying statement: Our planet is a small part of a vast solar system in an immense galaxy.	*Unifying statement: The atmosphere is a system which interacts with the land, lakes and oceans and which transfers energy and water from place to place.*	*Unifying statement: The Earth is composed of materials which are continually being changed by forces on and under the surface.*
Foundation Phase		
❖ Many different objects can be observed in the sky. Examples are birds, clouds, aeroplanes, the sun, stars, the moon, planets and satellites. All these objects have properties, locations and movements that can be investigated with a view to determining patterns, relationships and trends.	❖ Weather changes from day to day in ways that can be recorded and sometimes predicted. There are occasional unusual weather events like storms, floods or tornados which impact on people's lives.	❖ Soil and rocks vary in appearance and texture from place to place. By investigation, learners can find out that some soils erode more easily than others do, while some soil types support plant life better than others. They could investigate what some of the factors involved might be.
Intermediate Phase		
❖ Day and night may be explained by the rotation of the earth on its own axis as it circles the sun. ❖ The moon's apparent shape changes in a predictable way and these changes may be explained by its motion relative to the earth and sun. Many cultural traditions and special occasions are related to the shape or position of the moon.	❖ Weather may change from day to day. Weather can be described by measurable quantities, such as temperature, wind direction and speed, and precipitation. ❖ Other changes take longer to occur. An example of this type of medium-term change is annual seasonal changes, which may be described in terms of changes in rainfall, average wind direction, length of day or night and average maximum and minimum temperatures.	❖ Earth materials are solid rocks and soils, water, and the gases of the atmosphere. ❖ Erosion of the land creates the landforms that we see and also results in the deposition of rock particles that may be lithified to form sedimentary rocks. Erosion and deposition can be very slow and gradual or it can occur in short catastrophic events like floods.

Our Place in Space	Atmosphere and Weather	The Changing Earth
❖ The stars' apparent positions in relation to each other do not change, but the nightly position of the star pattern as a whole changes slowly over the course of a year. Many cultures recognise and name particular star patterns, and have used them for navigation or calendars.	❖ Water changes its form as it moves in a cycle between the hydrosphere, atmosphere and lithosphere in what is known as the 'water cycle'. ❖ Most of planet earth is covered by water in the oceans. A small portion of the planet is covered by land that is separated into continents. At the poles there are ice caps. Only a small amount of the water is available for living things on land to use and only a small portion of the land is easily habitable by humans.	❖ Rocks may be classified into igneous, sedimentary and metamorphic types. This classification is based on the origins and history of the rocks. ❖ Soil consists of weathered rocks and decomposed organic material from dead plants, animals, and bacteria. Soil forms by natural processes, but it takes an extremely long time to form. Soils have properties of colour and texture, capacity to retain water, and ability to support the growth of many kinds of plants, including those in our food supply. *(Links with Life and Living)* ❖ Fossils are the remains of life forms that have been preserved in stone. Fossils are evidence that life, climates and environments in the past were very different from those of today. *(Links with Life and Living)* ❖ The quality of water resources is determined by the quality of the catchment area. Proper care and management of catchment areas and water resources is essential, and factors affecting the quality of water resources and catchment areas may be investigated. *(Links with Life and Living)*

Our Place in Space	Atmosphere and Weather	The Changing Earth
Senior Phase		
❖ The earth is the third planet from the sun in a system that includes the moon, the sun, eight other planets and their moons, and smaller objects, such as asteroids and comets. The sun, an average star, is the central and largest body in the solar system. ❖ Most objects in the solar system are in regular and predictable motion. The motions of the earth and moon explain such phenomena as the day, the year, phases of the moon, and eclipses. ❖ Gravity is the force that keeps planets in orbit around the sun and governs the rest of the motion in the solar system. Gravity alone holds us to the earth's surface. ❖ The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle.	❖ The outer layers of the earth are the atmosphere, the hydrosphere and the lithosphere. We live in the biosphere, which is where all these layers interact to support life. ❖ Climate varies in different parts of the globe. It tends to be cold in the polar regions and hot in the tropics. Different types of plants and animals are adapted to living in different climatic regions. *(Links with Life and Living)* ❖ The atmosphere is a mixture of nitrogen and oxygen in fairly constant proportions, and small quantities of other gases that include water vapour. The atmosphere has different properties at different elevations. ❖ The atmosphere protects the earth from harmful radiation and from most objects from outer space that would otherwise strike the earth's surface. The atmosphere is the most important factor in keeping the earth's surface temperature from falling too low or rising too high to sustain life.	❖ The planet earth has a layered structure, with a lithosphere, a hot, convecting mantle and a dense, metallic core. ❖ Lithospheric plates larger than some continents constantly move at rates of centimetres per year, in response to movements in the mantle. Major geological events, such as earthquakes, volcanic eruptions and mountain building, result from these plate motions. ❖ Landforms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.

Our Place in Space	Atmosphere and Weather	The Changing Earth
❖ Space exploration programmes involve international collaboration in the use of earth-based telescopes (such as SALT in South Africa) and telescopes in orbit. Robotic spacecraft travel long distances to send back data about the planets and other bodies in our solar system, and research is being done on ways to send people to investigate the planet Mars.	❖ Human activities and natural events can slightly change the composition and temperature of the atmosphere. Some effects of these small changes may be changes in annual weather patterns and long-term changes in rainfall and climate.	❖ Many of the organisms in South Africa's fossil record cannot be easily classified into groups of organisms alive today, and some are found in places where present-day conditions would not be suitable for them. This is evidence that life and conditions on the surface of earth have changed through time. *(Links with Life and Living*) ❖ Fossil fuels such as coal, gas and oil are the remains of plants and animals that were buried and fossilised at high pressures. These fuels are not renewable in our lifetimes. *(Links with Energy and Change)* ❖ Mining is a major industry in South Africa, with local examples in all the nine provinces. It is important in terms of the supply of coal for energy, essential raw materials for other industries, employment and earnings for the country. A great number of other industries depend on the mining industry. Legislation controls mining, with regard to safety and environmental effects.

CORE KNOWLEDGE AND CONCEPTS IN MATTER AND MATERIALS

Properties and Uses of Materials	Structure, Reactions and Changes of Materials
Unifying statement: We can classify materials by their properties, in order to establish types and patterns. Properties determine the selection of materials for particular uses.	*Unifying statement: We can modify materials in ways we choose, through our understanding of their sub-structure.*
Foundation Phase	
❖ Materials have different properties such as texture, colour, strength and heaviness, and can be classified by these properties. We make things with materials which have the properties we want.	❖ Substances can be mixed and sometimes changes can be seen, such as the dissolving of a solid or new colours when food colourings/paints are mixed.
Intermediate Phase	
❖ Pure substances have melting temperatures and boiling temperatures which are characteristic for each substance, and help us to identify the substance. ❖ Materials are evaluated and classified by their properties (such as hardness, flexibility, thermal conductivity or insulation, electrical conductivity or insulation, whether they can be magnetised, solubility and rusting). ❖ Major classes of materials are metals, ceramics (including glasses) and polymers (including plastics and fibres). Composite materials combine the properties of two or more materials.	❖ Some changes to materials are temporary but other changes are permanent. ❖ Substances change when they receive or lose energy as heat. These changes include contraction and expansion, melting, evaporation, condensation and solidification. *(Links with Energy and Change)* ❖ The dissolving of a substance in a solvent depends on variables which affect the rate of dissolving.

Properties and Uses of Materials	Structure, Reactions and Changes of Materials
Senior Phase	
❖ Substances in different states ('phases') have distinct properties such as crystalline structures, or compressibility/incompressibility, or tendency to diffuse. ❖ Dark-coloured surfaces get hotter than light-coloured surfaces when exposed to radiating sources of energy like the sun. Dark-coloured objects radiate their energy as heat more readily than shiny light-coloured objects. *(Links with Energy and Change)* ❖ Some materials are magnetised by electric currents or magnets. Some materials can be electrically charged by rubbing them with a different material. *(Links with Energy and Change)* ❖ Some conductors and circuit components reduce the current in an electric circuit to a significant extent and are called resistors. Resistors can be selected or designed to control currents. ❖ A pure substance cannot be separated into different substances, while a mixture can be separated, usually by physical means. Differences in properties can be used to separate mixtures of different substances (by methods such as filtration, distillation, evaporation, chromatography or magnetism). *(Links with Matter and Materials)* ❖ Specific gases may be separated from the air or produced in reactions, and have many uses in industry and other sectors of the economy. Oxygen, hydrogen and carbon dioxide have characteristic properties and reactions by which we can identify them. ❖ Extracting useful materials from raw materials depends on chemical reactions and methods of separation. ❖ Raw materials, from which processed materials are made, must be mined, grown or imported from other countries. Raw materials that are mined are non-renewable and mining has environmental costs. Growing raw materials involves choices about the use of arable land and water catchment areas.	❖ A particle model of matter can explain physical changes of substances such as melting, evaporation, condensation, solidification, diffusion and heating by conduction. ❖ Many household substances are acidic or basic. Indicators are substances that react with acids and soluble bases to produce products that have distinctive colours. Acids and bases neutralise one another to form salts. Acids have characteristic reactions with metals, metal oxides, hydroxides and carbonates. ❖ Many chemical reactions need some energy to get started; many chemical reactions give off energy as they happen. ❖ Elements are made of just one kind of atom, whereas compounds are made of two or more kinds of atoms in fixed proportions. Elements may react to form compounds, and compounds may be decomposed into their elements. Energy input is needed to break a compound into its elements, whereas energy is given out when elements react to form a compound.

CORE KNOWLEDGE AND CONCEPTS IN MATTER AND MATERIALS

Properties and uses of materials	Structure, Reactions and Changes of Materials
(There are no further core knowledge statements for Matter and Materials in this Phase.)	❖ Oxygen has characteristic reactions with metals and non-metals, forming oxides. Some of these oxides dissolve in water to form acidic or alkaline solutions. Some metals react more readily with oxygen than other metals. Corrosion of iron is an economically important reaction which can be prevented through an understanding of the reactions between iron, water and oxygen. ❖ The reaction of oxygen with food releases energy in the cells of living things. *(Links with Life and Living)*

CHAPTER 6
LEARNER ASSESSMENT

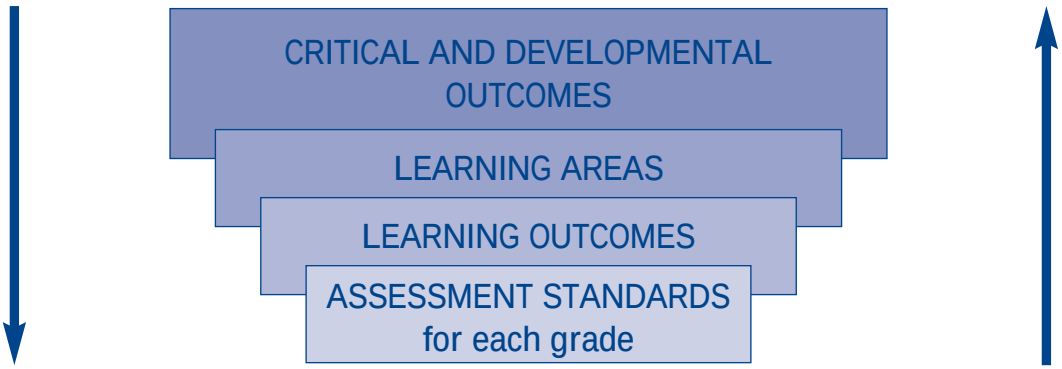
INTRODUCTION

The assessment framework of the Revised National Curriculum Statement for Grades R-9 (Schools) is based on the principles of outcomes-based education. Assessment should provide indications of learner achievement in the most effective and efficient manner, and ensure that learners integrate and apply knowledge and skills. Assessment should also help students to make judgements about their own performance, set goals for progress, and provoke further learning.

To assist in the process of learner assessment, this Revised National Curriculum Statement:

- outlines the Learning Outcomes and their associated Assessment Standards in each Learning Area and for each grade in the General Education and Training (Grades R-9) band;
- contextualises the Critical and Developmental Outcomes within the Learning Outcomes and Assessment Standards; and
- places Assessment Standards at the heart of the assessment process in every grade. Assessment Standards describe the level at which learners should demonstrate their achievement of the Learning Outcome(s) and the ways (depth and breadth) of demonstrating their achievement.

The following diagram illustrates the interaction between the design elements of this Revised National Curriculum Statement:



ASSESSMENT PRINCIPLES USED IN OUTCOMES-BASED EDUCATION

Definition

Assessment in the Revised National Curriculum Statement for Grades R-9 (Schools) is a continuous, planned process of gathering information about the performance of learners measured against the Assessment Standards of the Learning Outcomes. It requires clearly-defined criteria and a variety of appropriate strategies to enable teachers to give constructive feedback to learners and to report to parents, and other interested people.

Key Elements

Outcomes-based education is a way of teaching and learning which makes it clear what learners are expected to achieve. The principle by which it works is that the teacher states beforehand what the learners are expected to achieve. The teacher's task is to teach in order to help learners to satisfy the requirements of the Assessment Standards in the curriculum; the learners' task is to learn or do what the Assessment Standards expect. Assessment is essential to outcomes-based education because it must be possible to assess when a learner has achieved what is required in each grade.

To help learners to reach their full potential, assessment should be:

- transparent and clearly focused;
- integrated with teaching and learning;
- based on predetermined criteria or standards;
- varied in terms of methods and contexts; and
- valid, reliable, fair, learner-paced, and flexible enough to allow for expanded opportunities.

Purposes of Assessment

The main purpose of assessing learners should be to enhance individual growth and development, to monitor the progress of learners and to facilitate their learning. Other uses of assessment include:

- *baseline assessment of prior learning*
  Baseline assessment usually takes place at the beginning of a grade or phase to establish what learners already know. It assists teachers to plan learning programmes and learning activities.

- *diagnostic assessment*
  Diagnostic assessment is used to find out about the nature and cause of barriers to learning experienced by specific learners. It is followed by guidance, appropriate support and intervention strategies.

- *formative assessment*
  Formative assessment monitors and supports the process of learning and teaching, and is used to inform learners and teachers about learners' progress so as to improve learning. Constructive feedback is given to enable learners to grow.

- *summative assessment*
  Summative assessment gives an overall picture of learners' progress at a given time, for example, at the end of a term or year, or on transfer to another school.

- *systemic assessment*
  Systemic assessment is a way of monitoring the performance of the education system. One component of this is the assessment of learner performance in relation to national indicators. Systemic assessment is conducted at the end of each phase of the General Education and Training band. A representative sample of schools and learners is selected provincially or nationally for systemic assessment.

CONTINUOUS ASSESSMENT

Characteristics of Continuous Assessment

Continuous assessment is the chief method by which assessment takes place in the Revised National Curriculum Statement. It covers all the outcomes-based education assessment principles and ensures that assessment:

- *takes place over a period of time and is ongoing:* Learning is assessed regularly and the records of learners' progress are updated throughout the year.

- *supports the growth and development of learners:* Learners become active participants in learning and assessment, understand the criteria that are used for assessment activities, are involved in self-evaluation, set individual targets for themselves, reflect on their learning, and thereby experience raised self-esteem.

- *provides feedback from learning and teaching:* Feedback is a crucial element in formative assessment. Methods of feedback include appropriate questioning, focusing the teacher's oral and written comments on what was intended to be achieved by an assessment activity, and encouragement to a learner.

- *allows for the integrated assessment:* This may include assessing a number of related Learning Outcomes within a single activity, and combining a number of different assessment methods. Competence in particular Learning Outcomes can be demonstrated in many different ways, and thus a variety of assessment methods and opportunities must be provided through which learners can demonstrate their ability.

- *uses strategies that cater for a variety of learner needs (language, physical, psychological, emotional and cultural):* Continuous assessment allows teachers to be sensitive to learners with special education needs and to overcome barriers to learning through flexible approaches. In any group of learners, there are different rates and styles of learning. All learners do not need to be assessed at the same time and in the same way.

- *allows for summative assessment:* The accumulation of the results of continuous assessment activities provides an overall picture of a learner's progress at a given time. Summative assessment needs to be planned carefully from the beginning of the year, to include a variety of assessment strategies - for example,

exercises, tasks, projects, school and class tests - which will provide learners with a range of opportunities to show what they have learned.

Assessment Strategies

The choice of what assessment strategies to use is a subjective one, unique to each teacher, grade and school, and dependent on the teacher's professional judgement. The availability of space and resources influences this decision, but even when resources are similar, teachers differ in the way that they make their choices.

The methods chosen for assessment activities must be appropriate to the Assessment Standards to be assessed, and the purpose of the assessment must be clearly understood by all the learners and teachers involved. Competence can be demonstrated in a number of ways. Thus a variety of methods is needed to give learners an opportunity to demonstrate their abilities more fully.

Common Tasks for Assessment

The purpose of Common Tasks for Assessment is to:

- ensure consistency in teacher judgements;
- promote common standard setting;
- strengthen the capacity for school-based continuous assessment;
- increase the accuracy of the assessment process and tools;
- ensure that the school-based assessment tasks properly assess competencies and achievements; and
- ensure expanded opportunities for learners.

Common Tasks for Assessment may be set at national, provincial, district or cluster level, are conducted at school level, and are moderated externally.

MANAGING ASSESSMENT

People Involved in Assessment

The school and the teachers have overall responsibility for the assessment of learners. Teachers are expected to create a valid, reliable and credible assessment process. Provincial policies should ensure the involvement of learners, school assessment teams, district support teams, support services, and parents, as appropriate.

School Assessment Programme

Each school must develop an assessment programme based on provincial and national assessment guidelines. It needs to have a School Assessment Plan and a team to facilitate the implementation of this policy. The team should have representatives from each Phase and Learning Area.

To ensure a professional approach to assessment, the school assessment programme must outline clearly:

- the way continuous assessment is planned and implemented;
- how record books are to be kept, their accessibility and security;
- the assessment codes determined by the province;
- internal verification of assessment;

- how moderation takes place in the school;
- the frequency and method of reporting;
- the monitoring of all assessment processes; and
- the training of staff in areas of assessment.

Areas where in-school training needs to take place include:

- how to use criteria/rubrics to assess;
- finding agreement between teachers in the same grade about what is considered necessary to satisfy the Learning Outcomes;
- how to write comments for assessment results and reports; and
- achieving a common understanding of the school's assessment programme.

KEEPING RECORDS

Record Books

Good record keeping is essential in all assessment, particularly in continuous assessment. A record book or file must be kept up to date by each teacher. It should contain:

- learners' names;
- dates of assessment;
- name and description of the assessment activity;
- the results of assessment activities, according to Learning Areas or Learning Programmes;
- comments for support purposes.

All records must be accessible, easy to interpret, securely kept, confidential and helpful in the teaching and reporting process.

The school assessment programme determines the details of how record books must be completed. The assessment codes are used to express how the learner is performing against the Learning Outcomes. Codes used must be clear and understood by learners and parents.

Codes to Use for Assessment

There are many ways in which feedback from assessment can be provided to learners and recorded by teachers. Choosing the best way to do so for an assessment activity will depend on a number of factors, such as:

- the number of learners in the class and the amount of time available to the teacher;
- the complexity and the length of the assessment activity;
- the learning content or skills being assessed (e.g. Mathematics or writing);
- how quickly feedback is given;
- how individualised the feedback is;
- the criteria (or rubrics) used by the teacher to describe learners' performances and
- whether learners' performance is to be compared to peers, to previous performance, and/or the requirements of the Assessment Standards and Learning Outcomes.

Some assessment codes are better for some purposes than for others. For example, comments can be detailed, individual and provide suggestions for improvement. Comments are also useful for reporting on learner performance against Assessment Standards. However, comments take long to write and are not very easy to record. Codes such as 'Excellent', 'Very Good', 'Good', 'Competent', and 'Insufficient' are much quicker to write and allow assessment of progress against previous work and against Assessment Standards. However, they do not provide the detail made possible by comments. Marks, on the other hand, are quickly recorded and can be added together, multiplied and divided. They are useful for assessing learners' performance in relation to others in the class, and to other grades or schools. However, they provide little information on learners' performance against the Assessment Standards.

Examples, among many others, of further assessment codes are:

- not yet achieved, almost there, achieved;
- satisfactory performance, needs support;
- A, B, C; and
- phrases (or rubrics) designed especially for the assessment activity or report.

Whatever assessment code is used, feedback is more effective when combined with comments. There is more likely to be an improvement in achievement when learners are given written feedback rather than marks only. Although marks and percentages are very useful for recording purposes, as it is easy to write marks into a record book, they are often not useful for feedback and reporting. Other problems presented by marks are that they can be aggregated and manipulated and that they hide much about learners' achievement and progress. If learners have completed more than one assessment activity there is a temptation to use the marks arithmetically, to add and to average. When this is done, marks lose their usefulness to feed back information. An average or aggregate mark hides the fact that a learner might have achieved the intended learning well in one aspect but not in another.

Marks give an overall impression of achievement but hide the reasons for the assessment of the achievement (or lack of achievement) from the learner, and prevent a focus on learning something from the assessment. They also do not describe learner progress in the curriculum well. In many cases maintaining the same mark (provided it is a satisfactory one) is regarded as an indication of good progress. A mark of 70 against the Grade 5 Assessment Standards and a mark of 70 against the Grade 6 Assessment Standards disguises completely the progress a learner might have made during the year, which is best described in a statement, code, or comment(s).

National Codes

In recording or reporting on learner achievement in the Learning Outcomes specific to a grade, the following codes are to be used:

4 = Learner's performance ***has exceeded*** the requirements of the Learning Outcome for the grade.
3 = Learner's performance ***has satisfied*** the requirements of the Learning Outcome for the grade.
2 = Learner's performance ***has partially satisfied*** the requirements of the Learning Outcome for the grade.
1 = Learner's performance ***has not satisfied*** the requirements of the Learning Outcome for the grade.

Progression Schedules

At the end of each year, a progression schedule must be completed, and signed by the principal and a departmental official. The progression schedule is a record with summary information about the progress of all learners in the grade in the school.

The progression schedule should include the following information:

- name of the school and school stamp;
- list of learners in each grade;
- codes for progress in each Learning Area (National Coding System);
- codes for progress in each grade (progress to the next grade or stay in the same grade);
- comments on strengths and areas for support in each Learning Area; and
- date and signature of principal, teacher or other educator, and departmental official.

Learner Profiles

A learner profile is a continuous record of information that gives an all-round impression of a learner's progress, including the holistic development of values, attitudes and social development. It assists the teacher in the next grade or school to understand the learner better, and therefore to respond appropriately to the learner. The profile must be safeguarded for every learner and should accompany learners throughout their school careers.

The following kinds of information should be included in a learner profile:

- personal information;
- physical condition and medical history;
- schools attended and record of attendance;
- participation and achievements in extra-curricular activities;
- emotional and social behaviour;
- parental involvement;
- areas needing additional support;
- summative end-of-year overall report; and
- progression summary records of the schooling years.

Notes:

- The learner profile replaces all previous continuous record documents that have been used by schools, such as record cards, tutor cards and Edlab cards. The central purpose of a learner profile is to assist the learner by having access to the variety of information it includes.
- Personal information in a profile should never be used to discriminate unfairly against a learner.
- Learner profiles should not be confused with portfolios. A portfolio is a method of assessment that gives the learner and teacher together an opportunity to consider work done for a number of assessment activities. The work is placed in a folder, file or box. The learner profile, on the other hand, is a record containing information about a learner.

REPORTS

Information to be Included in Reports

Teachers need to be accountable to learners, parents, the education system and the broader community in assessing their learners. This takes place through reporting. In addition to written reports, oral or practical presentations, displays of learners' work and exhibitions might be used.

Every report on a learner's overall progress should include information on:

- the learning achieved;
- the learner's competencies;
- support needed; and
- constructive feedback, which should contain comments about the learner's performance in relation to peers and the learner's previous performance in relation to the requirements of the Learning Areas.

Reporting to parents should be done on a regular basis to encourage their involvement and participation. Teachers must report at the end of each term using formal report cards.

It will usually not be possible to give information on achievement in each Learning Outcome. However, reports should give information on achievement in each of the Learning Areas or Learning Programmes (in the case of the Foundation Phase).

Report Cards

The minimum requirements for a report card are:

1) Basic information

- name of school;
- name of learner;
- grade of learner;
- date of birth of learner;
- year and term;
- date and signature of parent or guardian;
- date and signature of teacher;
- date and signature of principal;
- dates of closing and opening of school;
- school stamp;
- school attendance profile; and
- the explanation of the codes of the national coding system.

2) Strengths and needs

- Give a description of the strengths, developmental needs, or areas of support required by the learner in each Learning Area or Learning Programme.

- Use the national coding system to evaluate performance against the Assessment Standards and the Learning Outcomes covered thus far - it is not necessary to give a code for each Learning Outcome. In an end of year report, the overall performance of the learner in the Learning Areas must be shown.

3) Comments on each Learning Area or Learning Programme

Give comments on each Learning Area or Learning Programme, with special emphasis on students who have exceeded the requirements or need further support. Comments on specific strengths and areas of support should be linked to the Assessment Standards. These comments will allow parents, learners and other educators to gain an understanding of what support the learner needs.

REFERENCE LISTS

CURRICULUM AND ASSESSMENT GLOSSARY

This is an alphabetical list of key terms used in designing the Revised National Curriculum Statement Grades R-9 (Schools) and its learner assessment principles.

assessment - a continuous planned process of gathering information on learner performance, measured against the Assessment Standards

Assessment Standards - the knowledge, skills and values that learners need to show to achieve the Learning Outcomes in each grade

baseline assessment - initial assessment used to find out what learners already know

continuous assessment - assessment model that encourages integration of assessment into teaching and the development of learners through ongoing feedback

critical outcomes - together with the Developmental Outcomes, key outcomes of Revised National Curriculum Statement Grades R-9 (Schools), that are inspired by the Constitution; they include core life skills for learners, such as communication, critical thinking, activity and information management, group and community work, and evaluation skills

Curriculum 2005 - the first version of the post-apartheid National Curriculum Statement. That 1997 education policy document gives a framework for Early Childhood Development, General Education and Training, Further Education and Training, and Adult Basic Education and Training. This Revised National Curriculum Statement Grades R-9 (Schools) aims to strengthen Curriculum 2005

developmental outcomes - together with the Critical Outcomes, key outcomes of the Revised National Curriculum Statement Grades R-9 (Schools) that are inspired by the Constitution; they include enabling learners to learn effectively and to become responsible, sensitive and productive citizens

exit-level - when learners complete Grade 9 and are awarded the General Education and Training Certificate

formative assessment - a form of assessment that assesses learner progress during the learning process in order to provide feedback that will strengthen learning

Foundation Phase - the first phase of the General Education and Training Band: Grades R, 1, 2 and 3

General Education and Training Band - the ten compulsory schooling years, made up of the Foundation, Intermediate and Senior Phases

General Education and Training Certificate - the certificate obtained on successful completion of the General Education and Training Band

integration - a key design principle of the Revised National Curriculum Statement Grades R-9 (Schools), that requires learners to use their knowledge and skills from other Learning Areas, or from different parts of the same Learning Area, to carry out tasks and activities

Intermediate Phase - the second phase of the General Education and Training Band: Grades 4, 5 and 6

language of learning and teaching - the language that is most used in a particular learning and teaching environment; some learners experience learning and teaching in an additional language (not their home language)

Learning Areas - the eight fields of knowledge in the Revised National Curriculum Statement Grades R-9 (Schools): Languages, Mathematics, Natural Sciences, Technology, Social Sciences, Arts and Culture, Life Orientation, and Economic and Management Sciences

Learning Area statements - the statement for each Learning Area that sets out its Learning Outcomes and Assessment Standards

learner profile - an all-round record of a learner's progress, including personal information, social development, support needs, samples of work and annual reports

Learning Programmes - programmes of learning activities, including content and teaching methods; these are guided by the Revised National Curriculum Statement Grades R-9 (Schools) but developed by provinces, schools and teachers

national coding system - a standard national system of performance codes to report on a learner's progress

outcomes - the results at the end of the learning process in outcomes-based education; these outcomes help shape the learning process

outcomes-based education - a process and achievement-oriented, activity-based and learner-centred education process; in following this approach, Curriculum 2005 and the Revised National Curriculum Statement Grades R-9 (Schools) aim to encourage lifelong learning

portfolio - individual file or folder of each learner's work

progression - a key design principle of the Revised National Curriculum Statement Grades R-9 (Schools) that enables the learner to gradually develop more complex, deeper and broader knowledge, skills and understanding in each grade

progression schedules - end-of-year tool for recording the progress of all learners in a grade, including codes for progress in each Learning Area and grade, and comments on support needed

summative assessment - different from formative assessment, as it is about regular reports of a learner's progress, usually at the end of the term or year

NATURAL SCIENCES LEARNING AREA GLOSSARY

anthropology - the study of human origins

bias - a predisposition or prejudice towards or against something

biodiversity - the wide range of plants and animals existing on the earth, including those plants and animals which have not yet been discovered by scientists

core knowledge - the 'big ideas' or principles or main concepts around which the details of knowledge are built (e.g. the principle of 'continuity of life' represents core knowledge for the Life and Living knowledge strand)

fair test - an investigation where all other variables that might interfere with the result are controlled (held constant) so as to ensure that the results obtained are due to the factor being tested and not any other factor (e.g. if the effect of wind on transpiration rate is being tested by measuring transpiration on a calm day and on a windy day, it is necessary to ensure that all other factors that might affect the rate of transpiration - such as humidity - are the same on both days). See also **interfering variable**.

focus areas - a subsection of one of the four major content areas around which the knowledge in the Natural Sciences Learning Area has been organised

indigenous knowledge - knowledge that has been produced by groups of people living in an area (e.g. province, country, continent) for a long period of time. Some of this knowledge may have served as the basis for modern technologies. In some instances, this knowledge and the wisdom that accompanies it have been lost, either because established practices have been changed or because people have moved away from their well-known environments.

interfering variable - factor which might affect the results of an investigation and thus give a misleading result. Such variables need to be held constant (controlled) in order for the investigation to be considered a fair one. See also **fair test.**

knowledge strand - one of the four major content areas around which scientific knowledge has been organised in this Learning Area (Life and Living, Earth and Beyond, Matter and Minerals, Energy and Change)

most fluent language - the language which best enables learners to participate in discussions. This might be the mother tongue, or the language of learning and teaching, or another language. When teachers develop a methodology to allow the use of various languages in the classroom, many learners who were previously excluded by language become enthusiastic contributors.

process skills - learning strategies that people use in the process of understanding a new situation or in presenting their understanding of it (see Chapter 1)

scientific literacy - includes aspects of Mathematics, Technology, Social Sciences and Natural Sciences, including:

(i) familiarity with the natural world and the interconnectedness of systems;
(ii) awareness of the relationships between Natural Sciences, Mathematics and Technology;
(iii) understanding some of the central concepts and principles of science, including the process of scientific inquiry;
(iv) knowing that mathematics, science and technology are human activities where ideas are contested and developed over time;
(v) understanding that in choosing technological solutions we make use of scientific analysis and judgements of risk and appropriateness.

world-views - the basic assumptions people hold about the meaning of life, the way the world works, and how events may be explained