education

Department of Education
REPUBLIC OF SOUTH AFRICA

National Curriculum Statement
Grades 10-12
(General)

LIFE SCIENCES

Department of Education

Sol Plaatje House
123 Schoeman Street
Private Bag X895
Pretoria 0001
South Africa
Tel: +27 12 312-5911
Fax: +27 12 321-6770

120 Plein Street
Private Bag X9023
Cape Town 8000
South Africa
Tel: +27 21 465-1701
Fax: +27 21 461-8110

http://education.pwv.gov.za

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HOW TO USE THIS BOOK

This document is a policy document divided into four chapters. It is important for the reader to read and integrate information from the different sections in the document. The content of each chapter is described below.

Chapter 1 - Introducing the National Curriculum Statement

This chapter describes the principles and the design features of the National Curriculum Statement Grades 10 – 12 (General). It provides an introduction to the curriculum for the reader.

Chapter 2 - Introducing the Subject

This chapter describes the definition, purpose, scope, career links and Learning Outcomes of the subject. It provides an orientation to the Subject Statement.

Chapter 3 - Learning Outcomes, Assessment Standards, Content and Contexts

This chapter contains the Assessment Standards for each Learning Outcome, as well as content and contexts for the subject. The Assessment Standards are arranged to assist the reader to see the intended progression from Grade 10 to Grade12. The Assessment Standards are consequently laid out in double-page spreads. At the end of the chapter is the proposed content and contexts to teach, learn and attain Assessment Standards.

Chapter 4 – Assessment

This chapter deals with the generic approach to assessment being suggested by the National Curriculum Statement. At the end of the chapter is a table of subject-specific competence descriptions. Codes, scales and competence descriptions are provided for each grade. The competence descriptions are arranged to demonstrate progression from Grade 10 to Grade 12.

Symbols

The following symbols are used to identify Learning Outcomes, Assessment Standards, grades, codes, scales, competence description, and content and contexts.


= Learning Outcome


= Scale


= Assessment Standard


= Competence Description


= Grade


= Content and Contexts


= Code

CONTENTS

ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
CASS	Continuous Assessment
CEDAW	Committee on the Elimination of Discrimination Against Women
CTA	Common Task Assessment
DO	Developmental Outcome
FBO	Faith-Based Organisation
DNA	Deoxyribonucleic Acid
FET	Further Education and Training
GET	General Education and Training
HIV	Human Immunodeficiency Virus
IKS	Indigenous Knowledge Systems
NCS	National Curriculum Statement
NQF	National Qualifications Framework
OBE	Outcomes-Based Education
SAQA	South African Qualifications Authority
SETA	Sector Education and Training Authority
STI	Sexually Transmitted Infection
TB	Tuberculosis

CHAPTER 1

INTRODUCING THE NATIONAL CURRICULUM STATEMENT

The adoption of the Constitution of the Republic of South Africa (Act 108 of 1996) provided a basis for curriculum transformation and development in South Africa. The Preamble 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.

The Constitution further states that 'everyone has the right … to further education which the State, through reasonable measures, must make progressively available and accessible'.

The National Curriculum Statement Grades 10 – 12 (General) lays a foundation for the achievement of these goals by stipulating Learning Outcomes and Assessment Standards, and by spelling out the key principles and values that underpin the curriculum.

PRINCIPLES

The National Curriculum Statement Grades 10 – 12 (General) is based on the following principles:

- social transformation;
- outcomes-based education;
- high knowledge and high skills;
- integration and applied competence;
- progression;
- articulation and portability;
- human rights, inclusivity, environmental and social justice;
- valuing indigenous knowledge systems; and
- credibility, quality and efficiency.

Social transformation

The Constitution of the Republic of South Africa forms the basis for social transformation in our post-apartheid society. The imperative to transform South African society by making use of various transformative tools stems from a need to address the legacy of apartheid in all areas of human activity and in education in particular. Social transformation in education is aimed at ensuring that the educational imbalances of the past are redressed, and that equal educational opportunities are provided for all sections of our population. If social transformation is to be achieved, all South Africans have to be educationally affirmed through the recognition of their potential and the removal of artificial barriers to the attainment of qualifications.

Outcomes-based education

Outcomes-based education (OBE) forms the foundation for the curriculum in South Africa. It strives to enable all learners to reach their maximum learning potential by setting the Learning Outcomes to be achieved by the end of the education process. OBE encourages a learner-centred and activity-based approach to education. The National Curriculum Statement builds its Learning Outcomes for Grades 10 – 12 on the Critical and Developmental Outcomes that were inspired by the Constitution and developed through a democratic process.

The Critical Outcomes require learners to be 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 require learners to be 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.

High knowledge and high skills

The National Curriculum Statement Grades 10 – 12 (General) aims to develop a high level of knowledge and skills in learners. It sets up high expectations of what all South African learners can achieve. Social justice requires the empowerment of those sections of the population previously disempowered by the lack of knowledge and skills. The National Curriculum Statement specifies the minimum standards of knowledge and skills to be achieved at each grade and sets high, achievable standards in all subjects.

Integration and applied competence

Integration is achieved within and across subjects and fields of learning. The integration of knowledge and skills across subjects and terrains of practice is crucial for achieving applied competence as defined in the National Qualifications Framework. Applied competence aims at integrating three discrete competences – namely, practical, foundational and reflective competences. In adopting integration and applied competence, the National Curriculum Statement Grades 10 – 12 (General) seeks to promote an integrated learning of theory, practice and reflection.

Progression

Progression refers to the process of developing more advanced and complex knowledge and skills. The Subject Statements show progression from one grade to another. Each Learning Outcome is followed by an explicit statement of what level of performance is expected for the outcome. Assessment Standards are arranged in a format that shows an increased level of expected performance per grade. The content and context of each grade will also show progression from simple to complex.

Articulation and portability

Articulation refers to the relationship between qualifications in different National Qualifications Framework levels or bands in ways that promote access from one qualification to another. This is especially important for qualifications falling within the same learning pathway. Given that the Further Education and Training band is nested between the General Education and Training and the Higher Education bands, it is vital that the Further Education and Training Certificate (General) articulates with the General Education and Training Certificate and with qualifications in similar learning pathways of Higher Education. In order to achieve this articulation, the development of each Subject Statement included a close scrutiny of the exit level expectations in the General Education and Training Learning Areas, and of the learning assumed to be in place at the entrance levels of cognate disciplines in Higher Education.

Portability refers to the extent to which parts of a qualification (subjects or unit standards) are transferable to another qualification in a different learning pathway of the same National Qualifications Framework band. For purposes of enhancing the portability of subjects obtained in Grades 10 – 12, various mechanisms have been explored, for example, regarding a subject as a 20-credit unit standard. Subjects contained in the National Curriculum Statement Grades 10 – 12 (General) compare with appropriate unit standards registered on the National Qualifications Framework.

Human rights, inclusivity, environmental and social justice

The National Curriculum Statement Grades 10 – 12 (General) seeks to promote human rights, inclusitivity, environmental and social justice. All newly-developed Subject Statements are infused with the principles and practices of social and environmental justice and human rights as defined in the Constitution of the Republic of South Africa. In particular, the National Curriculum Statement Grades 10 – 12 (General) is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors.

The National Curriculum Statement Grades 10 – 12 (General) adopts an inclusive approach by specifying minimum requirements for all learners. It acknowledges that all learners should be able to develop to their full potential provided they receive the necessary support. The intellectual, social, emotional, spiritual and physical needs of learners will be addressed through the design and development of appropriate Learning Programmes and through the use of appropriate assessment instruments.

Valuing indigenous knowledge systems

In the 1960s, the theory of multiple-intelligences forced educationists to recognise that there were many ways of processing information to make sense of the world, and that, if one were to define intelligence anew, one would have to take these different approaches into account. Up until then the Western world had only valued logical, mathematical and specific linguistic abilities, and rated people as 'intelligent' only if they were adept in these ways. Now people recognise the wide diversity of knowledge systems through which people make sense of and attach meaning to the world in which they live. Indigenous knowledge systems in the South African context refer to a body of knowledge embedded in African philosophical thinking and social practices that have evolved over thousands of years. The National Curriculum Statement Grades 10 – 12 (General) has infused indigenous knowledge systems into the Subject Statements. It acknowledges the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution. As many different perspectives as possible have been included to assist problem solving in all fields.

Credibility, quality and efficiency

The National Curriculum Statement Grades 10 – 12 (General) aims to achieve credibility through pursuing a transformational agenda and through providing an education that is comparable in quality, breadth and depth to those of other countries. Quality assurance is to be regulated by the requirements of the South African Qualifications Authority Act (Act 58 of 1995), the Education and Training Quality Assurance Regulations, and the General and Further Education and Training Quality Assurance Act (Act 58 of 2001).

THE KIND OF LEARNER THAT IS ENVISAGED

Of vital importance to our development as people are the values that give meaning to our personal spiritual and intellectual journeys. *The Manifesto on Values, Education and Democracy* (Department of Education, 2001:9-10) states the following about education and values:

Values and morality give meaning to our individual and social relationships. They are the common currencies that help make life more meaningful than might otherwise have been. An education system does not exist to simply serve a market, important as that may be for economic growth and material prosperity. Its primary purpose must be to enrich the individual and, by extension, the broader society.

The kind of learner that is envisaged is one who will be imbued with the values and act in the interests of a society based on respect for democracy, equality, human dignity and social justice as promoted in the Constitution.

The learner emerging from the Further Education and Training band must also demonstrate achievement of the Critical and Developmental Outcomes listed earlier in this document. Subjects in the Fundamental Learning Component collectively promote the achievement of the Critical and Developmental Outcomes, while specific subjects in the Core and Elective Components individually promote the achievement of particular Critical and Developmental Outcomes.

In addition to the above, learners emerging from the Further Education and Training band must:

- have access to, and succeed in, lifelong education and training of good quality;
- demonstrate an ability to think logically and analytically, as well as holistically and laterally; and
- be able to transfer skills from familiar to unfamiliar situations.

THE KIND OF TEACHER THAT IS ENVISAGED

All teachers and other educators are key contributors to the transformation of education in South Africa. The National Curriculum Statement Grades 10 – 12 (General) visualises 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 subject specialists.

STRUCTURE AND DESIGN FEATURES

Structure of the National Curriculum Statement

The National Curriculum Statement Grades 10 – 12 (General) consists of an Overview Document, the Qualifications and Assessment Policy Framework, and the Subject Statements.

The subjects in the National Curriculum Statement Grades 10 – 12 (General) are categorised into Learning Fields.

What is a Learning Field?

A Learning Field is a category that serves as a home for cognate subjects, and that facilitates the formulation of rules of combination for the Further Education and Training Certificate (General). The demarcations of the Learning Fields for Grades 10 – 12 took cognisance of articulation with the General Education and Training and Higher Education bands, as well as with classification schemes in other countries.

Although the development of the National Curriculum Statement Grades 10 – 12 (General) has taken the twelve National Qualifications Framework organising fields as its point of departure, it should be emphasised that those organising fields are not necessarily Learning Fields or 'knowledge' fields, but rather are linked to occupational categories.

The following subject groupings were demarcated into Learning Fields to help with learner subject combinations:

- Languages (Fundamentals);
- Arts and Culture;
- Business, Commerce, Management and Service Studies;
- Manufacturing, Engineering and Technology;
- Human and Social Sciences and Languages; and
- Physical, Mathematical, Computer, Life and Agricultural Sciences.

What is a subject?

Historically, a subject has been defined as a specific body of academic knowledge. This understanding of a subject laid emphasis on knowledge at the expense of skills, values and attitudes. Subjects were viewed by some as static and unchanging, with rigid boundaries. Very often, subjects mainly emphasised Western contributions to knowledge.

In an outcomes-based curriculum like the National Curriculum Statement Grades 10 – 12 (General), subject boundaries are blurred. Knowledge integrates theory, skills and values. Subjects are viewed as dynamic, always responding to new and diverse knowledge, including knowledge that traditionally has been excluded from the formal curriculum.

A subject in an outcomes-based curriculum is broadly defined by Learning Outcomes, and not only by its body of content. In the South African context, the Learning Outcomes should, by design, lead to the achievement of the Critical and Developmental Outcomes. Learning Outcomes are defined in broad terms and are flexible, making allowances for the inclusion of local inputs.

What is a Learning Outcome?

A Learning Outcome is a statement of an intended result of learning and teaching. It describes knowledge, skills and values that learners should acquire by the end of the Further Education and Training band.

What is an Assessment Standard?

Assessment Standards are criteria that collectively describe what a learner should know and be able to demonstrate at a specific grade. They embody the knowledge, skills and values required to achieve the Learning Outcomes. Assessment Standards within each Learning Outcome collectively show how conceptual progression occurs from grade to grade.

Contents of Subject Statements

Each Subject Statement consists of four chapters and a glossary:

- *Chapter 1, Introducing the National Curriculum Statement:* This generic chapter introduces the National Curriculum Statement Grades 10 – 12 (General).
- *Chapter 2, Introducing the Subject:* This chapter introduces the key features of the subject. It consists of a definition of the subject, its purpose, scope, educational and career links, and Learning Outcomes.
- *Chapter 3, Learning Outcomes, Assessment Standards, Content and Contexts:* This chapter contains Learning Outcomes with their associated Assessment Standards, as well as content and contexts for attaining the Assessment Standards.
- *Chapter 4, Assessment:* This chapter outlines principles for assessment and makes suggestions for recording and reporting on assessment. It also lists subject-specific competence descriptions.
- *Glossary:* Where appropriate, a list of selected general and subject-specific terms are briefly defined.

LEARNING PROGRAMME GUIDELINES

A Learning Programme specifies the scope of learning and assessment for the three grades in the Further Education and Training band. It is the plan that ensures that learners achieve the Learning Outcomes as prescribed by the Assessment Standards for a particular grade. The Learning Programme Guidelines assist teachers and other Learning Programme developers to plan and design quality learning, teaching and assessment programmes.

CHAPTER 2

LIFE SCIENCES

DEFINITION

The subject Life Sciences involves the systematic study of life in the changing natural and human-made environment. This systematic study involves critical inquiry, reflection, and the understanding of concepts and processes and their application in society.

PURPOSE

The study of the Life Sciences enables learners to explore those concepts that are essential for understanding basic life processes and the interrelationship and interdependence of components of the living and the physical world. Learners will develop inquiry, problem solving, critical thinking and other skills, and will use them to interpret and use Life Sciences concepts in explaining phenomena. They will be able to apply scientific knowledge in their personal lives and as responsible citizens in ways that will contribute to a healthy lifestyle and the sustainable management of resources. Through the study of the Life Sciences, learners can develop an understanding of the nature of science, the influence of ethics and biases, and the interrelationship of science, technology, indigenous knowledge, environment and society.

The subject Life Sciences enables learners to understand biological, physiological, environmental, technological and social processes that impact on the environment (e.g. food production, distribution and consumption, health promotion, conservation, sustainable living and genetic engineering). All these have implications for the socio-economic and technological advancement of society. A study of concepts and processes in the Life Sciences uses contributions from the past to inform the present, and therefore promotes construction of new knowledge. Exploring indigenous knowledge systems related to science exposes learners to different worldviews and allows them to appreciate, compare and evaluate different scientific perspectives.

Life Sciences will be accessible to learners with special learning needs, ensuring that learners with diverse abilities, interests and learning styles are given equal opportunities to achieve success.

SCOPE

The subject Life Sciences develops the following competences:

- scientific inquiry and problem-solving skills;
- construction and application of Life Sciences knowledge; and

- understanding the interrelationship of Life Sciences, technology, the environment and society, and of different attitudes and values.

Scientific inquiry and problem-solving skills

The skills that learners develop and use in the Life Sciences allow them to solve problems, think critically, make decisions, find answers and satisfy their curiosity. They are the focus of science learning and assessment activities in classrooms. These skills cannot be developed in isolation. They are best developed within the context of an expanding framework of knowledge. Learners were introduced to some of these skills in the General Education and Training band, but these skills need further development. In addition, new skills need to be developed. Details are given in the Learning Programme Guidelines.

Construction and application of Life Sciences knowledge

Knowledge in the Life Sciences is constructed and applied within the following knowledge areas:

- tissues, cells and molecular studies;
- structures and control of processes in basic life systems;
- environmental studies; and
- diversity, change and continuity.

It is important to remember that competences should not be developed in isolation, but within the context of these knowledge areas.

Concepts are developed within the four knowledge areas in each grade and are treated at varying levels of complexity. Examples of this are given under the Assessment Standards and in the section on 'Content and Contexts for the Attainment of Assessment Standards' in Chapter 3.

Life Sciences, technology, environment and society

Learners develop an understanding of the relationships between Life Sciences, technology, the environment and society. This understanding and the appropriate attitudes and values that are developed contribute to learners becoming informed and responsible citizens in their community and in South African society. It is important, therefore, for learners to understand:

- the scientific enterprise and, in particular, how scientific knowledge develops;
- that scientific knowledge is in principle tentative and subject to change as new evidence becomes available;
- that the knowledge that is contested and accepted often depends on social, religious and political factors;
- that other science understandings, such as African indigenous knowledge systems, should also be considered;

- that the explanations and limitations of scientific models and different theories need to be evaluated;
- how science relates to their everyday lives, to the environment and to a sustainable future; and
- the importance of scientific and technological advancements and their impact on human lives.

EDUCATIONAL AND CAREER LINKS

Life Sciences builds on the foundation laid by the Natural Sciences Learning Area in the General Education and Training band. The Natural Sciences Learning Area has three Learning Outcomes which focus on (i) scientific investigations, (ii) constructing science knowledge, and (iii) science, technology, environment and society. The subject Life Sciences likewise has three Learning Outcomes which build on these.

In the Natural Sciences Learning Area, achievement of Learning Outcomes is mediated through four themes: (a) life and living; (b) energy and change; (c) earth and beyond; and (d) matter and materials. Life Sciences focuses on one of these themes – that is, life and living.

The subject Life Sciences prepares learners for additional education and training, vocational careers, and the world of work and self-employment. The scope, Learning Outcomes and Assessment Standards of Life Sciences in the Further Education and Training band are deeper and broader, and cover more advanced knowledge and skills than those in the General Education and Training band. This allows learners to choose different directions in lifelong learning. The subject informs the choices learners make when pursuing Higher Education and different career pathways in various specialisations. It caters for careers such as medicine, bioengineering, psychology, nursing, education, marine biology, and environmental science.

LEARNING OUTCOMES

The subject Life Sciences has three Learning Outcomes that are based on the three main competences outlined in the ‘Scope’ section above. These are repeated here for the reader’s convenience:

- scientific inquiry and problem-solving skills;
- construction and application of Life Sciences knowledge; and
- understanding the interrelationship of Life Sciences, technology, the environment and society and of different attitudes and values.

Learning Outcome 1: Scientific Inquiry and Problem-solving Skills

The learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills.

In this Learning Outcome, the teaching and learning of Life Sciences focuses on exploring and investigating environmental, biological and technological systems in everyday life, using inquiry, problem solving and critical thinking skills. These involve the use of experimental and data-handling skills. Experimental skills include following instructions, making observations, measuring trends and recording information. Data-handling skills involve identifying, selecting, organising, presenting, translating, and manipulating data, as well as making inferences, deductions and conclusions from the data gathered. Learners present reasons for explanations of phenomena and create relationships between experimental processes and results obtained. They make predictions and hypotheses regarding phenomena in order to solve bigger problems.

Learning Outcome 2: Construction and Application of Life Sciences Knowledge

The learner is able to access, interpret, construct and use Life Sciences concepts to explain phenomena relevant to Life Sciences.

This Learning Outcome involves the construction of knowledge in the Life Sciences through learners collecting information and experiences from the world around them and linking these with their previous experiences (recognition of prior learning). This involves the use of inquiry and thinking skills to interpret, apply and extend their understanding of concepts, principles, laws, theories and/or models. Through sharing experiences and reaching a common understanding learners make sense of how Life Sciences knowledge applies to everyday life.

Learning Outcome 3: Life Sciences, Technology, Environment and Society

The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

It is important to understand how scientific knowledge develops. Modern science is based on traditions of thought that came together in Europe about 500 years ago. People from other cultures developed other ways of thinking and different knowledge, which are increasingly interactive with Western science. People from different cultures have contributed to scientific innovations by making their indigenous scientific knowledge available to scientists from the Western framework of science. This indigenous knowledge needs to be rediscovered for its value in the present day. Scientific knowledge is, in principle, tentative and subject to

change as new evidence becomes available. The study of historical perspectives on the acceptance of scientific explanations highlights how knowledge is contested and accepted depending on social, religious and political factors. All forms of scientific knowledge need to be explored and critically evaluated. As responsible citizens, learners need to evaluate the past and make informed decisions about the present and future use of science and technology in society, and about environmental management and lifestyle choices for a sustainable future.

This Learning Outcome raises learners' awareness of the existence of different viewpoints of in a multicultural society, and encourages open-mindedness towards all viewpoints. These viewpoints are based on scientific knowledge, beliefs, ethics, attitudes, values and biases, and may change over time due to new information.

CHAPTER 3

LEARNING OUTCOMES, ASSESSMENT STANDARDS, CONTENT AND CONTEXTS

INTRODUCTION

The three Learning Outcomes of the Life Sciences address the Critical and Developmental Outcomes. The Assessment Standards are vehicles of knowledge, skills and values through which the Learning Outcomes can be achieved.

The Assessment Standards per grade are the minimum requirements expected of a learner in order to progress to the next grade. Assessment Standards for each Learning Outcome specify more complex, deeper and broader knowledge, skills, values and understanding to be achieved in each grade. In each grade, learners are expected to demonstrate the knowledge, skills, values and attitudes achieved in the previous grade. The thrusts of the different Assessment Standards are stated under each Learning Outcome.

Learning Outcome 1: Scientific Inquiry and Problem-solving Skills

The learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills.

- *Focus of Assessment Standard 1:* The learner identifies and questions phenomena and plans an investigation.
- *Focus of Assessment Standard 2:* The learner conducts an investigation by collecting and manipulating data.
- *Focus of Assessment Standard 3:* The learner analyses, synthesises and evaluates data and communicates findings.

Learning Outcome 2: Construction and Application of Life Sciences Knowledge

The learner is able to access, interpret, construct and use Life Sciences concepts to explain phenomena relevant to Life Sciences.

- *Focus of Assessment Standard 1:* The learner accesses knowledge.
- *Focus of Assessment Standard 2:* The learner interprets and makes meaning of knowledge in Life Sciences.
- *Focus of Assessment Standard 3:* The learner shows understanding of how Life Sciences knowledge is applied in everyday life.

Learning Outcomes 3: Life Sciences, Technology, Environment and Society

The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

- *Focus of Assessment Standard 1:* The learner explores and evaluates the scientific ideas of past and present cultures.
- *Focus of Assessment Standard 2:* The learner compares and evaluates the uses and development of resources and products and their impact on the environment and society.
- *Focus of Assessment Standard 3:* The learner compares the influence of different beliefs, attitudes and values on scientific knowledge.

Grade 10

Learning Outcome 1

Scientific Inquiry and Problem-solving Skills

The learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills.

Assessment Standards

Identifying and questioning phenomena and planning an investigation

We know this when the learner is able to:

- Identify and question phenomena.

Attainment is evident when the learner, for example:

- observes that some pot plants are growing poorly and questions whether they are lacking a mineral salt.

- Plan an investigation using instructions.

Attainment is evident when the learner, for example:

- plans an experiment to test the effect of a mineral salt (e.g. magnesium on plant growth) following given instructions.

- Consider implications of investigative procedures in a safe environment.

Grade 11

Assessment Standards

Identifying and questioning phenomena and planning an investigation

We know this when the learner is able to:

- Identify phenomena involving one variable to be tested.

Attainment is evident when the learner, for example:

- observes that fungi grow better on fish paste than on peanut butter; or
- observes that a number of people in the local community are suffering from diarrhoea.

- Design simple tests to measure the effects of this variable.

Attainment is evident when the learner, for example:

- designs an investigation to test the influence of substrate type on fungal growth (e.g. decides to spread a tablespoon each of fish paste, peanut butter, marmite and syrup on a slice of white bread and to use a slice of bread with no spread as a control); or
- plans ways of collecting information about the number of people infected (e.g. survey, information from the local clinic).

- Identify advantages and limitations of experimental design.

Attainment is evident when the learner, for example:

- considers how 'fair' the experiment is (amount of spread used, calculation of % spread covered by fungus);
- considers the limitations of survey methods in collecting accurate data about diarrhoea.

Grade 12

Assessment Standards

Identifying and questioning phenomena and planning an investigation

We know this when the learner is able to:

- Generate and question hypotheses based on identified phenomena for situations involving more than one variable.

Attainment is evident when the learner, for example:

- observes the high incidence of respiratory problems in the community;
- hypothesises that this could be linked to smoking or the local oil refinery.

- Design tests and/or surveys to investigate these variables.

Attainment is evident when the learner, for example:

- designs a survey to find the correlation between smokers/non-smokers and respiratory problems;
- designs tests to find out the amount of air pollutants in the community.

- Evaluate the experimental design.

Attainment is evident when the learner, for example:

- checks the accuracy of the air pollution test or survey.

Grade 10

Learning Outcome 1 Continued

Scientific Inquiry and Problem-solving Skills

The learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills.

Assessment Standards

Conducting an investigation by collecting and manipulating data

We know this when the learner is able to:

- Systematically and accurately collect data using selected instruments and/or techniques and following instructions.

Attainment is evident when the learner, for example:

- follows instructions on a worksheet;
- sets up an experiment in which five pot plants are given magnesium sulphate (Epsom salts) in solution and five pot plants are given water only;
- follows instructions to control all other variables (e.g. to use plants of the same type and size, to provide all plants with the same amount of sunlight and water, and to keep them at the same temperature);
- measures the height of each plant every three days.

- Display and summarise the data collected.

Attainment is evident when the learner, for example:

- records results in a table;
- calculates the average height of the five plants with or without magnesium every three days and plots the result on a line graph.

Grade 11

Assessment Standards

Conducting an investigation by collecting and manipulating data

We know this when the learner is able to:

- Systematically and accurately collect data using selected instruments and/or techniques.

Attainment is evident when the learner, for example:

- sets up the experiment;
- decides how to calculate, every two days the percent of the spread covered by fungi;
- records findings in a table;
- discusses, in a group, the limitations of the techniques and instruments used to measure fungal growth.

OR

- as a member of a team (class) carries out a survey in selected areas;
- recognises that people responding to the survey may not give accurate answers for a variety of reasons;
- investigates possible sources of the infection (e.g. sewage entering the stream running through the area);
- collects information on possible causes of diarrhoea from books, the Internet, pamphlets from a clinic, talk by the community health nurse.

Grade 12

Assessment Standards

Conducting an investigation by collecting and manipulating data

We know this when the learner is able to:

- Compare instruments and techniques to improve the accuracy and reliability of data collection.

Attainment is evident when the learner, for example:

- works co-operatively in a group;
- uses different instruments and techniques to collect data on the air pollutants;
- compares data collected using the different instruments.

- Manipulate data in the investigation to reveal patterns.

- Identify irregular observations and measurements.

- Allow for irregular observations and measurements when displaying data.

Attainment is evident when the learner, for example:

- draws graphs using the data collected;
- takes note of data that does not fit the graph;
- displays irregular observations on the graph but does not include them in the construction of the graph.

Grade 10

Learning Outcome 1 Continued

Scientific Inquiry and Problem-solving Skills

The learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills.

Grade 11

Grade 12

Assessment Standards

Conducting an investigation by collecting and manipulating data

We know this when the learner is able to:

- Select a type of display that communicates the data effectively.

Attainment is evident when the learner, for example:

- displays the experimental design and group results in a 'paper';
- plots data on graphs.

OR

- combines all the results and plans to present the data in graphic form as part of a newspaper article.

Grade 10

Learning Outcome 1 Continued

Scientific Inquiry and Problem-solving Skills

The learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills.

Assessment Standards

Analysing, synthesising, evaluating data and communicating findings

We know this when the learner is able to:

- Analyse, synthesise, evaluate data and communicate findings.

Attainment is evident when the learner, for example:

- examines the graph and reaches a conclusion about the effect of magnesium on plant growth;
- displays results and conclusions on a poster.

Grade 11

Assessment Standards

Analysing, synthesising, evaluating data and communicating findings

We know this when the learner is able to:

- Compare data and construct meaning to explain findings.
- Draw conclusions and recognise inconsistencies in the data.
- Assess the value of the experimental process and communicate findings.

Attainment is evident when the learner, for example:

- draws meaning from graphs;
- explains findings;
- in a 'paper', discusses possible variables that could influence the results.

OR

- prepares and submits an article for the school newspaper or newsletter describing the research and findings on diarrhoea in the community.

Grade 12

Assessment Standards

Analysing, synthesising, evaluating data and communicating findings

We know this when the learner is able to:

- Critically analyse, reflect on and evaluate the findings.
- Explain patterns in the data in terms of knowledge.
- Provide conclusions that show awareness of uncertainty in data.
- Suggest specific changes that would improve the techniques used.

Attainment is evident when the learner, for example:

- analyses and reflects on data represented in graphs and other data, looks for evidence of the causes of respiratory problems, and evaluates experimental findings;
- presents a report to the class in which they communicate their findings;
- demonstrates an awareness of weaknesses in their design and possible inaccuracy of results, and proposes how they could improve their experiments.

Grade 10

Learning Outcome 2

Construction and Application of Life Sciences Knowledge

The learner is able to access, interpret, construct and use Life Sciences concepts to explain phenomena relevant to Life Sciences.

Note: Progression in this Learning Outcome is reflected in the increase in the number of concepts as well as the depth of understanding of some concepts, together with the establishment of links between different concepts to develop a well-organised knowledge base.

Assessment Standards

Accessing knowledge

We know this when the learner is able to:

- Use a prescribed method to access information.

Attainment is evident when the learner, for example:

- uses books and magazines to collect information on human nutrition.

Interpreting and making meaning of knowledge in Life Sciences

- Identify concepts, principles, laws, theories and models of Life Sciences in the context of everyday life.

Attainment is evident when the learner, for example:

- identifies structures and processes as food passes through the digestive system.

- Describe and explain concepts, principles, laws, theories and models.

Attainment is evident when the learner, for example:

- describes causes of various digestive problems (e.g. heartburn, gastric ulcers, irritable bowel syndrome, colon cancer, piles);
- explains the causes of nutrition problems (e.g. bulimia, anorexia, obesity, kwashiorkor, rickets, gout).

Grade 11

Assessment Standards

Accessing knowledge

We know this when the learner is able to:

- Use various methods and sources to access information.

Attainment is evident when the learner, for example:

- researches causes, effects and incidence of HIV/AIDS by making use of libraries, clinics, medical personnel, magazines and/or the Internet.

Interpreting and making meaning of knowledge in Life Sciences

- Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships.

Attainment is evident when the learner, for example:

- *uses information or sources collected to describe and explain meaningfully causes and effects of HIV/AIDS;*
- traces the source and incidence of the HIV/AIDS pandemic and its impact on society.

- Evaluate concepts, principles, laws, theories and models.

Attainment is evident when the learner, for example:

- evaluates different ideas on the cause of HIV/AIDS from information collected.

Grade 12

Assessment Standards

Accessing knowledge

We know this when the learner is able to:

- Use various methods and sources to access relevant information from a variety of contexts.

Attainment is evident when the learner, for example:

- searches for information on theories about the origin of life and about South Africa as the cradle of mankind by making use of various sources of information such as libraries, local people, the Internet and magazines.

Interpreting and making meaning of knowledge in Life Sciences

- Interpret, organise, analyse, compare and evaluate concepts, principles, laws, theories and models and their application in a variety of contexts.

Attainment is evident when the learner, for example:

- engages in debates regarding the origin of life;
- compares different theories regarding the origin of life and identifies their shortcomings;
- analyses and evaluates theories on changes in different species over time.

Grade 10

Learning Outcome 2 Continued

Construction and Application of Life Sciences Knowledge

The learner is able to access, interpret, construct and use Life Sciences concepts to explain phenomena relevant to Life Sciences.

Note: Progression in this Learning Outcome is reflected in the increase in the number of concepts as well as the depth of understanding of some concepts, together with the establishment of links between different concepts to develop a well-organised knowledge base.

Assessment Standards

Showing an understanding of the application of Life Sciences knowledge in everyday life

We know this when the learner is able to:

- Organise, analyse and interpret concepts, principles, laws, theories and models of Life Sciences in the context of everyday life.

Attainment is evident when the learner, for example:

- uses information or sources collected to describe and explain meaningfully the problems associated with health (e.g. heartburn).

Grade 11

Assessment Standards

Showing an understanding of the application of Life Sciences knowledge in everyday life

We know this when the learner is able to:

- Analyse and evaluate the costs and benefits of applied Life Sciences knowledge.

Attainment is evident when the learner, for example:

- writes a report on the impact of HIV/AIDS on the health and lifestyle of peers;
- makes suggestions and comes up with solutions for the HIV/AIDS problem.

Grade 12

Assessment Standards

Showing an understanding of the application of Life Sciences knowledge in everyday life

We know this when the learner is able to:

- Evaluate and present an application of Life Sciences knowledge.

Attainment is evident when the learner, for example:

- writes a report on how DNA can be used to identify the parents of a lost child.

Grade 10

Learning Outcome 3

Life Sciences, Technology, Environment and Society

The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Assessment Standards

Exploring and evaluating scientific ideas of past and present cultures

We know this when the learner is able to:

- Identify and investigate scientific ideas and indigenous knowledge of past and present cultures.

Attainment is evident when the learner, for example:

- investigates various home remedies for nutritional disorders.

Comparing and evaluating the uses and development of resources and products, and their impact on the environment and society

- Describe different ways in which resources are used and applied to the development of products, and report on their impact on the environment and society.

Attainment is evident when the learner, for example:

- describes the use and abuse of fossil fuels.

Grade 11

Assessment Standards

Exploring and evaluating scientific ideas of past and present cultures

We know this when the learner is able to:

- Compare scientific ideas and indigenous knowledge of past and present cultures.

Attainment is evident when the learner, for example:

- compares industrial production of fermented beer and/or food preservation in South Africa to the traditional method.

Comparing and evaluating the uses and development of resources and products, and their impact on the environment and society

- Compare different ways in which resources are used in the development of biotechnological products, and analyse the impacts on the environment and society.

Attainment is evident when the learner, for example:

- investigates the history of heart transplants;
- compares the new approaches to organ transplants.

Grade 12

Assessment Standards

Exploring and evaluating scientific ideas of past and present cultures

We know this when the learner is able to:

- Critically evaluate scientific ideas and indigenous knowledge of past and present cultures.

Attainment is evident when the learner, for example:

- critically evaluates ideas on parental care during early childhood in various communities (e.g. quarantine of mother and newborn baby immediately after birth).

Comparing and evaluating the uses and development of resources and products, and their impact on the environment and society

- Analyse and evaluate different ways in which resources are used in the development of biotechnological products, and make informed decisions about their use and management in society for a healthy, sustainable environment.

Attainment is evident when the learner, for example:

- differentiates, analyses and evaluates the impact of non-indigenous plants on the environment.

Grade 10

Learning Outcome 3 Continued

Life Sciences, Technology, Environment and Society

The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Assessment Standards

Comparing the influence of different beliefs, attitudes and values on scientific knowledge

We know this when the learner is able to:

- Analyse and describes the influence of different beliefs, attitudes and values on scientific knowledge and its application to society.

Attainment is evident when the learner, for example:

- discusses the views of peers on cloning.

Grade 11

Assessment Standards

Comparing the influence of different beliefs, attitudes and values on scientific knowledge

We know this when the learner is able to:

- Compare scientific ideas and indigenous knowledge of past and present cultures.

Attainment is evident when the learner, for example:

- compares traditional and modern medicines in healing various diseases.

Grade 12

Assessment Standards

Comparing the influence of different beliefs, attitudes and values on scientific knowledge

We know this when the learner is able to:

- Critically evaluate and take a justifiable position on beliefs, attitudes and values that influence developed scientific and technological knowledge and their application in society.

Attainment is evident when the learner, for example:

- debates and takes a justifiable position on deforestation and its impact on certain communities and the environment.

CONTENT AND CONTEXTS FOR THE ATTAINMENT OF ASSESSMENT STANDARDS

In this section content and contexts are provided to support the attainment of the Assessment Standards. The content indicated needs to be dealt with in such a way as to assist learners to progress towards the achievement of the Learning Outcomes. Content must serve the Learning Outcomes and not be an end in itself. The contexts suggested will enable the content to be embedded in situations which are meaningful to learners and so assist learning and teaching. The teacher should be aware of and use local contexts, not necessarily indicated here, which could be more suited to the experiences of the learners. Content and context, when aligned to the attainment of the Assessment Standards, provide a framework for the development of Learning Programmes. The Learning Programme Guidelines for the Life Sciences give more details in this respect.

Knowledge areas for the Life Sciences

In section on 'Scope' in Chapter 2, it was mentioned that knowledge in the Life Sciences is organised around the following four knowledge areas:

- tissues, cells and molecular studies;
- structures and control of processes in basic life systems;
- environmental studies; and
- diversity, change and continuity.

The section on Assessment Standards (above) provides levels of attainment as well as examples of how content and contexts could be used to attain the specified Assessment Standards. This section provides core knowledge and concepts to be used to attain the Assessment Standards of all three Learning Outcomes. This core knowledge covers 80% of the policy statement. The other 20% must be used by provinces and schools to adapt specified knowledge to local conditions or to incorporate local knowledge into the curriculum.

Certain factors must be kept in mind when the knowledge areas are used to attain the Assessment Standards. These are:

- The knowledge areas are neither Learning Outcomes nor Assessment Standards, but are vehicles to attain the Assessment Standards.
- The knowledge areas are applicable when dealing with all three Learning Outcomes. In each grade, every learner should be able to interpret and apply some of these knowledge areas in both familiar and unfamiliar contexts specified for that grade.
- The order in which the knowledge areas may be arranged is not fixed. However, care should be taken to ensure that, among others, the principles of progression and integration are adhered to. For example, knowledge, which is foundational to others, should be dealt with first.
- The knowledge areas have the same weighting.
- The Assessment Standards and not the knowledge areas determine the depth or level.

Selecting core knowledge and concepts

It is impossible to study all knowledge and concepts in the Life Sciences. The criteria used to select core knowledge and concepts were derived from the Learning Outcomes and Assessment Standards, as well as the principles underpinning the National Curriculum Statement Grades 10-12 (General) (discussed in Chapter 1). In addition, the following factors were taken into consideration when selecting core knowledge and concepts:

- Foundational knowledge that builds on the General Education and Training band should be dealt with first. This will provide the basis for further knowledge to be dealt with in this band. For example, cell structure should be dealt with before genetic engineering.
- It should be possible to link the core knowledge areas to all known knowledge in the Life Sciences.
- Progression should be from simple to more complex knowledge with higher cognitive demands.
- Knowledge and concepts have been selected that have vast practical significance and relevance (e.g. natural products with possible indigenous knowledge system links to industry, nutrition, health and other sciences), and that build a foundation for future science careers and further learning.

Using core knowledge and concepts to attain Assessment Standards

The following steps are used to decide which knowledge and concepts to use to attain Assessment Standards:

- Identify the Learning Outcome(s) to be achieved.
- Identify the Assessment Standards to be attained.
- Decide on the knowledge areas to attain the Assessment Standards.
- Select or decide on the concepts to attain Assessment Standards.
- Decide on appropriate contexts and local knowledge to achieve Learning Outcomes.

This approach will ensure that teachers do not focus only on topics in their teaching, but will make the effort to achieve the Life Sciences Learning Outcomes.

The concepts for the four core knowledge areas are used to attain Assessment Standards in the Further Education and Training band. The core content builds on the knowledge, skills, attitudes and values developed in the General Education and Training band. The table below indicates concepts and skills for these core knowledge areas.

All concepts can be treated at varying levels of complexity; this is discussed in the Learning Programme Guidelines. The material below gives suggestions on how content may be linked to grade. Developers of Learning Programmes must use Assessment Standards to guide them in the way they use the content table in each grade.

Progressive deepening and broadening of integrated thinking patterns must be part and parcel of the gradual progression of Assessment Standards from Grades 10 to 12. These should be the driving tools for the

progression of the content demarcated for the different grades. The content is used to develop competences in all three Learning Outcomes of the Life Sciences. The skills related to Learning Outcome 1, as well as the issues related to technology, environment and society in Learning Outcome 3, are not directly linked or limited to any particular grade. They are interrelated and their usage depends on the Assessment Standards visited.

Content areas within Grades 10 -12

TISSUES, CELLS AND MOLECULAR STUDIES

Learning Outcome 1: Scientific Inquiry and Problem-solving Skills

The learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills.

Grades 10 - 12

- Research in a field of biotechnology (e.g. chemotherapy).
- Microscopic skills or other comparative methods and resources.
- Investigation of (community) diseases: conduct surveys, collect data (e.g. on fungal, viral, animal and plant diseases, genetic diseases).
- Collection of latest research information on diseases (e.g. malaria resistance, TB incidence in South Africa).

Learning Outcome 2: Construction and Application of Life Sciences Knowledge

The learner is able to access, interpret construct and use Life Sciences concepts to explain phenomena relevant to Life Sciences

Grade 10

- Cell structure.
- Cell division (mitosis).
- Tissues.
- Related diseases (e.g. cancer).

Grade 11

- Micro-organisms (viruses, bacteria, protists and fungi):
  - diseases (e.g. rust, blight, rabies, HIV/AIDS, cholera, tuberculosis, malaria, thrush);
  - immunity.

Grade 12

- DNA, protein synthesis.
- Chromosomes, meiosis, production of sex cells, diseases (e.g. Down syndrome).
- Genes, inheritance, genetic diseases.

Learning Outcome 3: Life Sciences, Technology, Environment and Society

The learner is able to demonstrate an understading of the nature of science, the influence of ethics and baises in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Grades 10 - 12

- Historical developments (e.g. discovery of genes and DNA).
- Ethics and legislation:
  - tissue culture;
  - cloning;
  - genetic engineering;
  - ethics.
- Indigenous knowledge systems and biotechnology:
  - micro-organisms and biotechnology in the food industry (e.g. cheese, beer);
  - traditional technology (e.g. traditional medicines and healers);
  - medical biotechnology (e.g. immunity, antibiotics, hormones like insulin);
  - genetic engineering and its use in medicine and agriculture (e.g. genetically-modified crops);
  - cloning;
  - DNA, fingerprinting and forensics.
- Beliefs, attitudes and values:
  - beliefs and attitudes concerning diseases;
  - genetic counselling.

STRUCTURE, CONTROL AND PROCESSES IN BASIC LIFE SYSTEMS OF PLANTS AND HUMANS

Learning Outcome 1: Scientific Inquiry and Problem-solving Skills

The learner is able to demonstrate an understading of the nature of science, the influence of ethics and baises in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Grades 10 - 12

- Structure of systems*:*
  - investigation of kidneys, hearts and eyes through dissections;
  - other comparative techniques using models and charts.
- Experimental investigation (e.g. photosynthesis).
- Designing a model (e.g. anatomy of a system such as the digestive system).
- Microscope work (e.g. alveoli or stomata).
- Conducting research on any of the latest medical practices concerning life processes (e.g. heart transplants, laser surgery).

Learning Outcome 2: Construction and Application of Life Sciences Knowledge

The learner is able to demonstrate an understading of the nature of science, the influence of ethics and baises in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Grade 10

- Energy release.
- Food production.
- Human nutrition and related diseases and allergies.
- Gaseous exchange and related diseases and allergies.

Grade 11

- Support (structural).
- Transport.

- Excretion.
- Nervous and endocrine systems.
- Related diseases of the above.
- Medical conditions (e.g. stroke, diabetes, hyperthyroidism).

Grade 12

- Reproduction and related diseases.

Learning Outcome 3: Life Sciences, Technology, Environment and Society

The learner is able to demonstrate an understading of the nature of science, the influence of ethics and baises in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Grade 10 - 12

- Historical developments: indigenous knowledge systems, biotechnology, environment, legislation, social behaviour, ethics and beliefs.
- Food manufacturing and preservation (indigenous knowledge systems and industry).
- Blood transfusion.
- Life support systems (e.g. dialysis, and organ transplant) and ethics.
- Sperm banks, surrogate motherhood, test tube babies, abortion and ethics.
- Sexuality, ethics and beliefs.

ENVIRONMENTAL STUDIES

Learning Outcome 1: Scientific Inquiry and Problem-solving Skills

The learner is able to demonstrate an understading of the nature of science, the influence of ethics and baises in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

- Investigation of human influences on the environment (e.g. introduction of exotic species).
- Management and maintenance of natural resources.
- Investigation of a local environmental issue, problem solving and decision making (e.g. managing rubbish dumps).

Learning Outcome 2: Construction and Application of Life Sciences Knowledge

The learner is able to demonstrate an understading of the nature of science, the influence of ethics and baises in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Grade 10

- Biospheres, biomes and ecosystems.
- Living and non-living resources, nutrient cycles and energy flow within an environment.

Grade 11

- Human influences on the environment (air, land and water issues).
- Sustaining our environment.
- Air, land and water-borne diseases.

Grade 12

- Local environmental issues.
- Effect of pollutants on human physiology and health (e.g. allergies).

Learning Outcome 3: Life Sciences, Technology, Environment and Society

The learner is able to demonstrate an understading of the nature of science, the influence of ethics and baises in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Grades 10 - 12

- Historical developments: indigenous knowledge systems, biotechnology, environment, legislation, social behaviour and ethics.
- Exploitation vs. sustainability: exploring issues.
- Industrialisation and the impact of industry.
- Management of resources, and the use and abuse of resources (e.g. fossil fuel usage).
- Eco-tourism.
- Air (e.g. ozone, global warming and the greenhouse effect, acid rain and its consequences).

- Waste management.
- Rehabilitation of the environment.
- Land issues (e.g. ownership and use of land, nature and game reserves, agriculture, desertification, forestation/deforestation, urban decay).
- Exploring the land issue: politically, legally, economically, ethically, environmentally and other influences.

DIVERSITY, CHANGE AND CONTINUITY

Learning Outcome 1: Scientific Inquiry and Problem-solving Skills

The learner is able to demonstrate an understading of the nature of science, the influence of ethics and baises in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Grades 10 - 11

- Planning, conducting and investigating plants and animals – a comparison.
- Analysis of given data and findings to evaluate growth and behavioural issues within a population.
- Measurement of population growth using different techniques.
- Collection and analysis of data on specific community diseases that could impact on the population vigour dynamic.
- Analysis and evaluation of any specific human behaviour that could influence population growth.
- Collection and analysis of data on evolutionary trends in a population (e.g. human beings).

Learning Outcome 2: Construction and Application of Life Sciences Knowledge

The learner is able to demonstrate an understading of the nature of science, the influence of ethics and baises in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Grade 10

- Biodiversity of plants and animals and their conservation.
- Significance and value of biodiversity to ecosystem function and human survival.
- Threats to biodiversity.
- Parasitism, diseases (e.g. bilharzia).

Grade 11

- Population studies:
  - characteristics of populations,
  - population growth,
  - population fluctuation;
  - limiting factors.
- Social behaviour:
  - predation;
  - competition.
- Managing populations.

Grade 12

- Origin of species.
- Evolution theories, mutation, natural selection, macro-evolution and speciation.
- Fundamental aspects of fossil studies.
- Cradle of mankind - South Africa?
- Biological evidence of the evolution of populations.
- Popular theories of mass extinction.

Learning Outcome 3: Life Sciences, Technology, Environment and Society

The learner is able to demonstrate an understading of the nature of science, the influence of ethics and baises in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.

Grades 10 - 12

- Historical developments: indigenous knowledge systems, biotechnology, environment, legislation, social behaviour and ethics.
- Adaptation and survival.
- Sustainable development.
- History and the nature of science.
- Extinction of species, red data listing and endangered species.
- Fossils records, museums, zoos.
- Population changes over time.
- Beliefs about creation and evolution.
- Changes of knowledge through contested nature and diverse perceptions of evolution.

CHAPTER 4

ASSESSMENT

INTRODUCTION

Assessment is a critical element of the National Curriculum Statement Grades 10 – 12 (General). It is a process of collecting and interpreting evidence in order to determine the learner's progress in learning and to make a judgement about a learner's performance. Evidence can be collected at different times and places, and with the use of various methods, instruments, modes and media.

To ensure that assessment results can be accessed and used for various purposes at a future date, the results have to be recorded. There are various approaches to recording learners' performances. Some of these are explored in this chapter. Others are dealt with in a more subject-specific manner in the Learning Programme Guidelines.

Many stakeholders have an interest in how learners perform in Grades 10 – 12. These include the learners themselves, parents, guardians, sponsors, provincial departments of education, the Department of Education, the Ministry of Education, employers, and higher education and training institutions. In order to facilitate access to learners' overall performances and to inferences on learners' competences, assessment results have to be reported. There are many ways of reporting. The Learning Programme Guidelines and the Assessment Guidelines discuss ways of recording and reporting on school-based and external assessment as well as giving guidance on assessment issues specific to the subject.

WHY ASSESS

Before a teacher assesses learners, it is crucial that the purposes of the assessment be clear and unambiguous. Understanding the purposes of assessment ensures that an appropriate match exists between the purposes and the methods of assessment. This, in turn, will help to ensure that decisions and conclusions based on the assessment are fair and appropriate for the particular purpose or purposes.

There are many reasons why learners' performance is assessed. These include monitoring progress and providing feedback, diagnosing or remediating barriers to learning, selection, guidance, supporting learning, certification and promotion.

In this curriculum, learning and assessment are very closely linked. Assessment helps learners to gauge the value of their learning. It gives them information about their own progress and enables them to take control of and to make decisions about their learning. In this sense, assessment provides information about whether teaching and learning is succeeding in getting closer to the specified Learning Outcomes. When assessment indicates lack of progress, teaching and learning plans should be changed accordingly.

TYPES OF ASSESSMENT

This section discusses the following types of assessment:

- baseline assessment;
- diagnostic assessment;
- formative assessment; and
- summative assessment.

Baseline assessment

Baseline assessment is important at the start of a grade, but can occur at the beginning of any learning cycle. It is used to establish what learners already know and can do. It helps in the planning of activities and in Learning Programme development. The recording of baseline assessment is usually informal.

Diagnostic assessment

Any assessment can be used for diagnostic purposes – that is, to discover the cause or causes of a learning barrier. Diagnostic assessment assists in deciding on support strategies or identifying the need for professional help or remediation. It acts as a checkpoint to help redefine the Learning Programme goals, or to discover what learning has not taken place so as to put intervention strategies in place.

Formative assessment

Any form of assessment that is used to give feedback to the learner is fulfilling a formative purpose. Formative assessment is a crucial element of teaching and learning. It monitors and supports the learning process. All stakeholders use this type of assessment to acquire information on the progress of learners. Constructive feedback is a vital component of assessment for formative purposes.

Summative assessment

When assessment is used to record a judgement of the competence or performance of the learner, it serves a summative purpose. Summative assessment gives a picture of a learner's competence or progress at any specific moment. It can occur at the end of a single learning activity, a unit, cycle, term, semester or year of learning. Summative assessment should be planned and a variety of assessment instruments and strategies should be used to enable learners to demonstrate competence.

WHAT SHOULD ASSESSMENT BE AND DO?

Assessment should:

- be understood by the learner and by the broader public;
- be clearly focused;
- be integrated with teaching and learning;
- be based on the pre-set criteria of the Assessment Standards;
- allow for expanded opportunities for learners;
- be learner-paced and fair; and
- be flexible;
- use a variety of instruments;
- use a variety of methods.

HOW TO ASSESS

Teachers' assessment of learners' performances must have a great degree of reliability. This means that teachers' judgements of learners' competences should be generalisable across different times, assessment items and markers. The judgements made through assessment should also show a great degree of validity; that is, they should be made on the aspects of learning that were assessed.

Because each assessment cannot be totally valid or reliable by itself, decisions on learner progress must be based on more than one assessment. This is the principle behind continuous assessment (CASS). Continuous assessment is a strategy that bases decisions about learning on a range of different assessment activities and events that happen at different times throughout the learning process. It involves assessment activities that are spread throughout the year, using various kinds of assessment instruments and methods such as tests, examinations, projects and assignments. Oral, written and performance assessments are included. The different pieces of evidence that learners produce as part of the continuous assessment process can be included in a portfolio. Different subjects have different requirements for what should be included in the portfolio. The Learning Programme Guidelines discuss these requirements further.

Continuous assessment is both classroom-based and school-based, and focuses on the ongoing manner in which assessment is integrated into the process of teaching and learning. Teachers get to know their learners through their day-to-day teaching, questioning, observation, and through interacting with the learners and watching them interact with one another.

Continuous assessment should be applied both to sections of the curriculum that are best assessed through written tests and assignments and those that are best assessed through other methods, such as by performance, using practical or spoken evidence of learning.

METHODS OF ASSESSMENT

Self-assessment

All Learning Outcomes and Assessment Standards are transparent. Learners know what is expected of them. Learners can, therefore, play an important part, through self-assessment, in 'pre-assessing' work before the teacher does the final assessment. Reflection on one's own learning is a vital component of learning.

Peer assessment

Peer assessment, using a checklist or rubric, helps both the learners whose work is being assessed and the learners who are doing the assessment. The sharing of the criteria for assessment empowers learners to evaluate their own and others' performances.

Group assessment

The ability to work effectively in groups is one of the Critical Outcomes. Assessing group work involves looking for evidence that the group of learners co-operate, assist one another, divide work, and combine individual contributions into a single composite assessable product. Group assessment looks at process as well as product. It involves assessing social skills, time management, resource management and group dynamics, as well as the output of the group.

METHODS OF COLLECTING ASSESSMENT EVIDENCE

There are various methods of collecting evidence. Some of these are discussed below.

Observation-based assessment

Observation-based assessment methods tend to be less structured and allow the development of a record of different kinds of evidence for different learners at different times. This kind of assessment is often based on tasks that require learners to interact with one another in pursuit of a common solution or product. Observation has to be intentional and should be conducted with the help of an appropriate observation instrument.

Test-based assessment

Test-based assessment is more structured, and enables teachers to gather the same evidence for all learners in

the same way and at the same time. This kind of assessment creates evidence of learning that is verified by a specific score. If used correctly, tests and examinations are an important part of the curriculum because they give good evidence of what has been learned.

Task-based assessment

Task-based or performance assessment methods aim to show whether learners can apply the skills and knowledge they have learned in unfamiliar contexts or in contexts outside of the classroom. Performance assessment also covers the practical components of subjects by determining how learners put theory into practice. The criteria, standards or rules by which the task will be assessed are described in rubrics or task checklists, and help the teacher to use professional judgement to assess each learner's performance.

RECORDING AND REPORTING

Recording and reporting involves the capturing of data collected during assessment so that it can be logically analysed and published in an accurate and understandable way.

Methods of recording

There are different methods of recording. It is often difficult to separate methods of recording from methods of evaluating learners' performances.

The following are examples of different types of recording instruments:

- rating scales;
- task lists or checklists; and
- rubrics.

Each is discussed below.

Rating scales

Rating scales are any marking system where a symbol (such as A or B) or a mark (such as 5/10 or 50%) is defined in detail to link the coded score to a description of the competences that are required to achieve that score. The detail is more important than the coded score in the process of teaching and learning, as it gives learners a much clearer idea of what has been achieved and where and why their learning has fallen short of the target. Traditional marking tended to use rating scales without the descriptive details, making it difficult to have a sense of the learners' strengths and weaknesses in terms of intended outcomes. A six-point scale of achievement is used in the National Curriculum Statement Grades 10 – 12 (General).

Task lists or checklists

Task lists or checklists consist of discrete statements describing the expected performance in a particular task. When a particular statement (criterion) on the checklist can be observed as having been satisfied by a learner during a performance, the statement is ticked off. All the statements that have been ticked off on the list (as criteria that have been met) describe the learner's performance. These checklists are very useful in peer or group assessment activities.

Rubrics

Rubrics are a combination of rating codes and descriptions of standards. They consist of a hierarchy of standards with benchmarks that describe the range of acceptable performance in each code band. Rubrics require teachers to know exactly what is required by the outcome. Rubrics can be holistic, giving a global picture of the standard required, or analytic, giving a clear picture of the distinct features that make up the criteria, or can combine both. The Learning Programme Guidelines give examples of subject-specific rubrics.

To design a rubric, a teacher has to decide the following:

- Which outcomes are being targeted?
- Which Assessment Standards are targeted by the task?
- What kind of evidence should be collected?
- What are the different parts of the performance that will be assessed?
- What different assessment instruments best suit each part of the task (such as the process and the product)?
- What knowledge should be evident?
- What skills should be applied or actions taken?
- What opportunities for expressing personal opinions, values or attitudes arise in the task and which of these should be assessed and how?
- Should one rubric target all the Learning Outcomes and Assessment Standards of the task or does the task need several rubrics?
- How many rubrics are, in fact, needed for the task?

It is crucial that a teacher shares the rubric or rubrics for the task with the learners before they do the required task. The rubric clarifies what both the learning and the performance should focus on. It becomes a powerful tool for self-assessment.

Reporting performance and achievement

Reporting performance and achievement informs all those involved with or interested in the learner's progress. Once the evidence has been collected and interpreted, teachers need to record a learner's achievements. Sufficient summative assessments need to be made so that a report can make a statement about the standard achieved by the learner.

The National Curriculum Statement Grades 10 – 12 (General) adopts a six-point scale of achievement. The scale is shown in Table 4.1.

Table 4.1 Scale of achievement for the National Curriculum Statement Grades 10 – 12 (General)

Rating Code	Description of Competence	Marks (%)
6	Outstanding	80-100
5	Meritorious	60-79
4	Satisfactory	50-59
3	Adequate	40-49
2	Partial	30-39
1	Inadequate	0-29

SUBJECT COMPETENCE DESCRIPTIONS

To assist with benchmarking the achievement of Learning Outcomes in Grades 10 – 12, subject competences have been described to distinguish the grade expectations of what learners must know and be able to achieve. Six levels of competence have been described for each subject for each grade. These descriptions will assist teachers to assess learners and place them in the correct rating. The descriptions summarise the Learning Outcomes and the Assessment Standards, and give the distinguishing features that fix the achievement for a particular rating. The various achievement levels and their corresponding percentage bands are as shown in Table 4.1.

In line with the principles and practice of outcomes-based assessment, all assessment – both school-based and external – should primarily be criterion-referenced. Marks could be used in evaluating specific assessment tasks, but the tasks should be assessed against rubrics instead of simply ticking correct answers and awarding marks in terms of the number of ticks. The statements of competence for a subject describe the minimum skills, knowledge, attitudes and values that a learner should demonstrate for achievement on each level of the rating scale.

When teachers/assessors prepare an assessment task or question, they must ensure that the task or question addresses an aspect of a particular outcome. The relevant Assessment Standard or Standards must be used when creating the rubric for assessing the task or question. The descriptions clearly indicate the minimum level of attainment for each category on the rating scale.

The competence descriptions for this subject appear at the end of this chapter.

PROMOTION

Promotion at Grade 10 and Grade 11 level will be based on internal assessment only, but must be based on the same conditions as those for the Further Education and Training Certificate. The requirements, conditions, and rules of combination and condonation are spelled out in the *Qualifications and Assessment Policy Framework for the Grades 10 – 12 (General).*

WHAT REPORT CARDS SHOULD LOOK LIKE

There are many ways to structure a report card, but the simpler the report card the better, provided that all important information is included. Report cards should include information about a learner's overall progress, including the following:

- the learning achievement against outcomes;
- the learner's strengths;
- the support needed or provided where relevant;
- constructive feedback commenting on the performance in relation to the learner's previous performance and the requirements of the subject; and
- the learner's developmental progress in learning how to learn.

In addition, report cards should include the following:

- name of school;
- name of learner;
- learner's grade;
- year and term;
- space for signature of parent or guardian;
- signature of teacher and of principal;
- date;
- dates of closing and re-opening of school;
- school stamp; and
- school attendance profile of learner.

ASSESSMENT OF LEARNERS WHO EXPERIENCE BARRIERS TO LEARNING

The assessment of learners who experience any barriers to learning will be conducted in accordance with the recommended alternative and/or adaptive methods as stipulated in the *Qualifications and Assessment Policy Framework for Grades 10 – 12 (General)* as it relates to learners who experience barriers to learning. *Refer to White Paper 6 on Special Needs Education: Building an Inclusive Education and Training System.*

Grade 10

Code	Scale	Competence Descriptions
6	**80%-100% Outstanding**	**By the end of Grade 10 the learner with outstanding achievement can:** ■ compare, contrast, and make accurate conclusions from findings so as to determine the scientific meaning of conclusions made; ■ list various applications of Life Sciences knowledge in biotechnology, and describe and explain these applications; ■ analyse scientific and indigenous knowledge and their applications; ■ analyse and report different beliefs, attitudes and values as well as the impact of scientific and technological processes and products on a surrounding community.

Grade 11

Competence Descriptions

By the end of Grade 11 the learner with outstanding achievement can:

- compare, contrast, and recognise inconsistencies in data obtained, as well as assess the value of the experimental process;
- evaluate costs and benefits of biotechnological applications recently available;
- analyse the application of scientific and indigenous knowledge in the South African context and be able to debate emanating influence of different beliefs, attitudes and values;
- analyse and report on the impact of scientific and technological processes and products of different communities.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with outstanding achievement can:

- suggest specific changes to improve the experimental design as well as provide conclusions showing awareness of uncertainty in the data;
- analyse problems and make solutions to problems brought by biotechnology;
- evaluate the relevance of biotechnological applications to Life Sciences;
- critically evaluate the application of scientific and indigenous knowledge in South Africa and elsewhere;
- develop justifiable and responsible positions on the influences of different beliefs, attitudes and values in various communities;
- evaluate and give recommendations on the impact of scientific and technological processes and products on different communities.

Grade 10

Code	Scale	Competence Descriptions
5	**60%-79%** **Meritorious**	**By the end of Grade 10 the learner with meritorious achievement can:** ■ use relevant instruments and techniques to accurately and systematically collect and organise data; ■ analyse and contrast concepts, principles, laws, theories and models so as to make conclusions based on this data; ■ describe, compare and report on the application of scientific and indigenous knowledge on the surrounding community; ■ investigate the different beliefs, attitudes and values in the surrounding community; ■ investigate the impact of scientific and technological processes and products on a selected surrounding community.

Grade 11

Competence Descriptions

By the end of Grade 11 the learner with meritorious achievement can:

- analyse advantages and disadvantages of using an identified experimental design and identify its limitations in data collection techniques;
- construct meaning to explain findings and make conclusions based on evaluated concepts, principles, laws, theories and models;
- generate solutions to problems based on this information;
- describe, compare and report on the application of scientific and indigenous knowledge in the South African context;
- analyse and compare the influences of beliefs, attitudes and values;
- describe and explain the impact of scientific and technological processes and products of different communities.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with meritorious achievement can:

- analyse, reflect on, and evaluate findings of the investigation as well as identify and allow for irregular observations when displaying data;
- debate and show how concepts, principles, laws, theories and models influence one's behaviour;
- analyse the application of scientific and indigenous knowledge in the South African context as well as debate the influence of different beliefs, attitudes and values among different communities;
- analyse and report on the impact of scientific and technological processes and products on different communities.

Grade 10

Code	Scale	Competence Descriptions
4	**50%-59% Satisfactory**	**By the end of Grade 10 the learner with satisfactory achievement can:** ■ plan, identify and use instruments and techniques to systematically collect, summarise and display data; ■ describe, explain, interpret and compare concepts, principles, laws, theories and models from the data; ■ describe different beliefs, attitudes and values among peers as well as explain scientific and indigenous knowledge in the surrounding community; ■ identify the impact of scientific and technological processes and products on the environment.

Grade 11

Competence Descriptions

By the end of Grade 11 the learner with satisfactory achievement can:

- list advantages and disadvantages of using an identified experimental design;
- use relevant instruments and techniques to collect and display data as well as accurately display and illustrate concepts, principles, laws, theories and models from the data collected;
- describe the influences of different beliefs, attitudes and values among different communities as well as describe, compare and report on the application of scientific and indigenous knowledge of surrounding communities;
- identify and investigate the impact of scientific and technological processes and products on the environment.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with satisfactory achievement can:

- identify irregular observations, collect data and compare instruments for measurement used on variables being tested;
- organise, interpret and analyse concepts, principles, laws, theories and models and them apply in a variety of contexts;
- describe and report on the application of scientific and indigenous knowledge, as well as analyse and compare emanating influences of different beliefs, attitudes and values in different communities;
- describe and explain the impact of scientific and technological processes and products on the environment.

Grade 10

Code	Scale	Competence Descriptions
3	**40%-49%** **Adequate**	**By the end of Grade 10 the learner with adequate achievement can:** ■ plan and conduct an investigation and unsystematically collect and make displays of data; ■ organise collected information so as to identify concepts, principles, laws, theories and models; ■ describe and explain the influences of identified beliefs, attitudes and values of scientific and indigenous knowledge among peers and in the surrounding community; ■ describe the scientific and technological processes and products found in the surrounding community.

Grade 11

Competence Descriptions

By the end of Grade 11 the learner with adequate achievement can:

- summarise data, design tests to measure an identified variable, and explain concepts, principles, laws, theories and models based on collected information;
- differentiate scientific and indigenous knowledge in the surrounding community as well as explain emanating influences of different beliefs, attitudes and values among peers;
- describe scientific and technological processes and products found in the surrounding community.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with adequate achievement can:

- design accurate tests and surveys to investigate more than one variable, as well as evaluate and make changes to the experimental design used;
- identify, describe and explain concepts, principles, laws, theories and models and apply them in a variety of contexts;
- describe, explain and compare scientific and indigenous knowledge emanating from different beliefs, attitudes and values of different communities;
- identify and investigate the impact of scientific and technological processes and products found in the environment.

Grade 10

Code	Scale	Competence Descriptions
2	**30%-39% Partial**	**By the end of Grade 10 the learner with partial achievement can:** ■ identify all phenomena to be investigated and, using prescribed methods, conduct an investigation and collect information on concepts, principles, laws, theories and models; ■ conduct an investigation, using instructions, to identify and differentiate different beliefs among peers and in the surrounding community; ■ investigate scientific and technological processes and products in the surrounding community.

Grade 11

Competence Descriptions

By the end of Grade 11 the learner with partial achievement can:

- accurately and systematically collect data and use it to make displays as well as describe concepts, principles, laws, theories and models;
- independently investigate and describe scientific and indigenous knowledge in the surrounding community;
- describe different beliefs, values and attitudes among peers as well as investigate scientific and technological processes and products in the surrounding community.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with partial achievement can:

- generate and question an hypothesis to test identified phenomena involving one variable;
- use given instructions to conduct an investigation and then collect relevant information on concepts, principles, laws, theories and models using various methods;
- independently conduct an investigation on, and describe, the scientific and indigenous knowledge of different communities;
- identify emanating beliefs, attitudes and values;
- investigate and describe the impact of scientific and technological processes and products on different communities.

Grade 10

Code	Scale	Competence Descriptions
1	**0%-29%** **Inadequate**	**By the end of Grade 10 the learner with inadequate achievement can:** ■ identify the phenomena and follow instructions to access information; ■ identify own beliefs, as well as indigenous knowledge of the past and present cultures among peers; ■ identify products and processes used in the surrounding community.

Grade 11

Competence Descriptions

By the end of Grade 11 the learner with inadequate achievement can:

- identify a phenomenon and use instruments and techniques to conduct an investigation;
- unsystematically collect data and identify various methods to access information on collected information on concepts, principles, laws, theories and models;
- identify beliefs among peers as well as identify scientific beliefs and indigenous knowledge of the surrounding community;
- identify scientific and technological processes and products used in the surrounding community.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with inadequate achievement can:

- generate and question hypotheses to test identified phenomena involving one variable;
- identify various methods of accessing information;
- identify scientific indigenous knowledge as well as emanating beliefs from different communities;
- identify scientific and technological processes and products used in different communities.

GLOSSARY

bias – an attitude that leans towards one frame of mind as opposed to another. Biases are linked to belief systems. Engaging in debates may reaffirm or remove biases.

bio-diversity – the wide range of plants, animals and other organisms existing on the Earth, including those organisms which have not yet been discovered by scientists

classifying – grouping and separating organisms and structures on the basis of properties or rules which show similarities, differences and inert relationships

collecting and selecting data – using appropriate instruments and techniques to collect data. The data to be collected must be selected using the variables under investigation.

comparing sources – obtaining information from different sources, identifying similarities and differences, and selecting useful and appropriate information

complex settings – contexts that are completely new, unknown and beyond the experiences of the participants in a teaching/learning situation

conceptualising – a way of building up a mental understanding or mental picture of knowledge and process concepts

contested nature of science knowledge – different views about the nature of science itself. Because there will always be disagreements on how concepts are understood, there will always be a reason or need to re-evaluate what is understood and believed. What some people do not perceive to be science, others may regard as science.

criticising – showing problem areas and attempting to find answers to the problems that arise in experimental designs and data obtained that do not form part of an observed trend or expected outcomes

drawing conclusions – evaluating the relevance of data to come to valid conclusions about the investigation

ethics – rules and laws that arise from compromised consensus on issues of different knowledge and belief systems qualified by sound, rational and credible reasoning

experimenting – identifying variables, controls and appropriate apparatus in order to conduct an experimental investigation safely and efficiently

familiar settings – environments, backgrounds and contexts which are known to the learners and the educator and are therefore the basis of their experiences and knowledge

formulating and designing – putting information together, finding links, and using this information to create a process to test between two or more variables

handling apparatus and material – assembling common apparatus, and safe handling and preparation of equipment and materials

identifying – recognising a problem, questioning unusual phenomena and the factors that may be at work

identifying trends and patterns – using information to identify patterns and trends to draw inferences; seeing common elements in several items of the data

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.

justifying conclusions – comparing conclusions with the hypotheses or questions set at the beginning of the investigation with scientifically-accepted Life Sciences knowledge

knowledge area – one of the major content areas around which scientific knowledge has been organised in this subject statement

measuring – using appropriate measuring instruments and units of measurement in the SI metric system to qualify observations for precision and accuracy

observing – obtaining information about objects, situations or events, using as many senses as possible; may be qualitative or quantitative in nature

perception – insight or intuition gained by becoming aware of something through the senses

predicting – making an informed forecast of future events on the basis of organised data extrapolations beyond observed patterns of events and tests

process skills – learning strategies that people use in the process of understanding a new situation or in presenting their understanding of it

questioning – asking questions about how things happen, or how one can test for facts, or why things occur as they do

reflecting – thinking about what has been done or constructed, to see strengths and weaknesses in concepts and processes; refining an understanding of an experimental process by thinking about the reliability and validity of the findings, by checking the accuracy of the calculations, and by looking at anomalous results and explaining the variations

reporting – choosing the best presentation styles to inform different audiences about the outcome of the investigation (e.g. deciding whether to use verbal or written reports or posters)

translating data – organising data by means of words, diagrams, graphs, tables and other forms of presentation

unfamiliar settings – environments, backgrounds and contexts not known to the learners, and not the basis of their experiences and knowledge