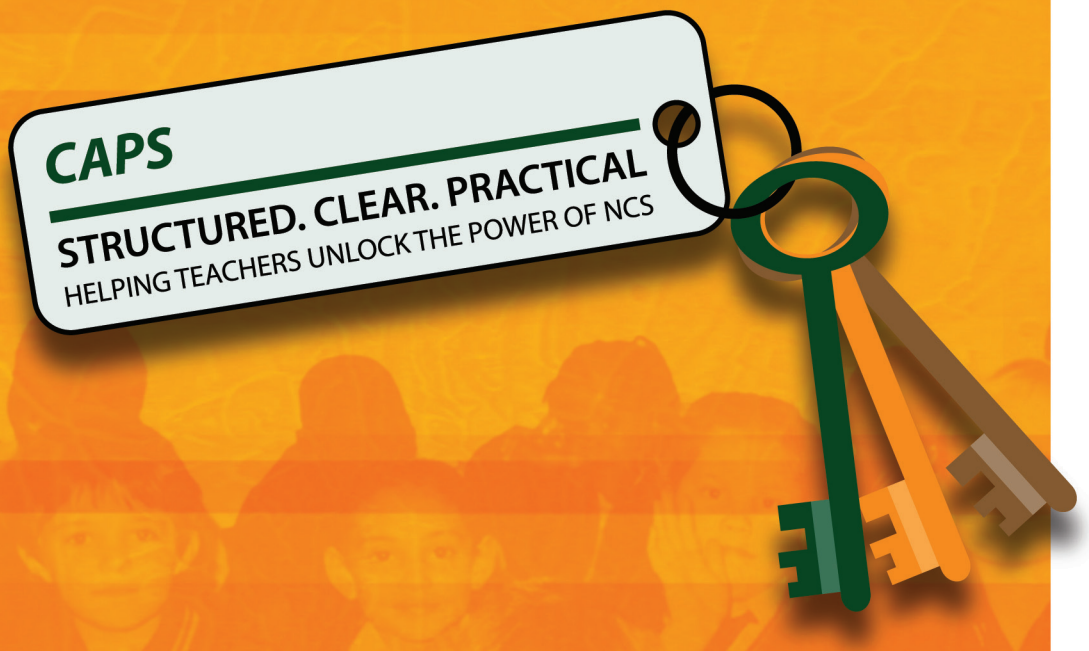
LIFE SCIENCES

National Curriculum Statement (NCS)

Curriculum and Assessment Policy Statement



Further Education and Training Phase Grades 10-12

basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

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CURRICULUM AND ASSESSMENT POLICY STATEMENT
GRADES 10-12

LIFE SCIENCES

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FOREWORD BY THE MINISTER

Our national curriculum is the culmination of our efforts over a period of seventeen years to transform the curriculum bequeathed to us by apartheid. From the start of democracy we have built our curriculum on the values that inspired our Constitution (Act 108 of 1996). The Preamble to the Constitution states that the aims of the Constitution are to:

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

Education and the curriculum have an important role to play in realising these aims.

In 1997 we introduced outcomes-based education to overcome the curricular divisions of the past, but the experience of implementation prompted a review in 2000. This led to the first curriculum revision: the *Revised National Curriculum Statement Grades R-9* and the *National Curriculum Statement Grades 10-12* (2002).

Ongoing implementation challenges resulted in another review in 2009 and we revised the *Revised National Curriculum Statement* (2002) and the *National Curriculum Statement Grades 10-12* to produce this document.

From 2012 the two National Curriculum Statements, for *Grades R-9* and *Grades 10-12* respectively, are combined in a single document and will simply be known as the *National Curriculum Statement Grades R-12.* The *National Curriculum Statement for Grades R-12* builds on the previous curriculum but also updates it and aims to provide clearer specification of what is to be taught and learnt on a term-by-term basis.

The *National Curriculum Statement Grades R-12* represents a policy statement for learning and teaching in South African schools and comprises of the following:

(a) Curriculum and Assessment Policy Statements (CAPS) for all approved subjects listed in this document;

(b) *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R-12*; and

(c) *National Protocol for Assessment Grades R-12.*

MRS ANGIE MOTSHEKGA, MP
MINISTER OF BASIC EDUCATION

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SECTION 1

INTRODUCTION TO THE CURRICULUM AND ASSESSMENT POLICY STATEMENTS FOR LIFE SCIENCES GRADES 10-12

1.1 Background

The *National Curriculum Statement Grades R-12 (NCS)* stipulates policy on curriculum and assessment in the schooling sector.

To improve implementation, the National Curriculum Statement was amended, with the amendments coming into effect in January 2012. A single comprehensive Curriculum and Assessment Policy document was developed for each subject to replace Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines in Grades R-12.

1.2 Overview

(a) The *National Curriculum Statement Grades R-12 (January 2012)* represents a policy statement for learning and teaching in South African schools and comprises the following:

(i) Curriculum and Assessment Policy Statements for each approved school subject;

(ii) The policy document, National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R-12; and

(iii) The policy document, National Protocol for Assessment Grades R-12 (January 2012).

(b) The *National Curriculum Statement Grades R-12 (January 2012)* replaces the two current national curricula statements, namely the

(i) Revised National Curriculum Statement Grades R-9, Government Gazette No. 23406 of 31 May 2002, and

(ii) National Curriculum Statement Grades 10-12 Government Gazettes, No. 25545 of 6 October 2003 and No. 27594 of 17 May 2005.

(c) The national curriculum statements contemplated in subparagraphs b(i) and (ii) comprise the following policy documents which will be incrementally repealed by the *National Curriculum Statement Grades R-12 (January 2012)* during the period 2012-2014:

(i) The Learning Area/Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines for Grades R-9 and Grades 10-12;

(ii) The policy document, National Policy on assessment and qualifications for schools in the General Education and Training Band, promulgated in Government Notice No. 124 in Government Gazette No. 29626 of 12 February 2007;

(iii) The policy document, the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF), promulgated in Government Gazette No.27819 of 20 July 2005;

(iv) *The policy document, An addendum to the policy document, the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF), regarding learners with special needs, published in Government Gazette, No.29466 of 11 December 2006, is incorporated in the policy document, National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R-12; and*

(v) *The policy document, An addendum to the policy document, the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF), regarding the National Protocol for Assessment (Grades R-12), promulgated in Government Notice No.1267 in Government Gazette No. 29467 of 11 December 2006.*

(d) The policy document, *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R-12*, and the sections on the Curriculum and Assessment Policy as contemplated in Chapters 2, 3 and 4 of this document constitute the norms and standards of the *National Curriculum Statement Grades R-12.* It will therefore, in terms of *section 6A* of the *South African Schools Act, 1996 (Act No. 84 of 1996,)* form the basis for the Minister of Basic Education to determine minimum outcomes and standards, as well as the processes and procedures for the assessment of learner achievement to be applicable to public and independent schools.

1.3 General aims of the South African Curriculum

(a) The *National Curriculum Statement Grades R-12* gives expression to the knowledge, skills and values worth learning in South African schools. This curriculum aims to ensure that children acquire and apply knowledge and skills in ways that are meaningful to their own lives. In this regard, the curriculum promotes knowledge in local contexts, while being sensitive to global imperatives.

(b) The National Curriculum Statement Grades R-12 serves the purposes of:

- equipping learners, irrespective of their socio-economic background, race, gender, physical ability or intellectual ability, with the knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society as citizens of a free country;
- providing access to higher education;
- facilitating the transition of learners from education institutions to the workplace; and
- providing employers with a sufficient profile of a learner's competences.

(c) The National Curriculum Statement Grades R-12 is based on the following principles:

- Social transformation: ensuring that the educational imbalances of the past are redressed, and that equal educational opportunities are provided for all sections of the population;
- Active and critical learning: encouraging an active and critical approach to learning, rather than rote and uncritical learning of given truths;
- High knowledge and high skills: the minimum standards of knowledge and skills to be achieved at each grade are specified and set high, achievable standards in all subjects;
- Progression: content and context of each grade shows progression from simple to complex;

- Human rights, inclusivity, environmental and social justice: infusing the principles and practices of social and environmental justice and human rights as defined in the Constitution of the Republic of South Africa. The National Curriculum Statement Grades R-12 is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors;
- Valuing indigenous knowledge systems: acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution; and
- Credibility, quality and efficiency: providing an education that is comparable in quality, breadth and depth to those of other countries.

(d) The National Curriculum Statement Grades R-12 aims to produce learners that are able to:

- identify and solve problems and make decisions using critical and creative thinking;
- work effectively as individuals and with others as members of a team;
- 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.

(e) Inclusivity should become a central part of the organisation, planning and teaching at each school. This can only happen if all teachers have a sound understanding of how to recognise and address barriers to learning, and how to plan for diversity.

The key to managing inclusivity is ensuring that barriers are identified and addressed by all the relevant support structures within the school community, including teachers, District-Based Support Teams, Institutional-Level Support Teams, parents and Special Schools as Resource Centres. To address barriers in the classroom, teachers should use various curriculum differentiation strategies such as those included in the Department of Basic Education's *Guidelines for Inclusive Teaching and Learning* (2010).

1.4 Time Allocation

1.4.1 Foundation Phase

(a) The instructional time in the Foundation Phase is as follows:

SUBJECT	GRADE R (HOURS)	GRADES 1-2 (HOURS)	GRADE 3 (HOURS)
Home Language	10	8/7	8/7
First Additional Language		2/3	3/4
Mathematics	7	7	7
Life Skills Beginning Knowledge Creative Arts Physical Education Personal and Social Well-being	**6** (1) (2) (2) (1)	**6** (1) (2) (2) (1)	**7** (2) (2) (2) (1)
TOTAL	**23**	**23**	**25**

(b) Instructional time for Grades R, 1 and 2 is 23 hours and for Grade 3 is 25 hours.

(c) Ten hours are allocated for languages in Grades R-2 and 11 hours in Grade 3. A maximum of 8 hours and a minimum of 7 hours are allocated for Home Language and a minimum of 2 hours and a maximum of 3 hours for Additional Language in Grades 1-2. In Grade 3 a maximum of 8 hours and a minimum of 7 hours are allocated for Home Language and a minimum of 3 hours and a maximum of 4 hours for First Additional Language.

(d) In Life Skills Beginning Knowledge is allocated 1 hour in Grades R-2 and 2 hours as indicated by the hours in brackets for Grade 3.

1.4.2 Intermediate Phase

(a) The instructional time in the Intermediate Phase is as follows:

SUBJECT	HOURS
Home Language	6
First Additional Language	5
Mathematics	6
Natural Sciences and Technology	3,5
Social Sciences	3
Life Skills Creative Arts Physical Education Personal and Social Well-being	**4** (1,5) (1) (1,5)
TOTAL	**27,5**

1.4.3 Senior Phase

(a) The instructional time in the Senior Phase is as follows:

SUBJECT	HOURS
Home Language	5
First Additional Language	4
Mathematics	4,5
Natural Sciences	3
Social Sciences	3
Technology	2
Economic Management Sciences	2
Life Orientation	2
Creative Arts	2
TOTAL	**27,5**

1.4.4 Grades 10-12

(a) The instructional time in Grades 10-12 is as follows:

SUBJECT	TIME ALLOCATION PER WEEK (HOURS)
Home Language	**4.5**
First Additional Language	**4.5**
Mathematics	**4.5**
Life Orientation	**2**
A minimum of any three subjects selected from **Group B** Annexure B, Tables B1-B8 of the policy document, *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R-12,* subject to the provisos stipulated in paragraph 28 of the said policy document.	**12 (3x4h)**
TOTAL	**27,5**

The allocated time per week may be utilised only for the minimum required NCS subjects as specified above, and may not be used for any additional subjects added to the list of minimum subjects. Should a learner wish to offer additional subjects, additional time must be allocated for the offering of these subjects.

SECTION 2

APPROACHING LIFE SCIENCES

2.1 What is Life Sciences?

'Life Sciences' is the scientific study of living things from molecular level to their interactions with one another and their environments. To be accepted as a science, it is necessary to use certain methods for broadening existing knowledge, or discovering new things. These methods must lend themselves to replication and a systematic approach to scientific inquiry. The methods include formulating hypotheses and carrying out investigations and experiments as objectively as possible to test these hypotheses. Repeated investigations are carried out and adapted. The methods and results are analysed, evaluated and debated before the community of scientists accepts them as valid.

Knowledge production in science is an ongoing endeavour that usually happens gradually but, occasionally, knowledge and insights take a leap forward as new knowledge, or a new theory, replaces what was previously accepted. As with all knowledge, scientific knowledge changes over time as scientists improve their knowledge and understanding and as people change their views of the world around them. Scientific investigations are mostly about things that are poorly understood or not understood at all. Scientists are frequently involved in debates and disagreements. As more people take on such investigations, they tend to reach consensus about the ways in which the world works. The science theory that is taught in schools has been tested and is generally accepted. A good teacher will inform learners of debates and arguments among the scientists who were the first to investigate a phenomenon.

Scientists continue to explore the unknown. They tackle questions to which no-one has definite answers, such as: 'Why is the climate changing?'; 'What is causing the universe to expand?'; 'What causes the Earth's magnetic field to change?'; and 'What, exactly, is the human mind?'. No one knows for sure

By studying and learning about Life Sciences, learners will develop:

- their knowledge of key biological concepts, processes, systems and theories;
- an ability to critically evaluate and debate scientific issues and processes;
- greater awareness of the ways in which biotechnology and knowledge of Life Sciences have benefited humankind;
- an understanding of the ways in which humans have impacted negatively on the environment and organisms living in it;
- a deep appreciation of the unique diversity of past and present biomes in Southern Africa and the importance of conservation;
- an awareness of what it means to be a responsible citizen in terms of the environment and life-style choices that they make;
- an awareness of South African scientists' contributions;
- scientific skills and ways of thinking scientifically that enable them to see the flaws in pseudo-science in popular media; and

- a level of academic and scientific literacy that enables them to read, talk about, write and think about biological processes, concepts and investigations.

2.2 Life Sciences as a School Subject

Life Sciences is the study of life at various levels of organisation and comprises a variety of sub-disciplines, or specialisations, such as:

- Biochemistry;
- Biotechnology;
- Microbiology;
- Genetics;
- Zoology;
- Botany;
- Entomology;
- Physiology (plant and animal);
- Anatomy (plant and animal);
- Morphology (plant and animal);
- Taxonomy (plant and animal);
- Environmental Studies; and
- Sociobiology (animal behaviour).

At school level, all of these sub-disciplines are introduced, to varying degrees, to provide a broad overview of the subject, Life Sciences. The three main reasons for taking Life Sciences are:

- to provide useful knowledge and skills that are needed in everyday life
- to expose learners to the scope of biological studies to stimulate interest in and create awareness of possible specialisations; and
- to provide a sufficient background for further studies in one or more of the biological sub-disciplines.

2.3 The Organisation of the Life Sciences Curriculum

The Life Sciences content framework is organised according to four ‘knowledge strands’. Knowledge strands are developed progressively over the three years of FET. These knowledge strands are:

- Knowledge Strand 1: Life at the Molecular, Cellular and Tissue Level;
- Knowledge Strand 2:Life Processes in Plants and Animals

- Knowledge Strand 3: Environmental Studies;
- Knowledge Strand 4: Diversity, Change and Continuity.

These Knowledge Strands and the topics within each knowledge strand should not be studied separately or independently. The Knowledge Strands do not need to be taught in the same sequence each year, nor do all four Knowledge Strands have to be covered in each year. This categorisation is simply a tool for organising the subject content and they are also not weighted equally. When teaching Life Sciences, it is very important to help learners to recognise the links between related topics so that they acquire a thorough understanding of the nature and inter-connectedness of life. These links must also be made across grades.

Life Sciences: Concept and Content Progression

Strands	Life at molecular, cellular, and tissue level	Life processes in plants and animals	Diversity, change and continuity	Environmental studies
Grade 10	• Chemistry of life - Inorganic compounds - Organic compounds • Cell - unit of life • Cell division (mitosis) • Plant and animal tissues	• Support and transport systems in plants • Support systems in animals • Transport system in mammals	• Biodiversity and classification • History of life on Earth	• Biosphere to ecosystems
Grade 11		• Energy transformations to support life: photosynthesis • Animal nutrition • Energy transformations: respiration • Gas exchange • Excretion	• Biodiversity - classification of microorganisms • Biodiversity - plants • Reproduction - plants • Biodiversity - animals	• Population ecology • Human impact on environment: current crises
Grade 12	• DNA code of Life • RNA and protein synthesis • Meiosis	• Reproduction in vertebrates • Human reproduction • Nervous system • Senses • Endocrine system • Homeostasis	• Darwinism and Natural Selection • Human evolution	• Human impact on environment: current crises Grade 11

The content framework focuses on ideas, skills and concepts as well as connections between them, rather than on listing the facts and procedures that need to be learned. It also does not prescribe particular instructional strategies or methodologies. Instead, educators have the freedom to expand concepts and to design and organise learning experiences according to their local circumstances, including the availability of resources.

In Grade 10, all four Knowledge Strands are addressed and serve to introduce learners to the four strands.

The recommended **Grade 10** teaching sequence for the four Knowledge Strands is:

1. Life at Molecular, Cellular and Tissue level (Molecules to organs)

2. Life Processes in Plants and Animals (Processes that sustain life)

3. Environmental Studies (Biosphere to Ecosystems)

4. Diversity, Change and Continuity (History of Life on Earth)

The rationale for this order In **Grade 10** is that some areas of South Africa are best suited for an environmental study during early spring and also because seasonal comparisons in a chosen ecosystem are required where possible. Some teachers may elect to deal with the Environmental Study at the beginning of the year. However it is important to retain the sequence of Knowledge Strand 1 **before** Knowledge Strand 2 and Knowledge Strand 3 before Knowledge Strand 4. Decisions regarding the sequence (starting the year with Knowledge Strands 1 and 2 or starting the year with Knowledge Strands 3 and 4) must be made by teachers.

The first section in Grade 10, called “Subject Orientation”, is designed to prepare learners for the FET phase, and is intended to:

- connect what learners learned in the GET (Natural Sciences) with what they will be learning in the FET (Life Sciences). The Life Sciences subject builds on knowledge and skills acquired from the Life Sciences knowledge areas in GET.

- describe how knowledge is built/constructed in science, and introduces the scientific approach that both teachers and learners are required to use when teaching and learning Life Sciences.

- introduce learners to some basic principles related to science.

- familiarise learners with the range of skills that they will need to develop.

The orientation should be done in the first lessons as an introduction but is **not** part of the assessable curriculum although the principles and skills will be assessed **in the context** of specific content during the year. Learners will have been exposed to similar orientations at the start of the Senior Phase (Grade 7) and at the start of High School (Grade 8). The orientation on Grade 10 should then simply remind learners of what is expected of them and expand on some of the aspects.

In Grade 11, three of the four Knowledge Strands are addressed and serve to ensure progression. The content described in Life at Molecular, Cellular and Tissue level in Grade 10 is used to understand Life Processes in Plant and Animals in Grade 11 but it is not taught as a separate strand in Grade 11.

The recommended **Grade 11** teaching sequence for the three Knowledge Strands is:

1. Diversity, Change and Continuity (Microorganisms, Plants and Animals)

2. Life Processes in Plants and Animals (Processes that sustain life)

3. Environmental Studies (Population Ecology and Human Impact)

In Grade 12, three of the four Knowledge Strands are addressed and serve to ensure progression. The content described in Environmental Studies: Human Impacts (Current Crises) is dealt with in Grade 11 in order to lessen the pressure in Grade 12 but this Knowledge Strand will be examined in the National Senior Certificate examination at the end of Grade 12.

The recommended **Grade 12** teaching sequence for the four Knowledge Strands is:

1. Life at Molecular, Cellular and Tissue level (DNA and protein synthesis)

2. Life Processes in Plants and Animals (Processes that sustain life)

3. Diversity, Change and Continuity (Darwinsim and Human Evolution)

4. Environmental Studies (Human Impact, taught and assessed in Grade 11)

The identified range of cognitive and practical skills must be taught, and assessed, in an integrated way in the context provided by the topics in the four Knowledge Strands in each year in the FET band.

2.4 The Purpose of Studying Life Sciences

- *The development of Scientific Knowledge and Understanding*

  Scientific knowledge and understanding can be used to answer questions about the nature of the living world around us. It can prepare learners for economic activity and self-expression and it lays the basis of further studies in science and prepares learners for active participation in a democratic society that values human rights and promotes acting responsibly towards the environment.

- *The Development of Science Process Skills (Scientific Investigations)*

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

- *The Development of an Understanding of Science's Roles in society*

  Both science and technology have made a major impact, both positive and negative, on our world. A careful selection of scientific content and the use of a variety of methods to teach and learn science should promote the understanding of science as a human activity as well as the history of science and the relationship between Life Sciences and other subjects. It also helps learners to understand the contribution of science to social justice and societal development as well as the need for using scientific knowledge responsibly in the interest of ourselves, society and the environment. Moreover, understanding science also helps us to understand the consequences of decisions that involve ethical issues.

2.5 Specific Aims

There are **three** broad subject-specific aims in Life Sciences which relate to the purposes of learning science. These are:

1. Specific Aim 1, which relates to knowing the subject content ('theory');
2. Specific Aim 2, which relates to doing science or practical work and investigations; and
3. Specific Aim 3, which relates to understanding the applications of Life Sciences in everyday life, as well as understanding the history of scientific discoveries and the relationship between indigenous knowledge and science.

WHAT DO THE THREE AIMS MEAN AND HOW DO THEY RELATE TO ASSESSMENT?

2.5.1 Specific Aim 1: Knowing Life Sciences

(Life Sciences concepts, processes, phenomena, mechanisms, principles, theories, laws, models, etcetera).

Specific Aim 1 involves knowing, understanding, and making meaning of sciences, thereby enabling learners to make many connections between the ideas and concepts. Making such connections makes it possible for learners to apply their knowledge in new and unfamiliar contexts. The process of acquiring a deep understanding of science is about more than just knowing a lot of facts. The scope of knowledge that learners should acquire includes knowledge of the process skills related to carrying out investigations.

The following cognitive (thinking) skills comprise the **range** of skills that all learners should develop by working through the curriculum in a school year. These skills indicate what should be assessed at **the appropriate grade level** in a variety of different kinds of assessments. Note that not every skill is assessed in every assessment, but that teachers must ensure that, by the end of the year, the assessments provide evidence that the range of different skills have been assessed for each learner.

2.5.1.1 Acquire Knowledge

In the process of acquiring knowledge learners must:

- **access** information from a variety of sources (teachers, reference books, textbooks, internet, experts, peers, parents, etc.);
- **select** key ideas;
- **recall** facts; and
- **describe** concepts, processes, phenomena, mechanisms, principles, theories, laws and models in Life Sciences.

Assessment

In order to assess these competences (or cognitive skills), teachers should use the following verbs in the tasks or assessments that they set: state, name, label, list, define, describe and any other verbs that indicate that learners' **knowledge** of the subject is being assessed.

2.5.1.2 Understand and Make Connections Between Ideas and Concepts to Make Meaning of Life Sciences

In the process of making meaning and achieving understanding learners must:

- **build a conceptual framework** of science ideas;
- **organise** or **reorganise** knowledge to derive new meaning;
- **write** summaries;
- **develop** flow charts, diagrams and mind maps; and
- **recognise** patterns and trends.

Assessment

In order to assess these competencies (cognitive skills), teachers should use the following verbs in the tasks or assessments they set: explain, compare, rearrange, give an example of, illustrate, calculate, interpret, suggest a reason, make a generalisation, interpret information or data, predict, select, differentiate or any other suitable verbs that indicate that learners' understanding of the subject is being assessed.

2.5.1.3 Apply Knowledge on Life Sciences in New and Unfamiliar Contexts

Learners must be able to:

- **use** information in a new way; and
- **apply** knowledge to new and unfamiliar contexts.

Assessment

In order to assess these competencies (cognitive skills), teachers should use the following verbs in the tasks or assessments that they set: demonstrate, interpret, predict, compare, differentiate, illustrate, solve and select as well as any other appropriate verbs that assess a learner's ability to apply knowledge. The key is that learners must be able to apply knowledge in a context or situation for which they have not yet acquired specific knowledge, or use the knowledge in a new way.

2.5.1.4 Analyse, Evaluate and Synthesise Scientific Knowledge, Concepts and Ideas

In the process of learning science, learners must be able to:

- **analyse** information/data;
- **recognise** relationships between existing knowledge and new ideas**;**
- **critically** evaluate scientific information;
- **identify** assumptions; and
- **categorise** information.

Assessment

In order to assess these competencies (cognitive skills), teachers should use the following verbs in the tasks or assessments that they set: appraise, argue, judge, select, evaluate, defend (a point of view), compare, contrast, criticise (an argument or assumption) differentiate, distinguish, discuss or any other suitable verbs that indicate that analysis, evaluation and synthesis are being assessed.

2.5.2 Specific Aim 2: Investigating Phenomena in Life Sciences

Learners must be able to plan and carry out investigations as well as solve problems that require some practical ability. This ability is underpinned by an attitude of curiosity and an interest in wanting to find out how the natural world and living things in it work.

The following range of skills relates to **doing** practical work in Life Sciences. All seven skills will not apply to every activity equally. The skills are aligned to what learners would be doing in the normal course of carrying out an investigation. Teachers must select those skills that apply to and can be assessed in the context of specific activities. By the end of the Grade 10 year, all seven skills must have been assessed at a **grade-appropriate** level.

Note: While **doing** practical investigations involves a specific range of skills, learners' knowledge on and understanding of science can, and should, be assessed within the context of the cognitive domains of Specific Aim 1.

Learners must be able to:

2.5.2.1 Follow Instructions

This is essential, especially in the lower grades and in large classes. Teachers cannot expect all learners to use unfamiliar equipment and to do so independently without giving them a clear set of instructions to follow. The amount of assistance required would indicate the level of performance in this regard. Adherence to safety rules should be part of this.

2.5.2.2 Handle Equipment or Apparatus

This should include having knowledge of the apparatus, that is, being able to name it and knowing what it is used for. The learner should be able to use different kinds of equipment. 'Handling equipment' is a generic skill and applies to any equipment used for many different kinds of investigations. Handling improvised equipment requires the same skills as would be required for handling standard laboratory equipment. The emphasis is on **using** equipment appropriately and safely (and not on only memorising the names of apparatus).

2.5.2.3 Make Observations

A variety of observations are possible and observations can be recorded in different ways, such as:

- drawings;
- descriptions;
- grouping of materials or examples based on observable similarities and/or differences;
- measurements;
- comparing materials before and after treatment;

- observing results of an experimental investigation which will involve recording information in an appropriate way; and
- counting.

2.5.2.4 Record Information or Data

This should include recording observations or information as drawings, descriptions, in simple table format, as simple graphs, etc. The skill of 'recording' is transferable across a range of different scientific activities.

2.5.2.5 Measure

Learners should know **what** to measure, **how** to measure it and have a sense of the degree of accuracy that is required. A variety of things could be measured including (but not limited to) length, volume, temperature, weight or mass and numbers (counting). Measuring is a way of quantifying observations and in this process learners should learn to make estimations.

2.5.2.6 Interpret

Learners should be able to convert information from one form, in which it was recorded, into another, for instance converting a table into an appropriate graph.

Learners should be able to perform **appropriate** simple calculations, to analyse and extract information from tables and graphs, apply knowledge of theory to practical situations, recognise patterns and/or trends, appreciate the limitations of experimental procedures as well as make deductions based on evidence.

2.5.2.7 Design/Plan Investigations or Experiments

Not all investigations are based on the 'classic' dependent-independent variables and controls. For example, an investigation could involve observing soil profiles or counting populations.

Designing an investigation is a different process to planning an investigation. In the design process options need to be considered in terms of the hypothesis and variables may have to be identified.

Skills include:

- identifying a problem;
- hypothesising;
- selecting apparatus or equipment and/or materials;
- identifying variables;
- suggesting ways of controlling variables;
- planning an experiment;
- suggesting ways of recording results; and
- understanding the need for replication or verification.

In Grades 10, 11 and 12, learners must be able to plan and/or design a simple investigation or experiment.

Note: Skills 2.5.2.1-2.5.2.6 (following instructions, handling equipment, making observations, recording information, measuring and interpreting information) are all required, in one form or another, to carry out an experiment or investigation. By separating seven different kinds of skills (2.5.2.1-2.5.2.7), these skills can apply to the **variety** of practical work that is appropriate for a particular grade in Life Sciences, including simple investigations or experiments. This approach makes it easier to assess learners in a range of different circumstances and it enables a teacher to judge a learner's ability to **do** science. The skills are based on what learners will be doing actions during the normal course of doing practical work. However, there are some circumstances in which only some of these skills would apply and not every skill can be assessed in every practical task.

2.5.3 Specific Aim 3: Appreciating and Understanding the History, Importance and Applications of Life Sciences in Society

The third aim of Life Sciences is to enable learners to understand that school science can be relevant to their lives outside of the school and that it enriches their lives.

Learners must be exposed to the history of science and indigenous knowledge systems from other times and other cultures. Scientific knowledge and understanding have been developed over time by people who were curious and who persevered with their quest for knowledge. Our present understanding of science will change and improve as modern scientists make new discoveries.

The skills that can be developed in the process of achieving Specific Aim 3 are cognitive rather than practical. These are the same cognitive skills as the ones identified for Specific Aim1.

Since the knowledge that will be acquired in respect of Specific Aim 3 always relates to specific subject content, the content provides the context for learning about various aspects of science in society. Science should therefore be taught in an integrated way in order to both enhance the subject and to clarify the relationship between the subject and society i.e. indigenous knowledge systems that relate to a specific topic, related history of scientific discoveries and the applications of science in everyday life.

2.5.3.1 Understanding the History and Relevance of Some Scientific Discoveries

The subject content provides the context for learning about the history of scientific discoveries and their relevance for society. These aspects, the history and relevance, should be linked to and taught in conjunction with the topics and content that are related to a particular discovery or a particular scientist.

2.5.3.2 The Relationship Between Indigenous knowledge and Life Sciences

All knowledge stems from views on how the world works. One of the differences between modern science (and technology) and traditional, indigenous knowledge systems is that they have their origins in different world views. Learners should understand the different cultural contexts in which indigenous knowledge systems were developed.

The examples of indigenous knowledge that are selected for study should, as far as possible, reflect different South African cultural groups. They should also link directly to specific areas in the Life Sciences subject content.

2.5.3.3 The Value and Application of Life Sciences Knowledge in the Industry in Respect of Career Opportunities and in Everyday Life

Knowledge of Life Sciences is applied in and relevant to various aspects of society. Examples should be relevant to the subject content that learners are dealing with at a particular time. There are career opportunities in the field of socio-biology and animal behaviour, plant pathology, game management, environmental impact studies, preservation

of biodiversity, palaeontology, palaeoanthropology, agriculture, horticulture, environmental law, science journalism, biotechnology, genetic engineering, and many others. Moreover, although learners should be made aware of career choices, it is not necessary to discuss or teach these in great detail.

Skills

Whilst the kind of knowledge is different for Specific Aims 1 and 3, the content should be taught in an integrated way in order for learners to understand the history, relevance and applications of science more easily. Importantly, the skills that must be developed and assessed for Specific Aim 3 are the same as those of Specific Aim 1 (under 2.5).

Learners must be able to:

- **access** information;
- **select** key ideas;
- **recall** information;
- **describe** knowledge of natural sciences;

Specific Aim 1.1

- **build a conceptual framework;**
- **organise** or **reorganise** knowledge;
- **write** summaries;
- **develop** flow charts and mind maps;
- **recognise** patterns and trends;

Specific Aim 1.2

- **apply** knowledge in new contexts;
- **use** knowledge in a new way;
- **analyse** information/data;

Specific Aim 1.3

- **critically evaluate** scientific information;
- **recognise** relationships between existing; knowledge and new ideas;
- **identify** assumptions; and
- **categorise** information.

Specific Aim 1.4

The three aims are aligned with the three learning outcomes with which teachers are familiar. Within each of these aims, specific skills or competences have been identified. It is not advisable to try to assess each of the skills separately, nor is it possible to report on individual skills separately. However, **well designed assessments** must show **evidence** that, by the end of the year, all of the skills have been assessed **at a grade-appropriate level**. There must be a clear link between the aims and the outcomes of learning. The processes of teaching, learning and assessment will provide the links between the specific aims and the achievement of the outcomes.

2.5.4 Developing Language Skills: Reading and Writing

Teachers of Life Sciences should be aware that they are also engaged in teaching language across the curriculum. This is particularly important for learners for whom the Language of Learning and Teaching (LoLT) is not their home language. It is important to provide learners with opportunities to develop and improve their language skills in the context of learning Life Sciences. It will therefore be critical to afford learners opportunities to read scientific texts and to write reports, paragraphs and short essays as part of the assessment, especially in (but not limited to) the informal assessments **for** learning.

2.6 Time

The time allocation for Life Sciences is 4 hours per week in Grades 10 to 12.

The curriculum for **Grade 10** has been designed to be completed within 32 weeks out of 40 weeks in the school year. This leaves 8 weeks in the year for examinations, tests and disruptions due to other school activities.

The curriculum for **Grade 11** has been designed to be completed within 32 weeks out of 40 weeks in the school year. This leaves 8 weeks in the year for examinations, tests and disruptions due to other school activities.

The curriculum for **Grade 12** has been designed to be completed within 27½ weeks out of 40 weeks in the school year. This leaves 12½ weeks in the year for examinations, tests and disruptions due to other school activities.

In Grades 10, 11 and 12 the time allocated for the teaching of the content **includes the practical tasks and investigations. These are an integral part of the teaching and learning process.**

2.7 Resources

The resources needed for teaching Life Sciences are listed next to each topic in order to assist teachers with planning and preparation.

Every learner must have his or her own textbook. Teachers should ensure that a system is in place for recovering textbooks at the end of every year. Schools must provide secure storage space where textbooks and other equipment can be stored safely.

Ideally, every learner should have access to sufficient workspace and equipment to carry out investigations. For safety reasons, no more than three learners may share space and equipment in instances where space and equipment are limited due to large classes. With regard to equipment, schools must make every effort to ensure that the essential equipment is provided.

While it is acknowledged that it is not ideal to use improvised equipment, teachers should remember that it is more important for learners to have the experience of carrying out a variety of investigations than to depend on the availability of standard laboratory equipment. If equipment is limited, teachers should be encouraged to improvise. The same skills can be developed using improvised equipment. Moreover, if there are no alternatives, it is more effective for teachers to demonstrate an investigation than to not do investigations at all due to a lack of equipment. Secure storage for equipment and chemicals must be provided by the school.

Teachers should ensure that learners are familiar with rules regarding the safe use of equipment and chemicals. The Life Sciences classroom or laboratory should be equipped with charts, Bunsen burners or spirit lamps, hand lenses, bioviewers and relevant biostrips, microscopes, a set of prepared slides, glass slides and cover slips, reference

books, blades or scalpels, models, field guides, identification keys, thermometers, glass beakers, test tubes and chemicals, and, if at all possible, access to appropriate DVDs and a DVD player.

Fresh plant material can be obtained from the surroundings and teachers should ensure that appropriate plants (e.g., *Impatiens*) are planted on the school grounds. Fresh animal material can very often be obtained at reasonable prices from local butchers.

Teachers must be qualified to teach the subject and must familiarise themselves with the equipment and how it is used.

SECTION 3

3.1 LIFE SCIENCES FOR GRADE 10: CONTENT

The first part of the curriculum in Grade 10, called 'Subject Orientation', is included to prepare learners for Life Sciences in the FET band. Its purpose is to:

- familiarise learners with the way in which the teacher will organise learning activities;
- familiarise learners with the behaviour that will be required and rules of safety;
- connect what learners have learnt in the Senior Phase with what they will learn and the range of skills that they must develop in FET;
- describe how knowledge is constructed in Life Sciences and to confirm a scientific approach that both teachers and learners will be required to use when teaching and learning Life Sciences; and
- introduce learners to some basic principles related to Life Sciences

GRADE 10

TERM 1	
Time	**Orientation to Life Sciences: Subject Orientation**
½ w**eek** **(2 hours)**	Establish links between Natural Sciences (GET) and Life Sciences (FET). Define life, its scope, and its continuity. Life on Earth is dynamic, with homeostasis maintaining balance at every level of organisation. Life is characterised by changes over billions of years. Living systems exhibit levels of organisation from molecules to biomes. The nature of science: science involves contested knowledge, and non-dogmatic inferences based on evidence and peer review. **How Science Works:** Science is based on: • fundamental knowledge built on scientific evidence and verified findings (articles that are published in journals or at conferences: peer review); • observing; • investigating; • making measurements and understanding the importance of scaling; • collecting and presenting data in the form of drawings, written descriptions, tables and graphs; • understanding the limitations of scientific evidence; • identifying patterns and relationships in data; • communicating findings; and • taking societal aspects of scientific evidence into account. Scientific skills involve: • importance of biological principles such as relationship between surface area and volume/size, the relationship between structure and function • biological drawings: principles that apply • translating 3 dimensional objects or specimens into 2 dimensional drawings and photographs and interpreting 2 dimensional drawings and photographs: transverse and longitudinal sections • general introduction to the range of skills listed under the Specific Aims that must be developed • introduction to graphs: different kinds of graphs and when to use them; interpreting graphs. • calculating
	Organisation of learning and rules include: • using equipment and other resources; • understanding procedures and how to safely use apparatus in laboratories and classrooms; • working in groups; • understanding assessment requirements; and • a very brief mention of careers and subject combinations for entrance to higher education. **Note:** This introduction is not assessable. However, the relevant aspects must be incorporated into in the context of the specific content where they apply, and will then be assessed.

TERM 1				
Strand 1: Life at the Molecular, Cellular and Tissue Level All living organisms are made of atoms which combine to form molecules. In turn, these molecules make up the basic units of life i.e. cells. Plant and animal cells have a complex organisation which enables them to carry out the basic processes of life, i.e. movement (movement in and around the cells and some cells move), nutrition (cells produce food or obtain food from elsewhere), respiration, excretion, growth, reproduction and responding to stimuli. Cells are specialised and form tissues which perform particular functions. The tissues are arranged into organs which are also specialised to carry out particular functions. This strand introduces learners to life at the molecular, cellular, tissue and organ level (links to Grade 9).				
Time	**Topic**	**Content**	**Investigations**	**Resources**
2½ weeks **(10 hours)**	**The Chemistry of Life**	**Molecules For Life** Organic molecules are made up of C, H, and O, and some contain other elements, such as N and P. Cells are made up of proteins, carbohydrates, lipids, nucleic acids and vitamins. (Only basic structural detail required.) **Inorganic Compounds** • The main functions of: - water: 2 H and 1 O; - minerals: e.g., Na, K, Ca, P, Fe, I, nitrates, phosphates; macro and micro elements; main functions and deficiency diseases *(link to nutrition and Grade 9).* • The need for fertilisers in over utilised soils, e.g., where crops are grown and regularly harvested, fertilizers are washed away into rivers, and eutrophication can take place *(link to ecology).*	**Optional:** • Construct models of simple and more complex molecules using beads or plasticine. • Analyse nutritional content indicated on food packaging: vitamins, minerals and other nutritional content.	• Textbooks • Charts • Equipment • Test tubes • A selection of food packaging showing nutritional content

TERM 1				
		Organic Compounds • carbohydrates - monosaccharaides (single sugars), e.g., glucose and fructose; disaccharides, (double sugars), e.g., sucrose and maltose; polysaccharides (many sugars), e.g., starch, cellulose and glycogen; • lipids (fats and oils) - 1 glycerol and 3 fatty acids: unsaturated and saturated fats; cholesterol in foods; and heart disease *(link to Grade 9);* • proteins - amino acids (C,H, O and N and some have P, S, Fe) - are sensitive to temperature and pH: loss of structure and function; the role of enzymes in breaking down/synthesising molecules; the influence of temperature and pH on enzyme action; the Lock and Key Model of how enzymes work; enzymes in everyday life (for instance using washing powders); • Mention of nucleic acids - DNA and RNA - consisting of C, H, O, N and P (no details of structure required); and • vitamins - e.g., A, one of the B vitamins, C, D and E. *(Simple diagrams to represent molecules. Review briefly why these substances are needed in plants and animals i.e. build on prior knowledge. Do not give detail of structure or function - functions will be dealt with in later sections where appropriate. This is a brief introduction to the molecular make-up of organisms.)*	**Essential:** • Food tests for starch, glucose, lipids and proteins. • Investigate the working of a 'biological' washing powder (containing enzymes). OR • Hydrogen Peroxide and chicken liver to demonstrate the effect of enzymes. OR • Fresh pineapple juice and solid egg white in a plastic drinking straw. AND • Observe, measure and record results of the experiment done at different temperatures. • Compare the Recommended Daily Allowance (RDA) with usual diet of individual learners. Draw a pie chart of the food types and discuss implications of the usual diet of learners.	• Chemicals • Bunsen burners • Thermometers • Washing powder • H_2O_2 and chicken liver or • Pineapple juice, egg white and plastic drinking straws

TERM 1				
3 weeks (12 hours)	**Cells: The Basic Units of Life**	**Molecular Make-Up** Cells are mostly made up of proteins, carbohydrates, lipids, nucleic acids and water. Brief overview of the history of microscopy: from lens and light microscopes and to electron microscopes. How these instruments enabled people to see cells and then structures within cells which led to cell theory. *(Briefly revise Grade 9 work on the cell.)* **Cell Structure and Function: The Roles of Organelles** • cell wall - support structure in plant cells only; • cell membrane - fluid mosaic model, boundaries and transport: movement across membranes**:** diffusion, osmosis and active transport; • nucleus, chromatin material, nuclear membrane, nucleopores, nucleolus: the control centre, heredity; • cytoplasm - storage and circulation of materials; • mitochondria - release energy during cell respiration; • ribosomes - protein synthesis; • endoplasmic reticulum (rough and smooth) - transport systems; • Golgi body - assembles secretions; • plastids - production and storage of food and pigments; and • vacuole, lysosomes, vesicles - storage, digestion and osmoregulation. Relate structure and location of organelles to their functions. *(This is an introduction; some organelle functions will be explored in more detail in other sections.)* **Cells differ** in size, shape and structure in order to carry out specialised functions *[link to tissues].* The differences between plant and animal cells *(link to Grade 9).*	• Explain and demonstrate how a light microscope works. Use a light microscope to observe and record (draw) the structure of a: - plant cell (wet mount of onion epidermis) and an - animal cell (cheek cells) If microscopes are not available, use micrographs. - Calculate magnification of drawing by measuring the field of view under a microscope. OR • Calculate the size of specimen on a micrograph using the scale line provided. • Investigate diffusion. • Investigate osmosis.	• Textbooks • Charts • Micrographs • Microscope slides • Chemicals • Electron micrographs (in text books) • Transparent rulers • Light microscopes • Bioviewers and biostrips • Beakers • Salt, • Potatoes or eggs

TERM 1				
2 weeks **(8 hours)**	**Cell Division: Mitosis**	**The Cell Cycle including Mitosis:** **I**nterphase, mitosis (with names of phases), cytokinesis and growth. The Continuous Process of Mitosis: The division of a cell to form two identical cells. *(Simple description with diagrams to show chromosome changes so that one parent cell forms **two identical** daughter cells.)* • The difference in telophase between plant and animal cells. **Chromosomes:** are found in nuclei of all cells; two chromatids and centromere. **Role of Mitosis:** growth and repair; Reproduction in some simple organisms. **Cancer:** Uncontrolled cell division and growth • causes of cancer; • beliefs and attitudes concerning cancer (discuss briefly); • treatments of cancer; and • medical biotechnology, e.g., radiotherapy and chemotherapy (no detail required).	• Use suitable resources to examine cell division, e.g., microscope slides, micrographs, posters and models. Record observations as drawings. • Research and present information on ONE of the cancers. This must include causes, prevalence and treatment. Information can be presented verbally or as a written report.	• Textbooks • Charts • Micrographs/micro-scope slides • Microscopes • Reference books
1 week **(4 hours)** **Total** **9 weeks** **(36 hours)**	**Plant and Animal Tissues**	**Introduction to tissues** Introduce the concept of a tissue as a group of similar cells adapted for a particular function; cell differentiation. Emphasise the relationship between their basic structure and function. **Plant Tissues** Xylem, phloem, parenchyma, collenchyma, sclerenchyma, epidermis and meristematic tissues.	• Examine and identify some plant tissues using microscope, biostrips, micrographs or posters. Draw cells that make up these tissues to show specialised structure.	• Textbooks • Charts • Microscope slides • Micrographs • Microscopes

TERM 1			
Assessment	• One formal, recorded class test. • Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework exercises, worksheets, reports, summaries, essays, etc. Refer to the range of skills listed under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	• One practical task. • Refer to the range of skills specified under Specific Aim 2.	

TERM 2				
Strand 1: Life at Molecular, Cellular and Tissue Level (continued)				
Time	**Topic**	**Content**	**Investigations**	**Resources**
2 weeks (8 hours)	**Plant and Animal Tissues (continued)**	**Animal Tissues** The Four basic types with some examples: • epithelial; • connective; • muscle; and • nerve tissues The relationship between structure and function. (No detail required - some tissues, e.g., blood and nerves in the reflex arc, will be covered in more detail in relevant sections.) **Applications of Indigenous Knowledge Systems and Biotechnology** • traditional technology, e.g., traditional medicines and healers; • medical biotechnology, e.g., immunity, vaccines, antibiotics and blood transfusions; and • the cloning of plant and animal tissues and stem cell research (ethics and legislation).	• Examine and identify some animal tissues using microscope, biostrips, micrographs or posters. Draw the cells that make up these tissues to show specialised structure. • Collect information on ONE field of biotechnology related to plant or animal tissues e.g., cloning, stem cell research or in vitro fertilisation.	• Textbook • Charts • Microscope slides/ micrographs • Microscopes • Reference books
½ week (2 hours)	**Organs**	Organs consist of a number of tissues. Leaf structure will be used as an example of an organ. Other organs will be dealt with in their relevant sections in life processes. **Leaf Structure** A cross-section of a dicotyledonous leaf to demonstrate and explain its structure in terms of its functions, i.e. photosynthesis, gas exchange and transport. Link this with plant tissues, appropriate cell organelles, movement across membranes and movement of molecules into, through and out of the leaf.	• Observe and draw a section of a dicotyledonous leaf. **Options:** • Observe prepared slides of a cross section of a leaf. OR • Observe micrographs. OR • Observe bioviewer slide strips	• Textbooks • Charts • Micrographs/bioviewers • Microscopes • Micrographs/bioviewers

TERM 2				
Strand 2: Life Processes in Plants and Animals Learners explore the anatomy of plants and animals in respect of support and transport systems. In animals, the different support systems are compared, with a focus on the human support system and locomotion.				
3 weeks **(12 hours)**	**Support and Transport Systems in Plants**	**Anatomy of Dicotyledonous Plants** *(link to Grade 7)* • Root and stem: the distribution of different tissues; • the structure of cells in different tissues *(link to plant tissues)*	• Use a microscope or micrographs to observe and draw cross sections of root and stem (plan only). • If microscopes are available make mounts of, and draw, whole xylem vessels from celery or pumpkin stalks to see secondary thickening patterns.	• Textbook • Microscopes • Prepared slides • Glass slides • Cover slips • Pumpkin or celery stems • Blades or scalpels
		• Secondary growth *(link to cell division);* the annual rings in a tree trunk to assess age and to infer climate change.	• Observe annual rings in a cut tree to assess age and climatic conditions .	• Coloured ink/food colouring
		Transpiration The relationship between water loss and leaf structure *(link to Term 1).* Factors that affect the rate of transpiration are: • temperature; • light intensity; • wind; • humidity.	• Design an investigation to discover the effect of temperature, light intensity or humidity on transpiration rate (using a simple potometer). Identify variables and control variables. • Investigate water uptake through the roots	• Potometer • Beakers • Leafy twigs
		• Wilting and Guttation • the intake of water and minerals into the xylem in roots; - the transport of water and minerals to leaves; - The translocation of manufactured food from leaves to other parts of plant	• Investigate water movement through xylem (use *Impatiens* if possible).	• Soft plant e.g., Busy Lizzie/*Impatiens* • Eosin • Glass containers

TERM 2				
3 weeks (12 hours)	**Support Systems in Animals**	**Skeletons** • Examples of animals with: - a hydrostatic skeleton, - an endoskeleton and - an exoskeleton Advantages and disadvantages of each. • Emphasise developmental progression and relate it to the need for support linked to a terrestrial lifestyle. **Human Skeleton** • the axial skeleton: mention of facial bones, cranium, foramen magnum, palate and jaws (*to link with human evolution in Grade* 12); and • the appendicular skeleton. **Functions of the Skeleton** • Movement • Protection • Support • Storage of minerals • Hearing • Structure of a long bone; • the relationship between the structure and function of the following tissues: - bone; - cartilage; - tendons; - ligaments.	• Observe the human skeleton (model or photographs). • Observe and draw a typical longbone: longitudinal section • Observe as many of these tissues as possible: fresh material from a butcher	• Textbooks • Models • Photographs • Selection of cut long bones (from butchery) • Obtain material from a butcher: Joint with bone, cartilage ligaments OR

TERM 2				
Total **8½ weeks** **(34 hours)**		**Joints** • Fixed joints • Partly movable joints • Freely movable (synovial) joints. Structure of synovial joints: ball and socket, hinge, pivot and gliding. **The roles of the following in human locomotion:** • bones; • joints; • ligaments; • tendons; • antagonistic muscles (e.g., biceps/triceps). • The Structure of voluntary skeletal muscles: Myofibrils and muscle contraction. • Diseases that affect the skeleton: Rickets in children, osteoporosis, arthritis, etc.	• Observe and describe the movement which occurs at each of these types of joints. If possible, observe an X-ray of ball and socket and hinge joints	• Microscope prepared slides OR • Micrographs • X-rays if possible
Assessment		• One formal, recorded class test. • Mid-year examination (2½ hrs). Refer to the range of skills specified in Specific Aims 1 and 3. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in homework exercises, written worksheets, reports, summaries, essays, tests, etc. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, homework exercises, reports, tests, essays and examinations. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	One practical task. Refer to the range of skills specified in Specific Aim 2.	

TERM 3				
Strand 2: Life Processes in Plants and Animals (Continued)) Learners study the transport systems of the human body.				
Time	**Topic**	**Content**	**Investigations**	**Resources**
3 weeks **(12 hours)**	**Transport Systems in Mammals (Human)**	**Circulatory System** • The blood circulation system: pulmonary and systemic (double, closed) circulatory systems, including the: - heart and associated blood vessels; - heart internal and external structure related to functioning; and - cardiac cycle (the flow of blood through the heart) • The direction of blood flow: the difference between oxygenated and deoxygenated blood in different parts of the system (diagram or schematic drawing): - lungs and pulmonary system and associated blood vessels; - major organs and systemic system; the associated major blood vessels of the brain, small intestine, liver and kidneys. • The mechanisms for controlling the cardiac cycle and heart rate (pulse). • The blood vessels, including the structure and functioning of arteries, veins with valves and capillaries. • **Lymph:** the relationship between the blood system and lymphatic system. Functions of lymphatic system. • Diseases of the heart and circulatory system, e.g., high and low blood pressure, heart attacks and strokes, the treatments of heart diseases, e.g., stents, valve replacements, bypass surgery, pacemakers, and heart transplants (mention only).	• Dissection of mammal heart (sheep, cow or pig) obtained from a butchery. Identify chambers, valves, muscle, and blood vessels. • In pairs, measure the pulse of one learner before and after exercise. Record, interpret and explain the data presented as a graph. • Observe and draw prepared microscope slides or micrographs of blood cells and blood vessels as seen in cross section. • Draw a table of the differences between different types of blood vessels.	• Textbooks • Charts • Sheep, cow or pig heart obtained from a butchery. • Scalpels or blades • Stop watch or cell phone clocks • Microscopes • Prepared slides or micrographs

TERM 3

Strand 3: Environmental Studies

Organisms interact with other organisms and with the environments in which they live in order to survive and produce offspring. The study of these interactions is called ecology. This section is structured to expose learners to some of the interactions that occur in nature and to the terminology and concepts that describe them. For the Grade 11 curriculum, the terminology and concepts selected here will be used across all strands, where appropriate. This will enable learners to contextualise the meaning of these terms and concepts within the familiar contexts of their local area as well as Southern Africa as a whole. The local area context is also used to introduce how humans influence the environments in which they and other organisms live. The effect man has had on the environment - both locally and globally - will be examined in more detail in Grade 11. This section also builds on the knowledge that has been acquired during the Senior Phase.

Time	Topic	Content	Investigations	Resources
6 weeks (24 hours)	**Biosphere to Ecosystems**	**Biosphere** • The concept of the biosphere. • The inter-connectedness with and components of the global ecosystem: the hydrosphere, lithosphere and atmosphere *(Links to Grade 8).* **Biomes** • Terrestrial and aquatic biomes of southern Africa and how climate, soils and vegetation influence the organisms found in each. • The location of the different biomes in South Africa. **Environment** The concept of environment in terms of human activities in and interactions with the natural environment. Abiotic and biotic factors: effects on the community. **Ecosystems** The concept of ecosystem, structure and ecosystem functioning: • **Abiotic factors:** - physiographic factors (aspect, slope, and altitude) - soil (pH, humus content, texture, water retention capacity and air content) - light (day length and seasonal changes) - temperature (effect of day/night and seasons) - water (water cycle and the importance of wetlands)	**Fieldwork** Choose ONE ecosystem (close to the school) within a local biome for special study. The study must: • deal with abiotic and biotic factors and the interactions between them; • the trophic relationships in an ecosystem; • record and describe seasonal changes over two terms either Terms 1 and 2 or Terms 3 and 4 • biodiversity within the ecosystem using field guides and keys • positive and/or negative human impact on the ecosystem	• Textbooks • Identification guides and keys to groups of organisms • Access to an ecosystem • Map of South Africa • DVDs • The internet • Nature programmes on TV • Local information • Appropriate instruments for measuring abiotic factors.

TERM 3				
Total: 9 weeks **(36 hours)**		- atmospheric gases *(link to pollution-Grade 12); and* - wind (*link to transpiration*). - **Biotic factors**, which include: *(Links to Grade 8)* - producers - consumers - decomposers. • Energy flow through ecosystems and relationship to trophic structure (food pyramids): - Trophic levels: producers, consumers (herbivores and carnivores and omnivores , decomposers *(link with Grade 9 and nutrition in Grade 11);* - Flow charts of the following: nutrients water, oxygen, carbon and nitrogen cycles (Names, e.g., nitrates are required but no detail of chemistry is necessary) • Ecotourism: - economics - ethics - opportunities	Different groups should investigate different factors. Each group must plan, collect, record and present, analyse and evaluate data. *(This serves as an introduction/link to human influences on the environment in Grade 11.)*	
Assessment		• One formal, recorded class test. • Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in written worksheets, homework exercises, summaries, reports, essays, etc. Refer to range of skills specified in Specific Aims1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to the knowledge and understanding of investigations.	One practical task Refer to the range of skills specified under Specific Aim 2.	

TERM 4				
Strand 4: **Diversity, Change and Continuity** Life exists in a huge array of forms and modes of life which scientists organise according to man-made classification systems. Modern life forms have a long history, extending from the first bacteria, around 3,5 billion years ago. South Africa has a rich fossil record of some key events in the history of life. Changes in life forms are related to climate changes as well as movements of continents and oceans over long periods of time.				
Time	**Topic**	**Content**	**Investigations**	**Resources**
1 week **(4 hours)**	**Biodiversity and Classification**	**Biodiversity** Enormous biodiversity on Earth (large variety of species, different ecosystems and genetic differences) with an emphasis on the extent of biodiversity and endemism in southern Africa: indigenous and endemic species. • **Classification Schemes** Classification schemes are a way of organising biodiversity • Brief history of classification: Scientists attempt to classify organisms based on shared features. As information increases classification changes. One of the currently accepted classification systems is the five-kingdom system: Animalia, Plantae, Fungi, Protista and Monera (Bacteria). • The naming of things in science: species concept and binomial system. Focus on Linnaeus (Carl von Linne) and his role in classification systems: Why do we use Latin? • Differences between prokaryotes and eukaryotes *(link to cell structure).* • The main groupings of living organisms, diagnostic features of each: - Bacteria - Protista - Fungi - Plants - Animals	• Principles of classification by grouping everyday objects on the basis of shared similarities into a simple nested hierarchy. • Classify a selection of familiar organisms into groups based on visible evidence. Use keys and identification guides.	• Textbooks • Photographs • Micrographs • A selection of everyday objects • Identification guides • Keys to groups of organisms • Identification guides • Keys • Photographs

TERM 4				
5 weeks (20 hours)	**History of Life on Earth**	**Life's History:Change throughtout the history of life on Earth** • Changes in the composition of the atmosphere (eg. increases in the levels of oxygen) • changes in climate (eg. ice ages) • geological events (eg. movements of continents) and their effect on the distribution of living organisms (biogeography) Evidence for changing sea level and rise and fall of the land (eg. bivalves and ammonites found on the Makhatini Flats in Northern KZN, whale fossils in the Sahara, trilobites in the Karoo • The three eras: Paleozoic, Mesozoic and Coenozoic periods are each divided into periods *(Names of periods not to be memorised)*: • **Geological Timescale** The meaning and use of timescales *(details not to be memorised)*. • **Cambrian Explosion** The Cambrian Explosion, which gives us insights into the origins of the major forms of all animal groups. In the last four million years, significant changes have occurred in species occurring in Africa (e.g., humans) *(Link with Grade 12).* • **Mass Extinctions** There have been five mass extinctions throughout history, two of which are particularly important: 250 mya (the extinction of about 90% of all life on Earth) and 65 Mya (the extinction of many species, including the dinosaurs). The rate of extinction on the Earth at present is higher than at any time in the past. The present time has been called the sixth extinction (*Links to Grades 11 and 12).*	• Construct a timeline showing the history of life on Earth. The timeline should show key events from the emergence of the earliest life forms to the present day to emphasise the long history of life. • Research 'missing link' between dinosaurs and birds eg. *Archaeopteryx* *Coelacanth as an example of a "living" fossil found off the coast of South Africa* Present a verbal or written report. • Various hypotheses have been proposed for the extinction, 65 million years ago, such as the meteorite impact theory and the volcanism evidence (in India) theory. Select ONE of these hypotheses and describe the evidence scientists have gathered in support of it. (*Nature of science)*	

TERM 4				
Total: 6 weeks (24 hours)		• **Fossil Formation and Methods of Dating Them** Fossil formation and methods of dating them, e.g., radiometric dating and relative dating. • **Key Events** There is evidence from South Africa of certain key events in life's history: • origins of the earliest forms of life: evidence of single-celled fossilised bacteria (stromatolites) from many parts of South Africa; • soft-bodied animals in Namibia, Northern Cape; • early land plants in the Grahamstown area; • forests of primitive plants such as *Glossopteris* near Mooi River and Estcourt; • location of coal deposits in South Africa (map only); • the coelacanth as a 'living fossil' found on the Northern KwaZulu-Natal coast; • mammal-like reptiles found in the Karoo (e.g. *Lystrosaurus* and *Thrinaxodon*); • dinosaurs (in the foothills of Drakensberg and Maluti mountains), as well as cone-bearing plants; • early mammals (Eastern Cape and Lesotho); • humans and pre-humans (eg Gauteng, (Cradle of Humankind) Namibia, North West (Taung), Free State (Florisbad), KwaZulu-Natal (Border Cave) and, Limpopo (Makapansgat)). **Understanding Fossils** • Scientists use deductive reasoning (inference) to understand fossils and the history of life on Earth. The impact of humans on biodiversity and the natural environment. **Fossil Tourism** Fossil tourism is a source of income and employment in some localities.	• Examine fossils at a museum or fossil site or study photographs of fossils. • Optional: Use plaster of Paris to construct a 'fossil'. • Map the Key fossil sites on a map of South Africa	

TERM 4		
Assessment	• One formal recorded class test • One project/assignment • End-of-year examination (2 x 2½ hours) Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in exercises, summaries, essays, tests, etc. Refer to range of skills specified in Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	**Practical examination(1 hour)** Note: The practical work done during the year must develop the range of skills described in Specific Aim 2. The practical examination will assess some of these skills.

3.2 GRADE 11: CONTENT

TERM 1				
Strand 1: Diversity, Change and Continuity Life exists in a wide variety of forms which live in different niches. This section enables learners to be exposed to an array of life forms from microorganisms to macroscopic plants and animals. These are organised according to a man-made system of classification based on observable features. Learners explore the roles of organisms in an ecosystem including microorganisms that are a major cause of diseases. This strand also includes some evolutionary development in plant and animal phyla.				
Time	**Topic**	**Content**	**Investigations**	**Resources**
3 weeks (12 hours)	**Biodiversity and Classification of Microorgaisms**	**Biodiversity** • Microorganisms: basic structure and general characteristics of the following groups *(links with Grade 9 and 10):* - viruses - bacteria - protista - fungi. (Macroscopic organisms in the protista and fungi should only be mentioned - not studied in any detail) • Mention of the roles that these groups play in maintaining balance in the environment and web of life. • Symbiotic relationships, including, nitrogen fixing bacteria in plants and *E.Coli* in the human intestine *(link with Grade 10).* • The effect and management of **one** disease from each of the four groups: - viruses (rabies, HIV/AIDS, influenza) - bacteria (blight, cholera, tuberculosis, anthrax) - protists (malaria) - fungi (rusts, thrush, ringworm, athlete's foot). • Immunity, including plants and animals' immune responses of against the infecting microorganism Vaccinations (briefly). • The use of drugs, e.g., antibiotics; effect on microorganisms • The use of microorganisms to produce medicines (e.g., insulin and antibiotics). • Traditional technology to produce, e.g., beer, wine and cheese.	• Where possible, the prevalence of bacteria/fungi should be demonstrated by growing cultures on agar plates, or bread mould (fungus) on bread. • Look for evidence of bacterial/fungal diseases on plants (school and home). Map the distriution of one disease in the study area.	• Textbooks • Reference books • Charts • Agar • Petri dishes • Hand lenses

TERM 1				
3 weeks (12 hours)	**Biodiversity of Plants (Focus on the Developmental Lines and Not on In-Depth Studies of Life Cycles. Learners should have a basic understanding of Phylogenetic Trees as reconstructions of evolutionary pathways) and cladograms**	• Grouping of bryophytes, pteridophytes, gymnosperms and angiosperms according to the presence/absence of: - vascular tissue (xylem and phloem) - true leaves and roots - seeds or spores - fruit. Decreasing dependence on water for reproduction from Bryophytes to Angiosperms	• Observe and draw relevant macroscopic parts to provide examples of each of the following divisions: - bryophytes: moss plant - pteridophytes: rhizome, frond with sori - gymnosperms: needles, cones and seeds; and - angiosperms: flower, fruit and seeds.	• Text books • Plant specimens • Identification guides/keys • Hand lens • Micrographs • Charts • Models • Microscopes • Prepared slides
	Reproduction in Plants	• **Asexual and sexual reproduction, name** advantages and disadvantages of each. • **Flowers as reproductive structures** Adaptations for pollination through (**different** pollinators) wind, insects and birds (South African examples **only)** differences and similarities. • **The Significance of Seeds** - seed banks; - seeds as a food source; and - endemic species in South Africa.	• Draw a phylogenetic tree showing the evolutionary history of the four plant groups and major structural changes in their history of development. • Dissect an example of each of the following types of flowers: - wind pollinated - insect pollinated - bird pollinated. Record observations in a comparative table. Optional: Germinate seeds: record process.	Various flowers Scalpels or blades Hand lenses Micrographs Seeds

TERM 1				
2 weeks (8 hours) **Total 8 weeks (32 hours)**	**Biodiversity of Animals with a focus on six of the major phyla** **(Focus on the Developmental Lines and Phylogenetic Trees. No Further Details are Required Regarding the Morphology of the Six Phyla).**	• The relationship between the body plan and grouping of animals in phyla. The concept of a phylum. • Six phyla (out of about 30 in the animal kingdom): - Porifera - Cnidaria - Platyhelminthes - Annelida - Arthropoda - Chordata. • Key features in respect of body plans: - symmetry and cephalisation; - the number of tissue layers developed from embryo; - the number of openings in the gut; - coelom and blood systems. • The relationship between body plans and modes of living for each of the six phyla; similarities and differences. • The role of invertebrates in agriculture and ecosystems (e.g., pollination, decomposition, soil aeration etc.)	• Calculate approximate surface area to volume ratios of selected examples. • Observe examples from as many phyla as possible (photographs/DVDs). • Select one phylum and design a poster to show diversity in that phylum in South Africa. • Construct a comparative table of these four key features in the six selected phyla.	• Textbooks • Reference books • Photographs • DVDs if possible.
Assessment		• One formal recorded class test. • Assess learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework exercises, worksheets, reports, summaries, essays, etc. Refer to the range of skills listed under Specific Aims 1 and 3. Note that knowledge and understanding to investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to the knowledge and understanding of investigations.	• One practical task. • Refer to the range of skills specified under Specific Aim 2.	

TERM 2

Strand 2: Life Processes in Plants and Animals

Organisms require energy to stay alive. They get this in one of two ways: by harnessing radiant energy from the sun and transforming it into chemical energy which they can use (autotrophs) or (if they cannot do this themselves), by eating other organisms (heterotrophs). The energy transformations that sustain life are include photosynthesis, (where energy is incorporated in to food), animal nutrition (where the food is processed so that it can get to the cells), and cellular respiration (how this energy is made available to organisms in order to stay alive). Gaseous exchange between an organism and its environment is necessary for photosynthesis and cellular respiration. Life processes also involve the removal of carbon dioxide and later the removal of nitrogenous wastes from the body through the kidney.

Time	Topic	Content	Investigations	Resources
3 weeks (12 hours)	**Energy Transformations to Sustain Life**	**Photosynthesis** • process of photosynthesis using words and symbols: the intake of raw materials, trapping and storing of energy, formation of food in chloroplasts and its storage. The release of oxygen. Mention only of light and dark phases *(no biochemical details of light and dark phases are required);* • importance of photosynthesis: release of oxygen, uptake of carbon dioxide from atmosphere, food production (trapping energy); • effects of variable amounts of light, carbon dioxide and temperature on the rate of photosynthesis (brief discussion together with graphs). • The role of carbon dioxide enrichment, optimum light and optimum temperatures in greenhouse systems to improve crop yields *(link to environmental issues discussed later).* • Role of ATP as an important energy carrier in the cell.	**Essential** • Investigate photosynthesis by showing that - starch is produced during photosynthesis; and - light is necessary for photosynthesis. • *The following investigations can be done (by learners) as experiments or as demonstrations:* - carbon dioxide is necessary for photosynthesis; - chlorophyll is necessary for photosynthesis - oxygen is produced during photosynthesis; or - data can be provided and interpreted by learners.	• Textbooks • Living plants • Suitable equipment • Chemicals

TERM 2				
3 weeks (12 hours)	**Animal Nutrition (Mammals)**	• The differences in dentition for herbivorous, carnivorous and omnivorous lifestyles in terms of nutritional requirements and energy relationships *(link with ecology - food chains).* • **Human nutrition** The macro-structure of the alimentary canal and associated organs and the functions of the different parts. • The Processes of ingestion, digestion, absorption, assimilation and egestion and the significance of each: - **Mechanical or physical digestion:** types and functions of different kinds of teeth, processes of chewing. Peristalsis - **Chemical digestion: Enzymes:** functions of carbohydrases, proteases and lipases: where produced; substrate, pH and end-products *(Specific enzymes need not be named - link to enzyme activity.)* - **Absorption:** small intestine as a region of most absorption of digested food; adaptations to increase surface area. Structure (to tissue level) and significance of villi. Importance of hepatic portal system in the transport of absorbed food to the liver and then through hepatic vein to the rest of the body - **Assimilation***:* incorporation of glucose and amino acids into cells, the role of the liver: glucose metabolism, deamination of excess amino acids, and the breakdown of alcohol, drugs and hormones. • **Homeostatic Control** Hormonal control of blood sugar levels.Increase in the number of people affected by diabetes in recent years and brief explanation of diabetes.	• Obtain intestines of a sheep from a butcher and trace the passage that food will take. • Cut open the stomach, portion of the small intestine and a portion of the large intestine to compare the structure of the wall in each.	• Textbooks • Newspapers • Popular magazines • Sheep intestines obtained from a butchery. • Scalpels or sharp knives • Hand lenses • DVD/video to show dissection of a mammal in progress

TERM 2				
		• The relationships between food intake, energy, growth and health. The importance of a balanced diet and changing requirements due to age, gender and activity levels. - Different diets due to cultural, religious, personal and health choices, e.g., vegan, vegetarian, halaal, kosher - Interpret dietary information on food packaging; - Dietary supplements: for health, sport, beauty and anti-ageing *(link to organic and inorganic substances)* - Malnutrition: the reason for and the effects of malnutrition with respect to unbalanced diets (e.g., kwashiorkor), starvation (e.g., marasmus and anorexia), bulimia, food allergies, coronary heart disease, diabetes and obesity. • Analysis of information in the popular press, or any other sources, with respect to malnutrition. • Tooth decay related to diet and fluoride in water supplies and its effect on teeth. • The effects of alcohol and drug abuse and the dangers associated with their misuse.	• Calculate the nutritional value of a meal/diet. Use dietary information or food packaging.	• Selection of food packaging • Photographs of the effects of kwashiorkor, marasmus, anorexia, obesity Magazines, newspaper articles etc.

TERM 2				
1½ weeks (6 hours) **Total 7½ weeks (34 hours)**	**Energy Transformations to Sustain Life**.	• **Cellular Respiration** The process of respiration and uses of energy for living cells: - **Aerobic respiration:** in cytoplasm and mitochondria; use words and symbols: glycolysis, Krebs cycle and oxidative phosphorylation *(no biochemical detail is required);* - **Anaerobic respiration:** production of lactic acid in muscles during exercise; words and symbols *(no biochemical detail of process is required);* - The role of anaerobic respiration in the industry, e.g beer brewing and bread making. A **comparison** between aerobic respiration and anaerobic respiration in terms of raw materials required, products and relative amounts of energy released.	• Design an investigation or demonstration to show that: - oxygen is used by living organisms during respiration. - carbon dioxide is produced by living organisms during respiration or - provide relevant data that can be interpreted by learners. Identify variables, suggest controls for variables and record observations	• Textbooks • Snails or • seedlings • Chemicals • Appropriate equipment
Assessment		• One formal recorded class test. • Mid-year examination (2½ hours) • Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework exercises, worksheets, reports, summaries, essays, etc. Refer to the range of skills listed under Specific Aims 1 and 3. Note that knowledge and understanding to investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	• One practical task • Refer to the range of skills specified under Specific Aim 2	

TERM 3				
Strand 2: Life Processes in Plants and Animals (continued)				
Time	**Topic**	**Content**	**Investigations**	**Resources**
2½ weeks (10 hours)	**Gaseous Exchange**	Distinguish between cellular respiration, breathing and gas exchange. The need for gas exchange. • **Requirements of efficient Gas Exchange Organs:** - large surface area - thin - moist - well ventilated - protected - transport system. These requirements are met in different ways in different environments, e.g., compare aquatic and terrestrial animals and plants. Brief mention of how these requirements are met in: - dicotyledonous plant - earthworm - insect - bony fish - mammal. • **Human Gas Exchange:** The structure (macro and tissue level), location, adaptations and functioning of the ventilation system: - trachea - epiglottis - bronchi - bronchioles	• Use books end on end and one on top of another to illustrate and calculate the differences in respect of surface area to volume ratio which is caused by different shapes: e.g., flatworm (Planaria) and earthworm. • Observe and investigate the structure of the lungs, diaphragm, associated pulmonary blood vessels and the heart of a pig or a sheep obtained from a butcher. • Construct a model of the human breathing system. Explain the limitations of the model. • Demonstrate that expired air contains carbon dioxide.	• Textbooks • Models • Charts • Dissection board and instruments • DVDs/videos • Hand lenses

TERM 3				
		- lungs - ribs - intercostal muscles - diaphragm - alveoli. Ventilation of the lungs: - gaseous exchange in alveoli; - the transport of gases around the body; - gaseous exchange in tissues; and - composition of inspired air vs. expired air- analyse data. Brief mention of the homeostatic control of breathing. • Diseases and abnormalities: causes symptoms and treatment of TB in South Africa. *(Link to biodiversity - microorganisms)* Brief study of other respiratory diseases: - asthma - hay fever - bronchitis - emphysema - lung cancer. The effects of smoking on gaseous exchange. Smoking legislation in South Africa. • Brief mention of artificial respiration and the effect of mouth to mouth resuscitation. • The effects of altitude on gaseous exchange, e.g., the performance of athletes in Johannesburg versus Durban or Cape Town.	• Measure and compare the depth of breathing of two or more learners and the effect of exercise on breathing/pulse rate. Interpret data on depth and rate of breathing. • Analyse and interpret data showing the effects of altitude on the number of red blood cells and the consequent effect on athletes at different altitudes *(Links to Grade 10.)*	

TERM 3				
2 ½ weeks (10 hours)	**Excretion in Humans**	• **Excretion in Various Organs**: Brief role of the following: - the lungs; - the kidneys and bladder; - the liver; - the alimentary canal (gut); and - the skin. The substances excreted by each and the origins of these substances. • **Urinary system** The structure of the: - urinary system: position of kidneys, ureters, bladder, urethra. - kidney: structure and functioning, removal of urea and excess water and salts, re-absorption of glucose and some salts. - nephron: structure and functioning; ultra-filtration, re-absorption, tubular excretion, pH control, formation of urine • Homeostatic control of water and salts: role of ADH and aldosterone: Dialysis and kidney transplants. • Mention of diseases affecting kidney function, e.g. kidney stones, kidney failure due to overuse of some painkillers, effect of bilharzia infection.	• Dissection of a sheep's or pig's kidney (obtained from butchery). Use a worksheet to identify the following: capsule, cortex, medulla, pyramids, blood vessels, pelvis, ureter and hilum. Draw and label the dissected kidney	• Textbooks • Charts • Models • Hand lenses • Sheep or pig kidney (from butchery) • Scalpel/blade • Dissecting boards • Scissors Note: A pig's kidney more closely resembles that of a human.

TERM 3				
Strand 3: Environmental Studies Organisms interact with other organisms and with the environments in which they live. This section is structured so that learners must explore the impact of people on their environments (global, international and local). Learners are encouraged to look for and suggest solutions to local environmental problems. The intention is that learners will become more informed and more sensitive to environmental issues and will modify their behaviour to lessen their impact on the environment.				
Time	**Topic**	**Content**	**Investigations**	**Resources**
4 weeks **(24 hours)**	**Population Ecology**	• **Population Size** Immigration, emigration, mortality, births. Fluctuations. Limiting factors and carrying capacity. Logistic and geometric growth curves with phases. • **Interactions in the Environment** - **predation:** two South African examples of predator-prey relationships: graphs; - **competition:** **interspecific**: for light, space, water, shelter and food**;** **intraspecific**: for food, access to mates, water, space, and shelter; survival is determined by access to the above, ecological niches; - **specialisation:** competitive exclusion and resource partitioning; discuss one example of coexistence in animals and one example in plants;	• Determine the size of a population by quadrant or simple sampling e.g., simulated mark/recapture. Collect and record data, Interpret data Calculate/estimate the population size. • **Case study**: Rationale for culling, e.g. elephants in the Kruger National Park as an example of an application of estimating population size (link to **researched** reasons for culling). • Draw up a public survey form to test the public opinion about culling. Show results in a pie graph.	• Textbooks • Reference books • Posters • Charts • Brochures • DVDs • Newspapers • Magazines • Watching nature programmes on TV

TERM 3				
Total 9½ Weeks (38 Hours)		- **parasitism:** two examples from South Africa; one species benefits - **mutualism:** two examples from South Africa; both species benefit; - **commensalism:** two examples from South Africa. • **Social Organisation:** The benefits of herds/flocks (avoidance); packs (hunting); dominance; and the division of tasks (castes) (mention only). • **Community change over time: Succession** Primary and secondary succession and possible endpoints depending on environmental fluctuations (mention only). • **Human Population** Reasons for exponential growth: - age and gender distributions for different countries, including South Africa; - forecast of South Africa's population growth over the next twenty years and predict possible consequences for the environment.	• Draw a life cycle of the bilharzia parasite or tapeworm (simplify larval stages). (Links to animal biodiversity) • Identify an area in or close to the school grounds where succession is taking/has taken place. (e.g., in the goal area on the sports field at the end of a season or a roadside that has been scraped).	
Assessment		• One formal recorded class test. • Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework exercises, worksheets, reports, summaries, essays, etc. Refer to the range of skills listed under Specific Aims 1 and 3. Note that knowledge and understanding to investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	• One practical task. • Refer to the range of skills specified in Specific Aim 1.	

TERM 4				
Stand 3 Environmental Studies (Continued): Human Impact on the Environment Note: Human Impact on the Environment must be completed in Grade 11, but this topic will be examined in **both** Grade 11 and in the National Senior Certificate at the end of Grade 12. In this knowledge strand, it is important to emphasise the interrelatedness and interdependence of the human impacts and the environment.				
Time	**Topic**	**Content**	**Investigations**	**Resources**
7 weeks **(28 hours)**	**Human Impact on the Environment: Current Crises for Human Survival: Problems to be Solved Within the Next Generation**	Causes and consequences of the following (relate to conditions and circumstances in South Africa): • **The atmosphere and climate change** - carbon dioxide emissions; - concept of 'carbon footprint' and the need to reduce the carbon footprint; - deforestation; - greenhouse effect and global warming: desertification, drought and floods; - methane emissions; - ozone depletion. • **Water** • Availability: - Construction of dams - Destruction of wetlands - Poor farming practices - Droughts and floods - Exotic plantations and depletion of water table - Boreholes and effects on aquifers - Wastage - Cost of water • Quality: - Water for domestic use, industry, agriculture and mining: pollution, diseases, eutrophication and algal bloom. - The effect of mining on quality of water - Thermal pollution	• Practical observation of ONE example of human influence on the environment in the **local area** (e.g., the impact of alien species on biodiversity). Written report on the chosen example.	• Textbooks • Reference books • Reports in the media • Share - Net booklets

TERM 4				
		- The need for water purification and recycling - Alien plants, e.g., *Eichornia* • **Food Security** *(link with population ecology dynamics)* - human exponential population growth; - droughts and floods (climate change); - poor farming practices: monoculture; pest control, loss of topsoil and the need for fertilisers; - alien plants and reduction of agricultural land; - the loss of wild varieties: impact on gene pools; - genetically engineered foods; - wastage. • **Loss of Biodiversity** (the sixth extinction) - habitat destruction: farming methods, e.g., overgrazing and monoculture, golf estates, mining, urbanisation, deforestation; loss of wetlands and grasslands; - poaching, e.g., for rhino horn, ivory and 'bush meat'; - alien plant invasions: control using mechanical, chemical and biological methods; and - indigenous knowledge systems and the sustainable use of the environment e.g., devils' claw, rooibos, fynbos, the African potato (*Hypoxis*) and *Hoodia*. • **Solid Waste Disposal** - managing dumpsites for rehabilitation and prevention of soil and water pollution; - the need for recycling; - using methane from dumpsites for domestic use: heating and lighting; and - safe disposal of nuclear waste.	• Rhino poaching in South Africa: read articles and make suggestions on how it can be prevented. • Analyse the solid waste generated in the household in one week, including paper, metals and plastic. Estimate the percentage that could be recycled or reused. • Visit a municipal landfill site, or a local refuse dump. Observe rehabilitation (or lack thereof) in practice. • Assess the effectiveness of waste management.	
Total **7 weeks** **(28 hours)**				

TERM 4		
Assessment	• One formal recorded class test. • One project/assignment. • End-of-year examination: 2 x 2 ½ hours. • Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework exercises, worksheets, reports, summaries, essays, etc. Refer to the range of skills listed under Specific Aims 1 and 3. Note that knowledge and understanding to investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	One practical exam (1 hour) Note: Refer to the range of skills specified in Specific Aim 2.

3.3 GRADE 12: CONTENT

TERM 1				
Strand 1: Life at Molecular, Cellular and Tissue Level All living organisms are made of atoms which combine to form molecules. Of these, DNA (or Deoxyribonucleic Acid) carries the genetic code for cell specialisation and cell functioning and DNA packages, as genes, determine what an organism will look like and how it will function. Plant and animal cells have a complex organisation which enables them to carry out the basic processes of life, i.e. movement, nutrition, respiration, excretion, growth, reproduction and responding to stimuli. Cells are specialised and form tissues which perform particular functions. Tissues are arranged into organs which are also specialised to carry out particular functions. In order to understand species, speciation, biodiversity and change, it is essential to understand how DNA and chromosomes enable continuity and change.				
Time	**Topic**	**Content**	**Investigations**	**Resources**
2½weeks **(10 hours)**	**DNA: The Code of Life**	• **Deoxyribonucleic acid (DNA)** - Location in the cell; chromosomes, genes and extranuclear DNA; - Discovery of the structure DNA by Watson, Crick, Franklin and Wilkins; - Structure of DNA; - Role of DNA: genes and non-coding DNA; - Replication: cell cycle *(link to Grade 10):* necessity for exact copy. **Ribonucleic Acid (RNA)** - Types and location in cells; - Structure of RNA; - Transcription from DNA; - Translation of RNA into proteins (protein synthesis) (mRNA, tRNA): sequence of events; and - Genetic code (basic understanding).	If possible: • Perform a simple process to extract DNA and examine the threads If possible: • DNA 'finger printing'/DNA profiling: (case study only)	• Textbooks • Micrographs • Equipment • Chemicals

TERM 1				
2 weeks **(8 hours)**	**Meiosis**	• **Meiosis:** the process of reduction division - purposes of reduction division (gametogenesis and exceptions: mosses, ferns); - importance of meiosis: diploid to haploid: production of gametes; - introduction of genetic variation (random segregation, crossing over); - consequences of abnormal meiosis, e.g., Down's syndrome • **Mitosis and meiosis** Similarities and differences between mitosis and meiosis *(link to Grade 10)*	• Observe and draw prepared microscope slides, micrographs or models of cells in selected stages of meiotic cell division, e.g., crossing over in metaphase I; anaphase I, metaphase II, telophase II.	• Textbooks • Posters • Models • Microscopes • Prepared microscope slides or micrographs

Strand 2: Life Processes in Plants and Animals

This knowledge strand deals with the ways in which animals are able to respond to their environments in order to ensure survival. Learners explore different reproductive strategies in animals. Reproduction in humans is dealt with in more detail as a specific example of animal reproduction. This expands on the basic knowledge of human reproduction that was introduced in Grades 7 and 9.

Time	Topic	Content	Investigations	Resources
½ week **(2 hours)**	**Reproduction in Vertebrates**	• **Diversity of reproductive strategies** Appropriate examples of different groups in the animal kingdom to illustrate maximising reproductive success in different environments: - external or internal fertilisation - ovipary, ovovivipary, vivipary - amniotic egg - precocial and altricial development - parental care.		• Textbooks • Charts • Reference books • DVDs (if possible)

TERM 1				
3 weeks (12 hours) **Total 8 weeks (32 hours)**	**Human Reproduction**	• The structure of male and female reproductive systems; (*link to Grade 7 and 9)* • The unique human characteristics of some aspects of reproduction (*link with Grade 9)*: - puberty: main changes; - gametogenesis: relate briefly to meiosis *(no individual names of stages)*; - menstrual cycle: emphasis on hormonal control; - fertilisation and development of zygote to blastocyst; - gestation *(mention briefly);* - implantation and development: the role of placenta.	• Prepared microscope slides of an ovary, testes and a section through a penis. Identify tissues and different structures • Observe and describe prepared microscope slides or micrographs or ultrasound pictures of embryonic development. • If possible observe stages of pregnancy by watching DVDs of the development of an embryo and the birth process. • Observe contraceptive devices	• Textbooks • Charts • Micrographs • Microscope • Prepared microscope slides • Ultrasound pictures of embryonic development • DVDs
Assessment		• One formal, recorded class test. • Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in homework exercises, written worksheets, reports, summaries, essays, tests, etc. Refer to range of skills specified in Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	• One practical task • Refer to the range of skills specified in Specific aim 2.	

TERM 2				
Strand 1: Life at Molecular, Cellular and Tissue Level (continued); and **Strand 4: Diversity, Change and Continuity** Life exists in a variety of life forms and it is in the study of DNA, genetics and inherited characteristics that life at molecular level intersects with Strand 4: Diversity, Change and Continuity. In order to understand species, speciation, biodiversity and change, it is essential to understand how DNA and chromosomes enable continuity and change				
Time	**Topic**	**Content**	**Investigations**	**Resources**
4 weeks **(16 hours)**	**Genetics and Inheritance**	• **Genes:** Dominant and recessive genes and alleles Mention of Mendel, father of genetics • **Inheritance and variation** - **Monohybrid crosses:** phenotype and genotype, homozygous and heterozygous (pure bred and hybrid); examples of complete, incomplete/partial dominance and codominance; - **Dihybrid crosses**: phenotypes and genotypes. • **Sex chromosomes** Sex-linked alleles; sex-linked diseases • **Mutations** - harmless and harmful mutations: examples of diseases, disorders; gene mutations and chromosomal aberrations; and - useful mutations, link with natural selection • Genetic engineering: Stem cell research, genetically modified organisms, biotechnology and cloning. • Mention mitochondrial DNA and the tracing of genetic links • Paternity testing and DNA finger printing (forensics)	**Solving genetic problems** • Monohybrid crosses • Dihybrid crosses • Complete and incomplete dominance • Blood groups • Sex chromosomes and sexually linked diseases e.g., haemophilia and colour blindness • Genetic lineages	• Textbooks • Reference books

TERM 2				
Strand 2: Life Processes in Plants and Animals (continued) This continues investigating the ways in which animals and plants are able to respond to their environments in order to ensure their survival.				
Time	**Topic**	**Content**	**Investigations**	**Resources**
4 weeks **(16 hours)**	**Responding to the Environment: Humans**	• **Humans have two systems: nerves and hormones that** enable them to respond to the environment. • **Human nervous system** Reactions to stimuli in the surroundings. - **Central Nervous System**: Brain: Meninges for protection, location and functions of cerebrum, cerebellum, corpus callosum, medulla oblongata, spinal cord - **Peripheral Nervous System:** location and functions only - **Autonomic Nervous System:** location and functions only - **Nerves: Structure of a nerve :** Nerve tissue: structure of sensory neurons and motor neurons - **Reflex arc:** Structure, function and significance of a simple reflex arc. Significance of synapses • **Disorders:** Alzheimer's disease and multiple sclerosis • **Injuries:** Brain and spinal damage. Mention stem cell research and the possibility of repairing injuries. • **Effects of drugs:** Dagga, heroin, ecstasy, tik, etc. *(Links to Grade 11)*	• Model of the brain or a sheep's brain in order to observe regions of brain. Identify the cerebrum, cerebellum and spinal cord • Examine a cross-section of spinal cord to observe the white and grey matter. • Design an investigation to determine the reaction time of different learners to a stimulus. Record the results and calculate the average time. Calculate the distance that will be travelled by a car travelling at 100 km per hour within the average reaction time. Apply this knowledge to safe driving: following distances..	• Textbooks • Wall charts • Scalpel or blade • Models: eye ear brain • Sheep's skull sawn in half to expose the brain (obtained from the butchery) • Obtain sawn through vertebrae from butcher to show spinal cord.

TERM 2				
Total **8 weeks** **(32 hours)**		• **Receptors** Detection of a range of stimuli: light, sound, touch, temperature, pressure, pain and chemicals (taste and smell). Details of the structure of the eye and ear (only) - **Human eye**: structure and functioning, binocular vision, accommodation, pupil reflex - Short-sightedness, long-sightedness, astigmatism, cataracts (brief explanations using diagrams) - **Human ear**: structure and functioning: hearing and balance - Hearing defects: deafness, middle ear infections, grommets	• Dissect the eye of a sheep or pig. Observe the different regions. Worksheet to be used to follow instructions for dissecting and observing the significant parts.	• Eye of sheep or pig obtained from butchery
Assessment		• One formal, recorded class test. • Mid-year examination (2½ hours) or control test • Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in homework exercises, flow diagrams, written worksheets, reports, summaries, essays, tests, etc. Refer to range of skills specified in Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, homework exercises reports, essays etc. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	• One practical task • Refer to the range of skills specified in Specific Aim 2	

TERM 3				
Strand 2:Life Processes in Plants and Animals (Continued) This continues investigating the ways in which animals and plants are able to respond to their environments in order to ensure their survival.				
Time	**Topic**	**Content**	**Investigations**	**Resources**
1½ weeks (6 hours)	**Human Endocrine System**	• **Endocrine glands** Location in the body, hormones secreted, roles of hormones of the following glands: - Hypothalamus : ADH - Pituitary gland : TSH, FSH,LH, prolactin, growth hormone (*link to reproduction)* - Thyroid gland: thyroxin - Pancreas: insulin, glucagon - Adrenal gland: adrenalin, aldosterone - Gonads: oestrogen, progesterone and testosterone (*link to reproduction)* Examples of negative feedback mechanisms: TSH and thyroxin; insulin and glucagon; diabetes	• Research disorders caused by under-and over secretion of at least one hormone. Different learners should research different hormones. Brief written report.	• Textbooks • Charts • Photographs of giantism, dwarfism, and persons suffering from: hypothyroidism and hyperthyroidism
1 week (4 hours)	**Homeostasis in Humans**	• **Homeostasis** The process of maintaining a constant, optimal internal environment: - **negative feedback:** glucose, carbon dioxide; water and salts; - **thermoregulation:** adaptations of human skin; sweating, vasodilatation, vasoconstriction.	• Observe prepared microscope slides of a section through human skin or use a micrograph or model. Identify main features.	• Textbooks • Microscope prepared slides or Micrographs or model

TERM 3				
1 week **(4 hours)**	**Responding to the Environment: Plants**	• **Plant hormones** The general functions of auxins, gibberellins, abscisic acid. Weed control by using growth hormones. • **Geotropism and phototropism** Growth regulation by auxins. • **Plant defence mechanisms** Chemicals, thorns.	• Design investigations to show geotropism and phototropism. Identify the variables and recommend ways to control the variables. Record and interpret the results.	• Textbooks • Suitable equipment: geotropism and phototropism experiments • If available, a klinostat should be used • Seedlings

Strand 4: Diversity, Change and Continuity (continued):

It is necessary to have a firm grasp on the work done earlier in the year on DNA, genetics and heredity in order to understand the concept of change, natural selection and evolution. This knowledge strand is expanded on by exploring the mechanisms of evolution and specifically human evolution in Africa. .

Time	Topic	Content	Investigations	Resources
2 weeks **(8 hours)**	**Evolution by Natural Selection**	• **Origin of ideas about origins** Different kinds of evidence: fossil record *(link to Grade 10),* modification by descent, biogeography *(link to Grade 10),* genetics *(Grade 12)* and other forms of evidence: - difference between hypothesis and theory; and - brief overview of history of different theories of development: Lamarckism, Darwinism, and Punctuated Equilibrium. • **Artificial selection**: ONE example of a domesticated animal **and** ONE example of a crop species. • **Darwin's theory of evolution by natural selection** • Evolution (change) through **natural selection** *(link to Genetics)*: depends on variation/gene pool of inherited characteristics, and the production of more offspring than is required. Changes in the environment. Pressure leads to extinction or successful adaption. Continuous and discontinuous variation.	• Class debate and discussion. • Demonstrate natural selection through games, e.g., camouflage • Research one example of artificial selection. Present findings in a report	• Textbooks • Reference books. • Biography of Darwin (if possible and if learner shows interest)

TERM 3				
		• **Formation/emergence of new species** Speciation; biological species concept. Interbreeding produces viable offspring in a species. ONE example of speciation due to geographic isolation (Galapagos finches, Galapagos tortoises, mammals or plants on different landmasses, e.g., baobabs in Africa and Madagascar, proteas in South Africa and Australia). • **Mechanisms for reproductive isolation:** Introduction to some examples: - breeding at different times of the year; - species-specific courtship behaviour; - adaptation to different pollinators (plants); - prevention of fertilisation; - infertile offspring in cross-species hybrids. • **Evolution in present times** Examples of natural selection and evolution, e.g., resistance to insecticides in insects, bill and body size of Galapagos finches, resistance to antibiotics in various bacteria (TB), HIV resistance to anti-retrovirals.		

TERM 3				
2 weeks (8 hours) **Total 7½ weeks (30 hours)**	**Human Evolution**	• **Evidence of common ancestors for living hominids including humans:** Anatomical differences and similarities between African apes and humans: - Fossil evidence: key features: bipedalism (spine and pelvic girdle), brain size, teeth (dentition), prognathism and palate shape, cranial and brow ridges. The number of fossils that have been found (it is important to know that thousands of fossil fragments have been found). - Genetic evidence: mitochondrial DNA - Cultural evidence tool-making. • **Out of Africa hypothesis** Evidence African origins for all modern humans: genetic links, mitochondrial DNA: - Rift valley fossil sites in East Africa (Kenya and Tanzania) and in Ethiopia. Scientists e.g., Johansen and White, the Leaky family - Fossils discovered at these sites: *Ardipithecus*, *Australopithecus*, *Homo* - Fossils sites in South Africa: Fossils discovered at these sites: *Australopithecus* and *Homo*	• **Poster presentation** Map out the three major phases in hominid evolution from 6 mya up to the present: - *Ardipithecus* (Ethiopia) - *Australopithecus* (East and South Africa) - *Homo* (various sites) The map/timeline should show the diagnostic features and the approximate times that examples of the three major genera existed. It is not necessary to show the relationships between genera. (Scientists may interpret relationships differently as new evidence is found) or (see Term 4)	• Textbooks • Newspaper articles (e.g., the discovery of Sediba) • DVDs if possible • Maps, pictures and photographs

TERM 3		
Assessment	• One formal, recorded test. • Trial examination: 2 x 2½ hours. • One project/assignment. • Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework exercise, written worksheets, reports, summaries, essays, etc. Refer to the range skills specified in Specific Aims 1 and 3 Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, homework, summaries, reports and essays and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	• One practical task. • Refer to the range of skills specified in Specific Aim 2.

TERM 4				
Strand 4: Diversity, Change and Continuity (continued)				
Time	**Topic**	**Content**	**Investigations**	**Resources**
2 weeks **(8 hours)**	**Human Evolution: continued**	• **Importance of the Cradle of Humankind**: - **Main fossil sites in South Africa, e.g.,** Taung, Sterkfontein, Kromdraai, Swartkrans, Malapa, Plovers Lake, Gladysvale, Makapansgat, Florisbad, Border Cave, Blombos: Evidence and evolutionary trends from these sites (*refer to dating of fossils Grade 10).* At least two examples should be studied to see evolutionary trends. Mention scientists such as Dart, Broome, Tobias, Brain, Ron Clark, Berger, Keyser and others • **Alternatives to evolution** - different cultural and religious expalanations for the origin and development of life on Earth: - Creationism; - Intelligent Design; - Literalism - Theistic evolution	• Poster presentation: Map out the changes in the evolution of the Genus: *Homo*. The map/timeline should show where the different fossils have been found and the approximate periods that the selected examples existed**.** The most significant features of each type of fossil (Genus and species) to illustrate the difference between them. • Research and discussion to share information about different explanations: cultural or religious explanations.	
2 weeks **(8 hours)**		• Do revision on particularly (but not only) Grade 11 work that will be examined in the NSC exam**.**		
Total **4 weeks** **(16 hours)**				
Assessment: 2 x 2½ hour exams: Paper 1 and Paper 2 (topics specified)				

SECTION 4

ASSESSMENT

4.1 Introduction

Assessment is a continuous planned process of identifying, gathering and interpreting information on learners' performance, using various forms of assessment. It involves four steps: generating and collecting evidence of achievement; evaluating this evidence, recording the findings and using this information to understand and thereby assist the learners' development in order to improve the process of learning and teaching.

Assessment should be both informal (Assessment for Learning) and formal (Assessment of Learning). In both cases, regular feedback should be provided to learners to enhance their learning experience.

Assessment is a process that measures individual learners' attainment of knowledge (content, concepts and skills) in a subject by collecting, analysing and interpreting the data and information obtained from this process to:

- enable the teacher to make reliable judgements about a learner's progress;
- inform learners about their strengths, weaknesses and progress; and
- assist teachers, parents and other stakeholders in making decisions about the learning process and the progress of the learners.

Assessment should be mapped against the content and intended aims specified for Life Sciences and in informal and formal assessments it is important to ensure that in the course of the year:

- all of the subject content is covered;
- the full range of skills is included; and
- different forms of assessment are used.

4.2 Informal Assessment or Daily Assessment

Assessment **for** learning has the purpose of continuously collecting information on learners' achievement that can be used to improve their learning.

Informal assessment is daily monitoring of learners' progress. This is done through observations, discussions, practical demonstrations, learner-teacher conferences, informal classroom interactions, etc. Informal assessment may be as simple as stopping during the lesson to observe learners or to discuss how their learning is progressing. Informal assessment should be used to provide feedback to the learners and to inform planning for teaching, but it need not be recorded. It should not be seen as separate from learning activities taking place in the classroom. Learners or teachers can mark these assessment tasks.

Self-assessment and peer assessment actively involve the learners being assessed. This is important as it allows learners to learn from and reflect on their own performance. The results of the informal daily assessment tasks are not formally recorded unless the teacher wishes to do so. The results of daily assessment tasks are not taken into account for promotion or certification purposes.

Informal, ongoing assessments should be used to structure the acquisition of knowledge and skills and should be a precursor to formal tasks in the Programme of Assessment.

4.3 Formal Assessment

Grades	Formal school-based assessments	End-of-year examinations
R - 3	100%	n/a
4 - 6	75%	25%
7 - 9	40%	60%
10 and 11	25% including a mid-year examination	75%
12	25% including mid-year and trial examinations	External examination: 75%

All assessment tasks that make up a formal programme of assessment for the year are regarded as formal assessment. Formal assessment tasks are marked and formally recorded by the teacher for progression and certification purposes. All formal assessment tasks are subject to moderation to ensure that appropriate standards are maintained.

Formal assessment provides teachers with a systematic way of evaluating how well learners are progressing in a grade and in a particular subject. Examples of formal assessments include tests, examinations, practical tasks, projects, oral presentations, demonstrations and performances. Formal assessment tasks form part of a year-long formal Programme of Assessment in each grade and subject.

The cognitive demands in assessment should be **appropriate for the age and developmental level** of the learners in the grade. Assessment in Life Sciences must cater for a range of cognitive levels and abilities of learners. The assessment tasks should be carefully designed to cover the content of the subject as well as the range of skills and the cognitive levels that have been identified in the specific aims. The design of assessments should therefore ensure that a full range of content and skills are assessed within each Grade in the Phase. The specific aims, topics, content and range of skills in the subject should be used to inform the planning and development of assessments.

Weighting of Cognitive Demands for the Assessment of content in Grades 10, 11 and 12

	Knowing Science	Understanding Science	Applying scientific knowledge	Evaluating, analysing and synthesising scientific knowledge
%	40%	25%	20%	15%
Examples of Useful Verbs	• State • Name • Label • List • Define • Describe and others	• Explain • Compare • Rearrange • Give an example of • Illustrate • Calculate • Make a generalisation and others	• Predict • Apply • Use knowledge • Demonstrate • Solve • Implement • Judge and others	• Select • Differentiate • Analyse • Infer • Suggest a reason • Discuss • Categorise and others

Note: A single, formal class test per term will not necessarily provide the most accurate and reliable evidence of every learner's performance. As far as possible, teachers should try to let learners write more than one test per term in order to get a better picture of their abilities. One formal class test per term is the minimum number that must be recorded.

The requirements (number and nature of tasks) for Life Sciences are indicated below:

4.4 Assessment Requirements for Life Sciences:

4.4.1 Grade 10

The programme of assessment is designed to spread formal assessment tasks in all subjects in a school throughout a term.

GRADE 10

PROGRAMME OF FORMAL ASSESSMENT

<table>
<tr><th colspan="4">FORMAL, RECORDED, SCHOOL-BASED ASSESSMENTS</th><th colspan="2">END-OF-YEAR INTERNAL EXAMINATION 75%</th></tr>
<tr><th colspan="2">Content</th><th colspan="2">Practical</th><th>Two Written Examinations (2½ Hours + 2½ Hours)</th><th>Practical Examination (1 Hour)</th></tr>
<tr><td colspan="2">• Four tests (minimum of 50 marks each)
• One midyear examination (2½ hours 150 marks)
• One project/assignment (can be done in any term: 100 marks in the fourth term)
• Skills are listed under Specific Aims 1 and 3</td><td colspan="2">A selection of three representative practical tasks, which cover the range of skills, must be marked and recorded. (The marks allocated for a practical task should range from 20 to 40.)
The range of skills is described in Specific Aim 2.</td><td>This exam tests knowledge on content, concepts and skills across all topics. Knowledge of practical work as well as some of the skills related to practical work must be assessed in the written examination.
80% = 60 marks</td><td>This exam tests practical knowledge and skills
This should be set by each teacher taking into account the resources that are available for practical examination.
20% = 15 marks</td></tr>
<tr><th colspan="4">School-based Assessment (During the Year)</th><th colspan="2">75</th></tr>
<tr><th>Term 1</th><th>Term 2</th><th>Term 3</th><th>Term 4</th><th colspan="2" rowspan="2"></th></tr>
<tr><td>• One test
• One selected practical task</td><td>• One test
• One selected practical task
• Mid-year examination</td><td>• One test
• One selected practical task
* Environmental studies: fieldwork</td><td>• One test
• One project/ assignment</td></tr>
<tr><td>25%</td><td>25%</td><td>25%</td><td>25%</td></tr>
<tr><td colspan="4">Convert to 25%</td><td colspan="2">75%</td></tr>
</table>

* This is an example of a project/assignment.

4.4.2 Grade 11

PROGRAMME OF FORMAL ASSESSMENT

<table>
<tr><td colspan="4">FORMAL, RECORDED, SCHOOL-BASED ASSESSMENTS</td><td colspan="2">END-OF-YEAR INTERNAL EXAMINATION 75%</td></tr>
<tr><td colspan="2">Content</td><td colspan="2">Practical</td><td>Two Written Examinations (2½ hours + 2½ hours)</td><td>Practical Examination(1 hour)</td></tr>
<tr><td colspan="2">• Four tests (minimum of 50 marks each)
• One mid-year examination (2½ hours, 150 marks)
• One project/assignment (can be done in any term: 100 marks in Term 4)
• Skills are listed under Specific Aims 1 and 3</td><td colspan="2">A selection of three representative practical tasks, which cover the range of skills, must be marked and recorded. (The marks allocated for a practical task should range from 20 to 40).
The range of skills is described in Specific Aim 2.</td><td>These exams test knowledge on content, concepts and skills across all topics. Knowledge of practical work as well as some of the skills related to practical work must be assessed in the written examination.

80% = 60 marks</td><td>This exam tests practical knowledge and skills
This should be set by each teacher taking into account the resources that are available for practical examination.

20% = 15 marks</td></tr>
<tr><td colspan="4">School-based Assessment (during the year)</td><td colspan="2">75</td></tr>
<tr><td>Term 1</td><td>Term 2</td><td>Term 3</td><td>Term 4</td><td colspan="2" rowspan="2"></td></tr>
<tr><td>• One test
• One selected practical task</td><td>• One test
• One selected practical task
• Mid-year examination</td><td>• One test
• One selected practical task
* Environmental studies: fieldwork</td><td>• One test
• One project/ assignment</td></tr>
<tr><td>25%</td><td>25%</td><td>25%</td><td>25%</td><td colspan="2"></td></tr>
<tr><td colspan="4"></td><td colspan="2">75%</td></tr>
</table>

*This is an example of a project/assignment.

The requirements (number and nature of tasks) for Life Sciences are indicated below:

4.4.3 Grade 12

PROGRAMME OF FORMAL ASSESSMENT

<table>
<tr><th colspan="4">FORMAL, RECORDED, SCHOOL-BASED ASSESSMENTS</th><th>TRIAL: END-OF-YEAR INTERNAL EXAMINATION 50%</th></tr>
<tr><th colspan="3">Content</th><th>Practical</th><th>Two written examinations
(2½ hours + 2½ hours)</th></tr>
<tr><td colspan="3">• Four tests (minimum of 50 marks each)
• *One mid-year examination (2½ hours, 150 marks) or control test
• One trial examination (2 x 2½ hours, 300 marks)
• One project/assignment (can be done in any term: 100 marks in term 3).
• Skills are listed under Specific Aims 1 and 3</td><td>A selection of three representative practical tasks, which cover the range of skills, must be marked and recorded. (The marks allocated for a practical task should range from 20 to 40).
The range of skills is described in Specific Aim 2.</td><td rowspan="4">These exams test knowledge of content, concepts and skills across all topics. Knowledge of practical work as well as some of the skills related to practical work must be assessed in the written examination

The trial (preliminary) examination should be set on the work completed in Terms 1, 2 and 3.</td></tr>
<tr><th colspan="4">School-based assessment (during the year)</th></tr>
<tr><th>Term 1</th><th>Term 2</th><th>Term 3 and Term 4</th><th></th></tr>
<tr><td>• One test
• One selected practical task</td><td>• One test
• One selected practical task
* Mid-year examination or control test</td><td>• One test
• One selected practical task (will not be included in year mark)
project/assignment
* Environmental studies: fieldwork</td><td></td></tr>
<tr><td>33%</td><td>33%</td><td>33%</td><td></td></tr>
<tr><td colspan="4">Convert to 50%</td><td>50%</td></tr>
</table>

* **Note:** Schools that are performing well (above an 80% pass rate in the previous year) **may** elect not to write the mid-year examination.

Note: The year mark will be converted to 25% and the **external** examination will count 75% of the final mark.

4.5 THE END-OF-YEAR EXAMINATIONS:

4.5.1 Grade 10

The examination will consist of two examination papers of 2½ hours and 150 marks each.

The weighting and assessment of topics in Paper 1 and Paper 2 will be as follows:

Paper 1

Topic	Time	Weighting	
		%	Marks
T1:			
• Chemistry of Life	2½ weeks	**16**	**23**
• Cells: Basic Units of Life	3 weeks	**17**	**25**
• Cell Division: Mitosis	2 weeks	**12**	**18**
• Plant and Animal Tissues	1 week	**5 (50)**	**9**
T2:			
• Plant and Animal Tissues	2 weeks	**13**	**20**
• Plant Organs (Leaf)	½ week	**3**	**5**
• Support and Transport Systems: Plants	3 weeks	**17**	**25**
• Support Systems: Animals	3 weeks	**17 (50)**	**25**
Totals	**17 weeks**	**100%**	**150**

Paper 2

Topic	Time	Weighting	
		%	Marks
T3:			
• Transport Systems in mammals	3 weeks	**20**	**30**
• Biosphere to Ecosystems	6 weeks	**40 (60)**	**60**
T 4:			
• Biodiversity and Classification	1 week	**7**	**10**
• History of Life and Earth	5 weeks	**33 (40)**	**50**
Totals	**15 weeks**	**100%**	**150**

The weighting per topic must serve as a guideline for teachers; slight deviations in respect of the number of marks allocated to a topic are acceptable. The purpose of providing the weighting is to ensure that all topics are covered according to approximately the correct weighting.

4.5.2 Grade 11

The examination will consist of two examination papers of 2½ hours and 150 marks each. The weighting and assessment of topics in Paper 1 and Paper 2 will be as follows:

Paper 1

Topic	Time	Weighting	
		%	Marks
T2			
• Energy transformations to sustain Life**:** Photosynthesis	3 weeks	**18**	**27**
• Animal Nutrition	3 weeks	**18**	**27**
• Energy transformation: Respiration	1½ weeks	**10**	**15**
T3			
• Gas exchange	2½ weeks	**15**	**22**
• Excretion in humans	2½ weeks	**15**	**23**
• Population Ecology	4 weeks	**24**	**36**
Totals	**16**½ weeks	**100%**	**150**

Paper 2

Topic	Time	Weighting	
		%	Marks
T 1			
• Biodiversity and classification of micro-organisms	3 weeks	**20**	**30**
• Biodiversity in plants and reproduction	3 weeks	**20**	**30**
• Biodiversity of animals	2 weeks	**13**	**20**
T4			
• Human impact on the environment:	7 weeks	**47**	**70**
• current crises			
Totals	**15 weeks**	**100%**	**150**

The weighting per topic must serve as a guideline for teachers; slight deviations in respect of the number of marks allocated to a topic are acceptable. The purpose of providing the weighting is to ensure that all topics are covered in approximately the correct weighting.

4.5.3 Grade 12

The examination will consist of two examination papers of 2½ hours and 150 marks each. The weighting and assessment of topics in Paper 1 and Paper 2 will be as follows:

Paper 1

Topic	Time	Weighting	
		%	Marks
T 1			
• Meiosis	1 week	**7**	**11**
• Reproduction in Vertebrates	½ week	**4**	**6**
• Human Reproduction	3 weeks	**21**	**31**
T2			
• Responding to be environment (humans)	4 weeks	**27**	**40**
T3			
• Human endocrine system	1½ weeks	**10**	**15**
• Homeostasis in humans	1 week	**7**	**11**
• Responding to the Environment (plants)	1 week	**7**	**11**
T4			
• Human impact (Grade 11)	'2½ weeks'	**17**	**25**
Totals	**14**½weeks	**100%**	**150**

Paper 2

Topic	Time	Weighting	
		%	Marks
T 1			
• DNA: Code of Life	2½ weeks	**19**	**27**
• Meiosis	1 week	**7**	**12**
T 2			
• Genetics and Inheritance	4 weeks	**30**	**45**
T3			
• Evolution through Natural Selection	2 weeks	**15**	**23**
T 3/T4			
• Human evolution	4 weeks	**29**	**43**
Totals	**13½ weeks**	**100%**	**150**

The weighting per topic must serve only as a guideline to teachers and examiners and is included to ensure that all topics are adequately covered in examinations. The number of marks per topic is not expected to be exactly according to this weighting in the examination papers.

4.6 RECORDING AND REPORTING

Recording is a process in which the teacher documents the level of a learner's performance in a specific assessment task. It indicates learner progress towards the achievement of knowledge as prescribed in the Curriculum and Assessment Policy Statement. Records of learner performance should provide evidence of the learner's conceptual progression within a grade and her or his readiness to progress or be promoted to the next grade. Records of learner performance should also be used to verify the progress made by teachers and learners during the teaching and learning process.

Reporting is a process of communicating learner performance to learners, parents, schools, and other stakeholders. Learner performance can be reported in a number of ways. These include report cards, parents' meetings, school visitation days, parent-teacher conferences, phone calls, letters, class or school newsletters, etc. For all grades, teachers report learners' achievements in percentages next to the appropriate subject. The various achievement levels and their corresponding percentage bands are as shown in the table below.

Note: The seven-point scale should have clear descriptions that give detailed information for each level. Teachers will record actual marks against the task by suing a record sheet; and report percentages against the subject on the learners' report cards.

Codes and Percentages for Reporting in Grades R-12

Rating code	Description of competence	Percentage
7	Outstanding achievement	80- 100
6	Meritorious achievement	70 - 79
5	Substantial achievement	60 - 69
4	Adequate achievement	50 - 59
3	Moderate achievement	40 - 49
2	Elementary achievement	30 - 39
1	Not achieved	0 - 29

Schools are required to provide quarterly feedback to parents on the Programme of Assessment using a formal reporting tool such as a report card. The schedule and the report card should indicate the overall level of a learners' performance.

4.7 MODERATION OF ASSESSMENT

Moderation refers to the process that ensures that the assessment tasks are fair, valid and reliable. Moderation should be implemented at school and district level and if necessary also at provincial level. Comprehensive and appropriate moderation practices must be in place for the quality assurance of all subject assessments.

4.7.1 Grades 10 and 11

In Grades 10 and 11 Formal School-based Assessment and the Practical Assessment Tasks should be moderated by the relevant subject specialists at district and, if necessary, provincial levels in consultation with the moderators at the school. Moderation serves five purposes:

- Firstly, it should ascertain whether the subject-specific content and skills are sufficiently covered.
- Secondly, the moderator must ensure that the various levels of cognitive demand are reflected in the assessments.
- Thirdly, that the assessments and marking are of an acceptable standard and consistency.
- Fourthly, to ensure that assessment in different schools are more or less comparable whilst recognising that different teachers have different standards.
- Finally, to identify areas in which the teacher may need further support and development and to provide such necessary support

In Grades 10 and 11 there is no compulsory national moderation. Moderation is therefore an ongoing process and not a once-off end-of-year event.

4.7.2 Grade 12

Moderation refers to the process which ensures that the assessment tasks are fair, valid and reliable. Moderation should be implemented at school, district, provincial and national levels. Comprehensive and appropriate moderation practices must be in place for the quality assurance of all subject assessments.

4.7.2.1 Formal Assessment (School-based Assessment - SBA)

In Grade 12, moderation must take place at four levels:

- *School-based moderation and verification of learner performance*

  This is intended to ensure that the assessments meet the requirements in terms of content, cognitive demands and skills; that the marking has been consistent and fair and that the marks are a true reflection of learners' performance in the assessments. This will enable the school to easily identify problems related to the pacing, standard and reliability of assessment and to ensure that appropriate interventions are put in place early. This is an ongoing process.

- *Moderation by the subject advisor*

  This is also an ongoing process. Subject advisors should moderate assessments, to ascertain whether:

  - Subject-specific content and skills have been covered adequately;
  - The prescribed number of assessments have been complied with;
  - the appropriate cognitive demands are reflected in the assessments;
  - the marking is of an acceptable standard and is consistent;
  - the assessments in different schools are comparable whilst recognising that different teachers teach and assess differently.

Subject advisors should provide teachers with the necessary guidance and support should any shortcomings be identified. Early identification of shortcomings and early interventions are essential. It is therefore necessary that moderation at this level should be ongoing and not a once-off end-of-year event.

- *Moderation by the province*

Moderation of SBA at this level is once-off and is related to the quality assurance processes that are necessary developed jointly by the Department of Basic Education and Umalusi in terms of National Policy.

- *At a national level*

Statistical moderation of learner performance in the School Based Assessment is necessary to ensure comparability across schools, districts, and provinces.

Note that, in Grade 12, the assessment of Practical work is incorporated into the SBA (per term) and that there is no practical examination. This is because schools are not all equally resourced and some learners may be disadvantaged because of this.

4.8 GENERAL

This document should be read in conjunction with:

4.8.1 *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R-12*; and

4.8.2 The policy document, *National Protocol for Assessment Grades R-12.*