LIFE SCIENCES (Updated October 2022)

This document must be read in conjunction with the IEB Manual for the Moderation of School-Based Assessment (Updated July 2022)

A. MEANS OF ASSESSMENT

Examination			
Paper I:	Theory	3 hours	[200]
Paper II:	Theory	2 hours	[100]
	Practical Assessment Task	1,5 hours	[50]
		Total: [350]	converted [300]
School-Based Assessment (SBA)			[100]

400 marks

B. REQUIREMENTS

1. EXAMINATION

	Paper I: 3 hours; 200 marks					
	Assesses via <u>three</u> of the following four Strands in any one year, that are not assessed in Paper II in that year: - Life at molecular, cellular and tissue level - Diversity, change and continuity of life - Environmental studies - Life processes in plants and animals					
Weighting of cognitive levels:	60%			40%		
	30% Knowledge	20% Comprehension	10% Application	10% Analysis	15% Synthesis	15% Evaluation
Structure of the paper:	The paper comprises four questions. Question 1 consists of objective type questions – 80 marks. Questions 2–4 consist of a variety of short and longer response-type questions that assess knowledge and application in unrehearsed contexts – 40 marks for each question. All questions are compulsory.					
	Paper II: 2 hours; 100 marks					
	Assesses via <u>one</u> of the following four Strands in any one year, that is not assessed in Paper I in that year: - Life at molecular, cellular and tissue level - Diversity, change and continuity of life - Environmental studies - Life processes in plants and animals					
Weighting of cognitive levels:	40%			60%		
	20% Knowledge	10% Comprehension	10% Application	15% Analysis	20% Synthesis	25% Evaluation
Structure of the paper:	The paper comprises three questions. Questions 1 and 2 are Case Studies – 30 marks for each question. Question 3 is a source-based essay – 40 marks. All questions are compulsory.					

Weighting of the AIMS across the papers		**AIM 1 Theory**	**AIM 2 Practical**	**AIM 3 Applications**
	Life Sciences PI	120 marks	40 marks	40 marks
	Life Sciences PII	30 marks	10 marks	60 marks
		50% of 300	17% of 300	33% of 300
	The weighting for Aims 1 and 3 may differ by 5% either way.			

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Note:

- **The one strand assessed in Paper II will rotate annually. Based on this, the remaining three strands will be assessed in Paper I in that year.**
- **Paper 1 and Paper 2 will be written on different days.**

2. PRACTICAL ASSESSMENT TASK

	PAT 1,5 hours; 50 marks					
	Assesses the 8 skill areas provided in Appendix A and within a specific context that is provided.					
Content to be covered:	A context is given in the preamble to the task which includes all the relevant content knowledge that is required for the task.					
Weighting of cognitive levels:				At least 60% at these levels		
	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation

Additional comments:	The PAT assesses AIM 2. It is conducted under controlled conditions by all candidates on the same day before the start of the main block of examinations. It is administered and marked by teachers, and moderated by a national panel. Candidates are expected to demonstrate a variety of skills in the PAT, such as their ability to design an experiment, evaluate an existing experiment (given to them), as well as perform a simple experimental procedure by collecting, graphing, analysing and interpreting data. The PAT will test all 8 skill areas as detailed in **Appendix A**. It will not necessarily relate to the Grade 12 content areas. The context is supplied and it is the testing of the skills that is important.

3. SCHOOL-BASED ASSESSMENT (SBA)

The following SBA requirements, and their later elaboration in this document, apply to schools that have chosen the conventional option for SBA. Those schools that have chosen the One Research Task Option must refer to the IEB Manual for the One Research Task Option for the relevant SBA requirements.

SBA Item	**Weighting**
Preliminary Examination/Trial paper	25
Standardised test #1	15
Standardised test #2	15
Compulsory Summative Practical Task	15
Two tasks chosen from the following options:	
Research Project	15
Case Study	15
Controlled writing piece (discursive essay)	15
Summative Practical Task	15
TOTAL	100

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C. INTERPRETATION OF REQUIREMENTS

1. EXAMINATIONS

1.1 Rationale for assessment structure:

- The two theory papers assess different content and emphasise different cognitive skills. Candidates need time to read and analyse the data that is included in the papers and to formulate appropriate responses.
- AIM 1 and AIM 3 can be assessed successfully in a theory examination.
- The optimal assessment method for AIM 2 is a practical, hands-on task.

1.2 The Assessment Syllabus

The purpose of this Assessment Syllabus is to assist IEB teachers in reaching a common understanding of the scope of the AIMS and therefore support schools in planning their teaching, learning and assessment programmes consistently; as well as to make the IEB examination and SBA requirements at grade 12 explicit for teachers, assessors and moderators.

The content described under AIM 1, Knowing Life Sciences, outlines what should be taught, and broadly what will be assessed in Grade 12. Teachers should consider the activities listed under AIM 2 to be necessary for candidates' understanding of that section of the syllabus. Teachers are encouraged to design further activities to develop candidates' competence in skills concerned with investigating phenomena in Life Sciences. The information under AIM 3 informs ways in which the knowledge in AIM 1 can be applied in society. Teachers are free to use other appropriate applications for AIM 3.

An Assessment Syllabus for Grades 10 and 11 is included in this document to assist teachers in their planning across the FET phase.

The Assessment Syllabus follows the SBA requirements.

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2. SCHOOL-BASED ASSESSMENT

2.1 Preliminary Examination/Trial Paper (25 marks out of 100)

This component must come from the last major Summative Assessment to have taken place before the Final NSC Examination. The Preliminary examination should mimic the external examination in its design, rigour and format (question paper, design grid and marking guidelines). Whilst all of the content may not have been covered by the date of the Preliminary Examination, there should be **two papers** that are set to the time and rigour of the Final Examination.

2.2 Controlled Tests (two tests: each to count 15 out of 100)

Controlled tests are written by the entire grade (preferably at the same time). These should count at least 50 marks each and must assess deeply within one Topic or across Topics. 60% of the marks should relate to lower order thinking skills (knowledge, comprehension and application) and 40% to higher order thinking skills (analysis, synthesis and evaluation). This weighting must be reflected in the design grid for each controlled test.

2.3 Tasks

2.3.1 Compulsory Summative Practical Task (15 marks out of 100)

This task must follow the format of the PAT (task, design grid and marking guidelines) in that it must count at least 50 marks and have a duration of 1,5 hours. The practical task should enable candidates to demonstrate a variety of skills such as their ability to **design** an experiment, **evaluate** an existing experiment (given to them), as well as **perform a simple experimental procedure** by collecting, graphing, analysing and interpreting data. The design grid must reflect the correct weightings for the cognitive levels (at least 60% of the questions should assess higher cognitive skills).

The Summative Practical Task must cover all eight skill areas as detailed in Appendix A. In order to provide evidence of a particular skill area being covered, a mark must be allocated to that particular skill area in the design grid.

It is advisable to use past Life Sciences Paper III Examinations or Practical Assessment Tasks in order to ensure compliance. It is important to note that the Summative Practical Task can only be given after a number of shorter formative tasks have been completed. There is no minimum number of formative tasks prescribed. Teachers must decide how many formative tasks are needed as these tasks are not required in the SBA. Candidates must be able to demonstrate in the Summative Task the skills that they have learned in the formative tasks.

Another important consideration is that of content. This particular component of the SBA does not assess AIM 1.

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Candidates are not required to learn content for the practical task. A context should be given in the preamble to the task with all of the relevant content knowledge that is required. The Summative Practical Tasks do not need to relate to the Grade 12 Assessment Syllabus. The context is supplied and it is the testing of the skills that is important.

2.3.2 Two tasks selected from the following options:

- Research Project
- Case Study
- Controlled Writing Piece
- Summative Practical Task

Each candidate within the same school may submit any two options.

Research Project (15 marks out of 100)

The emphasis in this project must be on giving the candidates an opportunity to get involved in research of some kind and then to write a comprehensive report on their research findings.

This task may involve several different research methodologies. It may involve primary / mixed research where initial library / internet based / desktop research is followed by actual data collection (investigation) which is performed at home, in the school laboratory or in the field. It may also be a secondary research project which comprises a literature review using Library / Internet based sources in order to solve a problem / answer a research question set by the teacher or the candidate. The final outcome of this activity is a written report detailing the results of the research findings.

Teachers must be particularly vigilant with regards to plagiarism in this type of task. It is a good idea to set aside some class time to allow candidates to bring their research findings to class and to insist that they write up in class. If computer-generated reports are to be accepted, the teacher must make use of a reliable means for checking that pieces of work have not been directly plagiarised from source. It is a good idea to encourage candidates to run their final electronic copies through plagiarism-checking software (free shareware software is available) and to staple the report to the front of their final submission.

The project may be assessed using memoranda, checklists or rubrics or a combination of the three. Teachers may develop their own rubrics or adapt the generic rubrics supplied in Appendix F.

The research should relate to a question, problem or case study / scenario.

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- It should require candidates to engage in unfamiliar / unrehearsed contexts that are age appropriate, real-life, and relevant to the AIMS for Life Sciences in Grade 12.
- It should require candidates to use knowledge, skills, attitudes and values gained over time.
- 60% of the marks allocated to the task should relate to lower order thinking skills (knowledge, comprehension and application) and 40% to higher order thinking skills (analysis, synthesis and evaluation).
- It should involve assessment at different stages of the process not just of the product.
- It should require metacognition by the candidates.
- Marking guidelines must be provided in the Teachers' File.

Case Study (15 marks out of 100)

This task is located in AIM 3 and must be based on current scientific data / published resources that relate to the content in Grade 12. The case study task involves the interpretation and analysis of suitable texts / articles published or reported on in a credible scientific magazine or scientific source. The texts / articles must be accessible to Grade 12 candidates and highlight authentic scientific information or research related to the content in one or more of the 4 strands in Grade 12. The article/s should include some form of data handling (analysis, interpretation, translation and critique) and / or ethics of scientific research. Candidates are required to analyse the provided information and present their interpretations and solutions, supported by reasoning and assumptions. The case study should cover a substantial amount of content (not be set in a small topic) and assess across all cognitive levels, with a ratio of 40 lower-order thinking : 60 higher-order thinking skills. In order to provide evidence of this. A design grid providing evidence of this must be included in the Teacher's file.

The task must be completed under controlled conditions, in either one or two lessons (the suggested time being 1,5 hours) and count at least 50 marks. Preparatory reading on the topic may be given a week before the lesson after which the questions will be provided and answers written under controlled conditions. If the answers are written across more than two consecutive lessons, the answers that have been completed must be taken in so that they cannot be modified. In the final lesson each candidate will continue with the completion of his / her case study answers on a new sheet of paper. The assessment process followed should be evident in the instructions to the candidates or an explanation in the Teachers' file.

Excellent articles may be found in popular scientific magazines e.g. *National Geographic* and *New Scientist*. An article could form the basis of a case study, but may need to be reworked. Teachers can access several additional sources to compile a

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more complete and varied case study which covers a reasonable amount / wider perspective.

Controlled Writing Piece (15 marks out of 100)

This SBA item is designed to test higher order thinking skills of analysis, synthesis and evaluation of biological knowledge in a timed pen and paper exercise. The Controlled Writing Piece is a discursive type of essay and is not to be confused with the source-based essay set in Paper 2, where candidates are required to give an opinion and a debated argument to justify their opinion based on given sources. It is important to give the candidates enough time to thoroughly plan and execute this activity. The content area / theme of the essay (**not the actual question**) must be provided to the candidates as a **short written instruction a maximum of five school days before this activity**. This allows them to do some initial reading and planning. Teachers may provide reading material or the candidates may make use of their notes, textbooks, the internet, scientific journals, etc. to prepare for the activity. One hour is recommended as the ideal amount of time required to plan and write a 2½ – 3 page essay. The actual question for the essay must only be provided as an instruction sheet on the day, as candidates enter the venue to write. Candidates must be allowed to bring resources such as textbooks and notes into the session with them to allow them the opportunity to check facts for biological accuracy. It is important to note that it is not the content of the essay that is of prime importance in this activity but rather how the candidate has used the content to motivate their response. Questions must therefore lend themselves to a **discursive** type of essay and **not** a narrative type.

The theme / content area given to the candidates must relate to the Grade 12 Assessment Syllabus. This activity provides an opportunity for the candidates to connect new knowledge to their existing biological knowledge. This SBA piece must be assessed against the Marking Rubric provided in **Appendix C** in order to standardise the assessment process and facilitate the moderation process.

Summative Practical Task (15 marks out of 100)

This task must follow the format and rigour of the PAT. It must count at least 50 marks and have a duration of 1,5 hours. The practical task should enable candidates to demonstrate a variety of skills such as their ability to **design** an experiment, **evaluate** an existing experiment (given to them), as well as **perform a simple experimental procedure** by collecting, graphing, analysing and interpreting data.

The Summative Practical Task must cover all eight skill areas as detailed in Appendix A. In order to provide evidence of a particular skill area being covered, a mark must be allocated to

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that particular skill area in the design grid which must be provided.

It is advisable to use past Life Sciences Paper III Examinations or Practical Assessment Tasks in order to ensure compliance. It is important to note that the Summative Practical Task can only be given after a number of shorter formative tasks have been completed. There is no minimum number of formative tasks prescribed. Teachers must decide how many formative tasks are needed as these tasks are not required in the SBA. Candidates must be able to demonstrate in the Summative Task the skills that they have learned in the formative tasks.

Another important consideration is that of content. This particular component of the SBA does not assess AIM 1.
Candidates are not required to learn content for the practical task. A context should be given in the preamble to the task with all of the relevant content knowledge that is required. The Summative Practical Tasks do not need to relate to the Grade 12 Assessment Syllabus. The context is supplied and it is the testing of the skills that is important.

Moderation at School Level (Refer to the IEB Manual for the Moderation of School-Based Assessment updated September 2015)
It is expected that moderation of the assessment process has taken place at school level to ensure that assessment is valid, fair and reliable. This includes moderation of assessments before they are done by candidates, moderation of the marking of the candidate evidence by the teacher / assessor and checking of the calculations of candidates' results. Evidence of this having taken place must be included in both the Teacher's and Learner's Files. **School moderation should be done in purple pen.**

Moderation at Cluster Level (Refer to the IEB Manual for the Moderation of School-Based Assessment updated September 2015)
Moderation of the Teacher and Learner **Files** at cluster level is not required. However teachers are expected to engage in some sort of moderation **activity** at cluster level. This could include, for example, moderation of the design of one or more tasks before they are given to candidates, moderation of the marking of one or more tasks or the standardisation of marking guidelines for one or more tasks. This process is in place to build consistency of standards across schools. Teachers should look for and comment on the positive aspects of the assessment process but also encourage improvements and make suggestions for future use. It is important to concentrate on the tasks, not the individuals, and criticism should be constructive. Evidence of engagement in cluster moderation activities must be included in the Teacher's File (and the Learner's File if applicable).

If cluster / common papers are written, they must be written on the same day. There must be a formal note in the teacher’s file that clearly indicates which schools are involved and on what date the assessment was conducted.

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LIFE SCIENCES: ASSESSMENT SYLLABUS

INTRODUCTION TO LIFE SCIENCES

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 change over billions of years. Living systems exhibit levels of organisation from molecules to biomes.

How science works:
- Fundamental knowledge built on scientific evidence
- Observation
- Designing an investigation
- Making measurements and the importance of scaling
- Presenting data in the form of drawings, written descriptions, tables and graphs.
- Identifying patterns and relationships in data
- Societal aspects of scientific evidence
- Limitations of scientific evidence.

The contested nature of scientific knowledge:
- Testing hypothesis (educated predictions) by means of investigations,
- facts as what structures/objects consist of/are made of,
- scientific theories as overarching explanations of how processes/mechanisms work,
- peer verification by means of publications, conferences, verifying results.

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GRADE 10

STRAND: Environmental Studies

Grade 10: Biosphere to ecosystems

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 so as to expose students to some of the interactions that occur in nature and to the terminology and concepts that describe them. The terminology and concepts selected here (AIM 1) will be used in Grade 11 and Grade 12 across all strands, where appropriate. It also enables students to contextualise the meaning of these terms and concepts within the familiar contexts of both southern Africa (AIM 1) and their local area (AIM 2). The use of a local area context is also used to introduce human influences on the environments in which they and other organisms live (AIM 3), a thread which will be expanded on both within local and global contexts, in more detail, in Grade 11.

AIM 2: ***INVESTIGATING PHENOMENA IN LIFE SCIENCES***	***AIM 1:*** ***KNOWING LIFE SCIENCES***	***AIM 3:*** ***APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
Biosphere to ecosystems		
Choose an ecosystem within a local biome for special study Identify the abiotic and biotic factors operating and describe the interactions between them Explain the trophic relationships present If possible, record and describe seasonal changes Use keys and field guides to learn about biodiversity within the biome	**Biosphere** Concept of the *biosphere*. Inter-connectedness of components of global ecosystem. **Biomes** Terrestrial and aquatic *biomes* of southern Africa: describe in terms of climate, soils and vegetation **Ecosystems** Theoretical understanding of *ecosystems*. ***Abiotic*** *and* ***biotic factors***: effects on community structure and ecosystem function ***Energy flow*** through ecosystems and relationship to trophic structure • Trophic levels: producers, consumers (herbivores and carnivores), decomposers • Food chains, food webs and food pyramids ***Nutrient cycles***: water, oxygen, carbon and nitrogen *[Names, e.g. nitrates are required but no detail of chemistry is necessary]*	Choose at least ONE example of human influence within the ecosystem chosen for study in Aim 2 Describe the selected human influence and the reasons for it having a positive and/or a negative impact on the ecosystem *[This serves as an introduction/link to human influences on the environment in Grade 11]* Ecotourism: economics, ethics and opportunities Link the nutrient cycles to current environmental issues, example the threat of global warming and how it is affecting the Earth.
Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.		

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STRAND: Diversity, change & continuity

Grade 10: History of life and biodiversity

Underlying concept: Life exists in a huge array of forms and modes of life at present, which scientists organise according to a man-made classification system. Modern life has a long history, extending from the first cells 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 and movements of continents and oceans over long periods of time.

AIM 2: INVESTIGATING PHENOMENA IN LIFE SCIENCES	***AIM 1: KNOWING LIFE SCIENCES***	***AIM 3: APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
Biodiversity and classification		
Demonstrate classification principles by grouping everyday objects on the basis of shared similarities and construct a simple nested hierarchy Classify organisms into groups based on evidence. *[Links to use of keys and identification guides]*	Enormous biodiversity on Earth at present emphasising the extent of biodiversity and endemism in southern Africa Classification schemes as a way of organising biodiversity. Main groupings of living organisms are bacteria, protists, fungi, plants and animals. (NB: These should not be taught in a systematic way but integrated into other sections, e.g. nutrient cycling and anaerobic respiration. They can also be used as a vehicle for exploring AIM 2 and AIM 3.) **Bacteria**: simple single-celled organisms with no nucleus **Protists**: Very diverse group including single-celled or simple multicellular organisms, some obtain energy by photosynthesis (algae), some ingest other organisms, some absorb molecules through the cell membrane. **Fungi**: Single-celled (e.g. yeasts) to multicellular organisms; body composed of very fine threads; saprotrophic nutrition. **Plants**: Multicellular terrestrial organisms; cells have cell walls; obtain energy through photosynthesis **Animals**: Multicellular aquatic and terrestrial organisms; cells have no cell walls; feed on other organisms.	History of classification: Scientists attempt to classify organisms based on shared features. As information increases classification changes. Some examples of classification systems are: • Two-kingdom system: plants and animals (no longer used) • Five-kingdom system: Plantae, Animalia, Fungi, Protista and Monera (Bacteria) • Three-domain system: Eubacteria, Archaea, Eukarya, with kingdoms in each domain, e.g. Plantae, Animalia, Fungi, Protista in the Eukarya Naming things in science: why do we use Latin? Linnaeus and his role in classification systems

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History of life on Earth		
Examine fossils at a museum or fossil site or look at photos of fossils. Construct a timeline showing the history of life on Earth and major events in life's history as you progress through this section. The timeline should emphasise the long history of life. Find out what the earliest amphibians looked like [Links to coelacanth] Various hypotheses have been proposed for the extinction, 65 million years ago, such as the meteorite impact theory and the volcanic eruptions in India theory. Select at least ONE of these hypotheses and describe the evidence scientist have gathered in supporting it. *[Nature of science]* Research the 'missing link' between dinosaurs and birds, *Archaeopteryx*.	**Fossil formation and methods of dating**, e.g. radiometric dating and relative dating. **Life's history:** Interpret different representations of life's history and its relationship to climatic (e.g. increase in oxygen levels, ice ages) and geological events (e.g. movement of continents) *[extension of GET work]* Cambrian explosion – origins of early forms of all animal groups Mass extinctions – there have been five, two of which are particularly important: 250 mya (resulted in the extinction of about 90% of all life on Earth) and 65 mya (resulted in the extinction of many species, including the dinosaurs) **Key events** in life's history for which there is evidence from southern Africa (locations should be identified on a map) • Origins of the earliest forms of life (fossilised bacteria from the Barberton district, Mpumalanga) • Soft-bodied animals in Namibia • Early land plants in the Grahamstown area • Forests of primitive plants such as *Glossopteris* (near Mooi River and Estcourt) and which form most of the coal deposits in southern Africa • The coelacanth as a 'living fossil', of the group that is ancestral to amphibians. • Mammal-like reptiles in Karoo • Dinosaurs (Drakensberg and Maluti mountains, *Euskylosaurus* from Lady Grey in the Eastern Cape) and cone-bearing plants • First mammals (Eastern Cape and Lesotho) • Humans (Gauteng, Free State, KwaZulu-Natal, Western Cape) Life-forms have gradually become more similar to present life-forms, but even in the last million years, significant changes have occurred in species occurring in Africa (e.g. humans) *[Link with Grade 12]*	Scientists use <u>deductive reasoning (inference)</u> to understand fossils and the history of life on Earth. The role of South African scientists in the discovery of the first living coelacanth. 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]* Debate the impact of humans on biodiversity and the natural environment. Fossil tourism is a source of income and employment in some fossil localities.
Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.		

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STRAND: Life at the molecular, cellular and tissue level

Grade 10: Molecules to organs

All living organisms are made of atoms which combine to form molecules, and these make up the basic unit of life i.e. cells. Plant and animal cells have a complex organisation which enables them to carry out the basic properties 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. These cells are specialised and form tissues which perform particular functions. The tissues are arranged in organs which are also specialised to carry out particular functions. This strand introduces candidates to life at the molecular, cellular, tissue and organ level.

AIM 2: INVESTIGATING PHENOMENA IN LIFE SCIENCES	***AIM 1: KNOWING LIFE SCIENCES***	***AIM 3: APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
	The chemistry of life	
Activities that involve models of molecules which candidates can use to construct simple and more complex molecules and to show that enzymes break up or synthesise more complex molecules. Investigations of the organic content of some foods: food tests for starch, glucose, lipids and proteins. Simple investigations of enzyme action.	**Molecules for life:** Organic molecules made up of C, H, O & some also contain other elements, e.g. N and P • Carbohydrates – monosaccharides (single sugars), e.g. glucose, fructose; disaccharides (double sugars), e.g. sucrose, maltose; polysaccharides (many sugars), e.g. starch, cellulose, glycogen • Lipids (fats & oils) – glycerol and fatty acids • Proteins – amino acids. • Role of enzymes in breaking down/synthesising molecules. Influence of temperature and pH on enzyme action. • Nucleic acids • Vitamins • Inorganic substances • Water • Mineral salts (e.g. Na, K, Ca, P, Fe, I, nitrates, phosphates) *[Use simple diagrams representing molecules. Review briefly why these substances are needed in plants and animals i.e. build on GET prior knowledge. No detail of structure or function here- functions will be dealt with in later sections where appropriate. This is a brief introduction to the molecules making up organisms]* *[This links to nutrition]*	Unsaturated and saturated fats. Heart disease. Cholesterol in foods. Enzymes in industry, e.g. washing powders. Need for fertilisers in overutilised soils, e.g. where crops are grown and regularly harvested, problem of fertilisers washed into rivers, eutrophication. *[Links to ecology]*

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Cells: the basic unit of life		
Explain and demonstrate how a light microscope works. *[If microscopes are not available, use diagrams.]* Investigate the structure of animal and plant cells using microscopes and/or other resources, e.g. micrographs, models. Record observations in biological diagrams. Experiments to demonstrate diffusion and osmosis.	Molecular make-up: Cells are mostly made of proteins, carbohydrates, lipids, nucleic acids and water **Cell structure and function:** Introduce the idea of a cell as the smallest unit that has a complex organisation and carries out the properties of life e.g. • Cell wall – support structure • Cell membrane – boundaries and transport • Nucleus, chromatin material, nuclear membrane, nucleopores, nucleolus – the control centre • Cytoplasm – storage, circulation of materials • Mitochondria – powerhouse of the cell, releases energy • Ribosomes – protein synthesis • Endoplasmic reticulum (rough and smooth) - transport systems • Golgi body – packaging centre • Plastids – production & storage of food, pigments • Vacuole, lysosomes, vesicles – storage, digestion, osmoregulation. *[This is a brief introduction; some organelle functions will be explored in more detail in other sections.]* **Differences** between plant and animal cells **Movement across membranes:** diffusion, osmosis and active transport **Cells differ** in size, shape and structure in order to carry out specialised functions *[link to tissues]*	History of microscopy: from lens to light and then electron microscopes. How the development of microscopes by Hooke, van Leeuwenhoek and others enabled people to see cells and then structures within cells and led to cell theory: • All living things consist of cells. • All cells arise from pre-existing cells.

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<table>
<tr><th colspan="3">Cell division – mitosis</th></tr>
<tr><td>Use suitable resources to examine cell division, e.g. microscope slides, micrographs, posters, models.

Research and present information on ONE of the cancers – causes, prevalence, treatment.</td><td>The cell cycle including mitosis: interphase, mitosis, cytokinesis, growth.
[Simple description with diagrams to show changes to chromosomes so that one parent cell forms two identical daughter cells. Names of phases not necessary.]

Role of mitosis: Growth, repair and reproduction in some simple organisms.</td><td>Cancer: Uncontrolled cell division & growth.
• Causes of cancer
• Beliefs and attitudes concerning cancer.
• IKS and biotechnology – treatment of cancer
– Traditional technology, e.g. traditional medicines & healers
– Medical biotechnology, e.g. radiotherapy and chemotherapy [no detail required]</td></tr>
<tr><th colspan="3">Plant and animal tissues
NB: should not be taught systematically but covered on a need-to-know basis in the context of relevant sections, e.g. photosynthesis and respiration</th></tr>
<tr><td>Examine and identify some plant and animal tissues using, e.g. microscopes, biostrips, micrographs.

Draw observed cells making up a tissue to show specialised structure

Investigate and collect information on ONE field of biotechnology related to plant or animal tissues, e.g. cloning, stem cell research.</td><td>Introduce concept of a tissue as a group of similar cells adapted for a particular function

Tissues: focus on the relationship between basic structure and function
• Plant tissues: xylem, phloem, parenchyma, collenchyma and sclerenchyma, epidermis
• Animal tissues: 4 basic types i.e. epithelial, connective, muscle and nerve and some examples of each.
[No detail required – an introduction to the tissues. Some tissues, e.g. blood, will be covered in more detail in relevant sections]</td><td>IKS and biotechnology
• Traditional technology, e.g. traditional medicines and healers
• Medical biotechnology, e.g. immunity, antibiotics, blood transfusion
• Cloning of plant and animal tissues and stem cell research

Ethics and legislation: cloning & stem cell research
Current trends being made in terms of stem cell research

Careers in biotechnology</td></tr>
<tr><th colspan="3">Organs
NB: should be covered on a need-to-know basis in the context of relevant sections</th></tr>
<tr><td>Observation, interpretation and drawings of sections through leaves, as seen using light microscope slides and/or micrographs.
[Emphasise principles of biological drawing.]</td><td>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: Cross section of a dicotyledonous leaf to demonstrate and explain its structure in terms of its functions i.e. photosynthesis, gaseous exchange and transport. Link with plant tissues, appropriate cell organelles, movement across membranes and movement of molecules into, through and out of the leaf.</td><td></td></tr>
<tr><td colspan="3">Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.</td></tr>
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STRAND: Life processes in plants and animals

Grade 10: Life processes that sustain life

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 (photosynthesis) and which make energy available to organisms to stay alive (cellular respiration) are covered first. Animal nutrition considers how different animals obtain and process their energy sources depending on their habitat. Gaseous exchange between an organism and its environment is necessary for photosynthesis and cellular respiration to take place.

AIM 2: ***INVESTIGATING PHENOMENA IN LIFE SCIENCES***	***AIM 1:*** ***KNOWING LIFE SCIENCES***	***AIM 3:*** ***APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
Energy transformations sustain life		
Investigations of photosynthesis and respiration. *[Emphasise principles and design of scientific experiments.]* Candidates should carry out the investigations below; • Starch is produced during photosynthesis • Light is necessary for photosynthesis *The remainder can be done as learner investigations, demonstrations or interpretations of data.* • Carbon dioxide is necessary for photosynthesis • Chlorophyll is necessary for photosynthesis. • Photosynthesis gives off oxygen • Oxygen is used by living organisms. • Carbon dioxide is released by living organisms (anaerobic and/or aerobic)	**Photosynthesis** Definition of and description of process in words and symbols: intake of raw materials, trapping and storing of energy, formation of food in chloroplasts and its storage. *[No biochemical detail of light dependent and light independent phases required.]* The effects of variable amounts of light, carbon dioxide and temperature on the rate of photosynthesis **Cellular respiration** Definition of and description of process; uses of energy for living cells **Aerobic respiration:** definition of and description of process taking place in cytoplasm and mitochondria. Use words and symbols *[No biochemical detail of glycolysis, Krebs' cycle or oxidative phosphorylation is required.]* **Anaerobic respiration:** definition of and description of process in words and symbols *[No biochemical detail of process is required.]* Production of lactic acid in muscles during exercise **Comparison** between aerobic respiration and anaerobic respiration in terms of raw materials required, products and relative amounts of energy released **Role of ATP** as an important energy-carrier in the cell	The role of carbon dioxide enrichment, optimum light and optimum temperatures in greenhouse systems *[Links to Grade 10 & 11 environmental issues.]* Discuss the impact of large scale removal of vegetation such as deforestation on environment and society?(link to grade 11 Environmental studies. Compare the industrial production of fermented beer in South Africa to the Traditional method. Role of anaerobic respiration in industry - brewing and bread-making

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Animal nutrition		
Interpretation of dietary information on food packaging Calculating the nutritional value of a meal/diet Dissection of an animal (obtained by ethical and legitimate means) to observe alimentary canal and/ or gaseous exchange surfaces or video or Internet. Data analysis of available data from popular press or other sources with respect to malnutrition.	Food intake vs energy growth and health requirements – **balanced diet** and how this changes with age, sex and activity of an animal **Processes** of ingestion, digestion, absorption, assimilation and egestion and the significance of each **Comparison** of a herbivorous, a carnivorous and an omnivorous lifestyle in terms of the processes above, different structures and energy relationships. **Human nutrition** Identification of the macro-structure of the alimentary canal and associated organs and the functions of the different parts ***Mechanical/physical breakdown:*** types and functions of different kinds of teeth, tooth decay; processes of chewing and peristalsis ***Chemical digestion:*** function of carbohydrases, proteases and lipases with respect to where produced, substrate and end-products *[Specific enzymes need not be named – link to molecular structures and enzyme activity.]* ***Absorption:*** small intestine as a region of most absorption of digested food; structure (to tissue level) and significance of villi, importance of hepatic portal system in the transport of absorbed food to rest of the body ***Assimilation:*** the role of the liver in glucose metabolism, deamination of excess amino acids, and the breakdown of alcohol, drugs and hormones in the liver **Hormonal control:** Concept of a hormone Role of gastrin and secretin only **Homeostatic control:** of blood sugar level (Brief description of the process involving insulin and glucagon)	Different diets: Cultural, religious, personal and health choices of diet, e.g. vegan, vegetarian, halal, kosher. Dietary supplements: for health, sport, beauty, anti-ageing. Malnutrition: reason for **and** the effects of malnutrition with respect to unbalanced diets (e.g. kwashiorkor), starvation (e.g. marasmus and anorexia), coronary heart disease, diabetes and obesity. Effects of alcohol and drug abuse and the dangers associated with their misuse. Tooth decay related to diet Fluoride in water supplies and its effect on teeth Rise in diabetes in modern times Link between obesity and diabetes

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<table>
<tr><th colspan="3">Gaseous exchange</th></tr>
<tr>
<td>Measuring and comparing depth of breathing between individuals OR interpreting data on same

Making a model of human breathing system and critiquing its limitations

Composition of inspired air vs expired air – using data analysis

Demonstration to show that expired air contains carbon dioxide

Analysis and interpretation of data showing altitudinal effects on gaseous exchange, e.g. athletes' performance in Johannesburg versus Cape Town or Durban.</td>
<td>Distinguish between cellular respiration, breathing and gaseous exchange

Need for gaseous exchange

Requirements of efficient gaseous exchange organs:
large surface area, thin, moist, well ventilated, protected, transport system.

These requirements are met in different ways in different environments, e.g. aquatic and terrestrial and between plants and animals
Refer to the following only as a brief overview:
With reference to the following organisms: a dicotyledonous plant, a flatworm, an earthworm and an insect, a bony fish and a mammal, describe simply how the requirements stated above are met in relation to an organism's habitat, structure and its surface area:volume ratio.

Human gaseous exchange:
The structure (macro and tissue level) location, adaptations and function of the ventilation system (trachea, bronchi, bronchioles, lungs and alveoli)

Ventilation of the lungs; gaseous exchange in alveoli; transport of gases around body; gaseous exchange in tissues

Homeostatic control of breathing (Brief description of process involving the levels of CO_2 in blood).</td>
<td>Respiratory disorders: origins, symptoms and treatment of TB in South Africa. Other disorders, e.g. asthma, hay fever, bronchitis, emphysema and lung cancer

The effects of smoking on gaseous exchange

Artificial respiration – how mouth-to-mouth resuscitation works</td>
</tr>
<tr><td colspan="3">Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.</td></tr>
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GRADE 11

STRAND: Life processes in plants and animals

Grade 11: Life processes related to homeostasis

Different organisms need support, transport and excretory systems, which differ in relation to size, surface area to volume ratio AND type of habitat (aquatic or terrestrial). There is a relationship between transport, nervous and excretion systems of larger organisms and gaseous exchange mechanisms *[done in Grade 10].*

AIM 2: ***INVESTIGATING PHENOMENA IN LIFE SCIENCES***	***AIM 1:*** ***KNOWING LIFE SCIENCES***	***AIM 3:*** ***APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
Support and transport in plants		
Interpretation of microscope slides and/or electron micrographs of sections through roots and stems Aging a tree by counting annual rings Demonstrations of • water movement through xylem • transpiration of water through leaves • effect of environment on rate of transpiration	**Anatomy of dicotyledonous plants** Root and stem *[leaf done in Grade 10]* including the distribution of the different tissues – epidermis, xylem, phloem, sclerenchyma, collenchyma, parenchyma. Secondary growth NB: Not the process, only as a phenomenon used to calculate age of trees and indicate climate change **Uptake of water and mineral salts** into a root and their transport to leaves **Translocation** of manufactured substances from leaves to other parts **Transpiration:** definition of and how water loss is related to leaf structure *[recap of grade 10]* and the effects of variation in temperature, humidity and light intensity on transpiration rate; how wilting occurs	Economic uses of plants related to their anatomy, e.g. fibres (xylem and sclerenchyma) used to make paper, fabric, for weaving, baskets, etc. and secondary growth – wood for furniture, building and containers

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Supporting systems and movement in animals		
Exploring different ways of moving, related to ecological niche preferably from the ecosystem studied in Grade 10, e.g. running, walking, hopping, crawling, swimming, flying Comparing skeletons of (or photographs of) different vertebrates Analysis of x-rays of human bones and joints Observing a longitudinal and transverse section through a long bone. Demonstration to show that a combination of mineral salts and organic fibres produces hard strong resilient bone (HCl and burning) Examining microscope slides or micrographs of skeletal muscle tissue and drawing the muscle tissue observed. Making models of how antagonistic muscles work	Different kinds of skeletons: hydrostatic skeleton, endoskeleton, exoskeleton. NB: Only as an introductory overview. **Human skeleton** Identify bones comprising the axial skeleton *[bones forming the skull not required]* and the appendicular skeleton. *[It is not necessary to know the parts of the bones.]* Functions related to movement, protection, support, mineral storage and hearing. Structure of a long bone Tissues: Bone, cartilage, tendons and ligaments – structure as related to function only. *[Other details of tissue structure not necessary.]* **Joints** Types of joints: fixed, partly moveable and freely moveable (synovial) joints. Structure of a synovial joint. Role of each of the following in human locomotion- bones, joints, ligaments, tendons and antagonistic muscles **Muscles** How antagonistic muscles work together to raise or lower a limb. Structure of skeletal muscle and changes in myofibril structure when muscles contract	Diseases of the musculo-skeletal system: rickets, osteoporosis, arthritis, muscular dystrophy. Injuries: sprains, strains, cramps, dislocations and fractures Incidence of back injuries Importance of exercise for healthy muscular and skeletal development and avoidance of injuries

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Transport in animals		
	NB: The following is optional [Many animal groups have transport systems which include *blood, blood vessels and heart* arranged as circulatory systems Basic design of open circulatory systems, closed circulatory systems]	
Dissection of a mammalian heart Measuring pulse rates of a number of individuals Effects of exercise on pulse and pulse rate and how they relate to heart rate. Examining micrographs or slides of blood and drawing the blood tissue observed.	**Human circulatory system** Structures indicating *closed, double circulatory system (pulmonary and systemic),* identifying: *heart* and its associated *blood vessels; brain, small intestine, liver, kidneys* and their associated major *blood vessels*, indicating the direction of blood flow and distinction between oxygenated and deoxygenated blood in different parts of the circulatory system-this can be explained in diagrammatic format. ***Heart structure*** – internal and external structure related to functioning-to be articulated diagrammatically. Events of cardiac cycle, relating events to the flow of blood through the heart Mechanisms controlling heartbeat and heart rate ***Blood vessels*** – structure and function of *arteries, veins and capillaries* ***Blood and lymph as a tissue:*** Structure and function of constituent parts Relationship between lymphatic system and blood system Functions of lymphatic system	Cardiovascular diseases – congenital and those cause by poor diet and lifestyle *[link to grade 10]*, e.g. anaemia, high and low blood pressure, heart attacks, strokes. Significance of resting pulse rate in relation to fitness. Blood transfusions and blood types *[link to genetics in grade 12]* Prof Chris Barnard and the first successful heart transplant conducted in SA.

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Excretion		
Dissection of a mammalian kidney Interpretation of data related to composition of fluids in different parts of the nephron and collecting duct.	Define excretion **Excretion in humans** The role of each of the following: lungs, kidney, liver, gut, bladder, skin indicating the substance each excretes and the origin(s) of those substances. **The urinary system** in humans – position of kidneys, ureters, bladder and urethra. Structure and function of the kidney in terms of the removal of urea and excess water and salts and the reabsorption of glucose and some salts Homeostatic control of water and salts in the kidney involving ADH and aldosterone The structure and function of the nephron in filtration, reabsorption and formation of urine	Diseases leading to kidney failure, e.g. kidney stones, kidney infections, bilharzia Injuries to kidneys and protective measures Dialysis and how it works with respect to kidney machines Discuss the advantages and disadvantages of kidney transplants, compared with dialysis

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Human nervous system		
Observations of the response of some invertebrates, e.g. wood lice, to light and humidity Observe and draw nervous tissue using microscope slides or micrographs. Observing and relating the sensory organs of groups of animals in relation to the mode of life (details of structure not necessary) Dissection of mammalian eye Observation of pupillary mechanism	Enables humans to react to stimuli and react to their surroundings Central nervous system - position and functions of cerebrum, cerebellum, hypothalamus, medulla oblongata and spinal cord Peripheral nervous system - position and functions only Autonomic nervous system – functions only Structure and functioning of nerves Structure of a nerve*:* composed of nerve fibres held together by connective tissue. Nervous tissue: structure of a motor neuron including: nucleus, cell body, cytoplasm, myelin sheath, axon and dendrons or dendrites. Transmission of nerve impulses along neurons and across synapses. (No detail of electrical charges is necessary). Structure and functioning of synapse. Structure and functioning of a simple reflex arc. Significance of a reflex action. Receptors Receptors detect a variety of different stimuli: light , sound, touch, temperature, pressure, pain and chemicals (taste and smell). No structure and names necessary except for eye and ear. *Human eye:* structure and function including binocular vision, accommodation and pupil reflex No cellular detail required. *Human ear:* structure and function (hearing and balance) No cellular detail required.	Any ONE disease or disorder of the nervous system (e.g. Alzheimer's disease, depression) in terms of causes, symptoms, treatment. Effects of certain drugs: dagga, heroin, ecstasy and tik on the central nervous system Visual defects: short-sightedness, long-sightedness, astigmatism, cataracts. The role of glasses and surgery as treatment. Hearing defects: middle ear infections, grommets, deafness and the link to speech disorders. The role of hearing aids and cochlear-implants as treatments and the use of sign language
Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.		

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STRAND: Life at the molecular, cellular and tissue level

Grade 11: Viruses, bacteria, protists and fungi

In grade 11, we look at four main groups of organisms i.e. viruses, bacteria, protists and fungi. These 4 groups consist of micro-organisms and, in the case of the protists and fungi, macro-organisms. They are either single-celled or form colonies of similar cells or are made of primitive tissues. The viruses, bacteria, protists and fungi play a very important role in the environment. In addition, many micro-organisms have an effect on the health of other living organisms. Humans have used these organisms for thousands of years for a variety of purposes.

AIM 2: ***INVESTIGATING PHENOMENA IN LIFE SCIENCES***	***AIM 1:*** ***KNOWING LIFE SCIENCES***	***AIM 3:*** ***APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
Viruses, bacteria, protists and fungi		
Research using other resources, e.g. books, health pamphlets: Investigate a disease caused by ONE of the microorganisms and common in a community, e.g. HIV/AIDS, malaria, cholera, TB, influenza. Select data on occurrence, effects on body, resistance to drugs and suitable treatment. **Practical investigation:** Look for evidence of viral, bacterial or fungal diseases on plants, e.g. in the school garden, candidates' garden, amongst their vegetables or crops. Identify ONE of these diseases and describe the effect on the plant. Find out about at least TWO ways of treating this disease, and conduct a scientific investigation to compare the effectiveness of these treatments, e.g. different chemicals and natural remedies, etc.	**Biodiversity** of these organisms. *[Link with grade 10]* **Basic structures and general characteristics** **Important role** in maintaining balance in the environment/in web of life. *[Links to grade 10 & 12]* **Roles in symbiotic relationships**, e.g. nitrogen-fixing bacteria in plants; *E. coli* in human intestines. *[Links to grade 10]* **Effects and management** of at least ONE disease from each of the four groups • viruses – e.g. rabies, HIV/AIDS, influenza • bacteria – e.g. blight, cholera, tuberculosis, anthrax • protists – e.g. malaria • fungi – e.g. rusts, thrush, ringworm **NB: The following is optional** **[Immunity]** • Immune response by plants or animals against infecting micro-organisms • Use of drugs, e.g. antibiotics and response of infecting micro-organisms]	**Historical developments** • Discovery of viruses and bacteria • Debates about classifying these organisms, e.g. classifying viruses as living organisms **IKS and biotechnology** • Traditional technology, e.g. beer, mahewu amasi (link to Grade 10) • Micro-organisms and biotechnology in the food industry, e.g. cheese, wine; and in other industries **Economic use** of bacteria, protists and fungi, e.g. mushrooms, seaweeds **Medical biotechnology**, e.g. immunity, antibiotics **Beliefs, attitudes and values** concerning causes of and cure of at least ONE disease, e.g. HIV/AIDS, malaria. TB, cholera.

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STRAND: Diversity, change and continuity

Grade 11: Diversity of animals and plants and biogeography

Underlying concepts: Plants and animals can be grouped according to similarities in their basic structure or body plan. Members of each group have modified versions of their basic body plan, depending on their mode of life. Biogeographic variation shows that different but similarly adapted species inhabit different continents and islands.

AIM 2: ***INVESTIGATING PHENOMENA IN LIFE SCIENCES***	***AIM 1:*** ***KNOWING LIFE SCIENCES***	***AIM 3:*** ***APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
Plant and animal diversity in South Africa		
Illustrate through diagrams, charts and graphs, the numbers of species of each major group represented in South Africa. Read and interpret distribution maps of species.	Enormous diversity of life in southern Africa, and the number of endemic species.	Threats to biodiversity in South Africa: Consider the impact of agriculture, industry, human population growth, cities and roads on biodiversity. Value of retaining biodiversity: tourism potential, aesthetic value of retaining biodiversity for its own sake.
Plant diversity		
Candidates should be able to identify South African examples of each of these groups of plants. • Bryophytes (mosses and liverworts). • Pterophytes (ferns) • Gymnosperms (yellowwoods, cycads) • Angiosperms (flowering plants) Compare the external morphology of a local monocotyledonous and a dicotyledonous plant, including the flowers.	Plants can be grouped according to the presence or absence of: • vascular tissue (xylem and phloem) • true leaves and roots • seeds or spores • fruit, as well as the dependence on water for reproduction These groups include the: • Bryophytes: no vascular tissue, no true leaves and roots, spores, depend on water for fertilisation • Pterophytes: vascular tissue, true leaves and roots, spores, depend on water for fertilisation. • Gymnosperms and angiosperms: vascular tissue, true leaves and roots, seeds, fertilisation independent of water. Gymnosperms produce cones which bear seeds with no protective covering. Angiosperms produce flowers, the seed is enclosed in a fruit. **NB: No details of life cycles required**	Ancient and unique plant groups in southern Africa: cycads and *Welwitschia.* Ecotourism and theft of cycads, conservation efforts. Angiosperms include many agriculturally important plants, such as fruit trees, and crops such as maize, wheat, oats and sorghum. Forestry – economic importance and impact on ecosystems *[Link to environmental issues.]*

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Animal diversity		
Interpret a phylogenetic tree representing the evolutionary history of animals. Identify Southern African representatives of each of the phyla listed below, through photographs, appropriate books, or during visits to museums or on field trips and by using field guides. • Porifera (sponges) • Cnidaria (jelly fish, blue bottles, corals, sea anemones) • Platyhelminthes (*Planaria*, flukes, e.g. bilharzia worm, tapeworm) • Annelida (earthworm, polychaetes, leeches) • Nematoda (roundworms, hookworms, threadworms) • Arthropoda (insects, arachnids, crustaceans, myriapods) • Mollusca (snails, oysters, limpets, octopus and squid) • Echinoderms (sea urchins, starfish) • Chordata (fish, amphibians, reptiles, birds, mammals). Choose ONE phylum or class from the list above and illustrate its biodiversity in South Africa on a poster. (Individuals or small groups each select a different animal group)	**NB: The following section is optional** [Concept of phylum as illustrated by a body plan.] The Animal kingdom contains about 30 phyla, but we will focus on only six, i.e. Porifera, Cnidaria, Platyhelminthes, Annelida, Arthropoda, Chordata, with respect to the following body plans. • Symmetry (asymmetry, bilateral symmetry, radial symmetry) • Number of tissue layers developing from the embryo (two or three). • Absence or presence of a coelom (a cavity within the mesoderm). • Presence or absence of a through-gut Relate body plans to mode of life. • Phylum Porifera: asymmetrical, no tissues and no coelom; simple but highly specialised for filter-feeding • Phylum Cnidaria: radially symmetrical, two tissue layers, no coelom, single opening to the gastrointestinal cavity. Simple, but possess highly specialised nematocysts. • Phylum Platyhelminthes: bilaterally symmetrical, three tissue layers, no coelom, and a single opening to the gut. • Phylum Annelida: bilaterally symmetrical, three tissue layers, a coelom, a through-gut. • Phylum Arthropoda: bilaterally symmetrical, three tissue layers, coelom, through-gut, an exoskeleton made of chitin • Phylum Chordata: bilaterally symmetrical, three tissue layers, coelom, through-gut. Internal skeleton made of cartilage and bone. A very brief comparative analysis of the body plans of the different phyla is required. It should be explained in the context of evolution.]	Any ONE of the parasitic worms found in South Africa: distribution, prevalence, life cycle, effects on host, treatment, and ways of reducing the spread. (Select a local parasitic worm that is problematic for humans or other animals). Role of arthropods as ectoparasites and vectors of pathogens that cause disease, e.g. flies and cholera, ticks and tick bite fever, mosquitoes and malaria, tsetse flies and sleeping sickness. Role of invertebrates in agriculture and ecosystems (e.g. pollinators, decomposition, aerating the soil). Sustainable use of animals in South Africa, e.g. perlemoen/fishing/game farming: economic and employment opportunities. Problems with poaching.

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Modifications of basic body plans		
Select ONE of the following for investigation *[Link to LO 2]:* Identify the limb bones of vertebrates from diagrams, and make notes of how the bones are modified to suit each function. OR Identify feeding or locomotory appendages of insects. OR Identify modified flowers.	Select ONE of the following for further study: Mammal forelimb: basic plan modified for digging (mole), flying (bat), fast running (horse), swimming (seal) and climbing trees (monkey). Link to the skeleton OR Modification of feeding or locomotory appendages of insects for eating different foods OR Modification of flowers such as orchids (or any other suitable group) for specific pollinators.	Nature of science: Looking for explanations for modifications of body plans: Charles Darwin proposed that modification of basic body plans indicates common descent from a single ancestor. *[Relate to examples in LO 2]*
Biogeography		
Draw a map of the world and put pictures of ostrich, emu, rhea and moa where they occur.	Diversity exists within continents, but is even more striking on different landmasses and islands. Worldwide distribution of large flightless birds: ostrich in Africa, emu in Australia, rhea in South America, and moa (recently extinct) in New Zealand. These flightless birds resemble each other, and have similar modes of life in each landmass, but they are distinctly different species.	Nature of science: Darwin's explanation for the biogeographic distribution of species.
Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.		

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STRAND: Environmental Studies

Grade 11: Human influences on the environment

Over thousands of years, humans have gradually changed the environments they live in, in order to make their lives and their human endeavours easier, safer, and more profitable. With the human population explosion and modern technology, these changes to the environment have been massive and have had a significant local, national and global impact upsetting the balance in natural ecosystems and threatening the continuation of life on earth. In grade 11, we examine human influences on the environment and consider ways in which we can contribute to a more sustainable future.

[This section could possibly be considered as belonging to AIM 3, but we have chosen to place much of the content in AIM 1 since scientific concepts are involved.]

AIM 2: ***INVESTIGATING PHENOMENA IN LIFE SCIENCES***	***AIM 1:*** ***KNOWING LIFE SCIENCES***	***AIM 3:*** ***APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
Human influences on the environment		
Conduct a practical investigation on ONE example of human influences on the environment in your local area, e.g. impact of alien species or overgrazing on biodiversity, river pollution on a river ecosystem, oil refinery waste on a local community, or smoke from burning coal on a local community. • Identify the problem • Collect and analyse data • Make decisions concerning ways to solve the problem. • Present the findings in a suitable way, e.g. a poster, newspaper article, flyer, written assignment or illustrated talk. Propose solutions to the environmental problem. Take action to solve the problem and report on that action.	Air, land and water pollution: causes, impact on the environment and on human health, and possible solutions. Local, national and global issues: • ozone depletion • greenhouse effect and its importance for sustaining life on earth; enhanced greenhouse effect leading to global warming • desertification, deforestation • effects of overgrazing, crops and commercial forests on biodiversity. • deposits of poisonous substances in rivers and the water table. Use food pyramids and food webs to interpret environmental changes caused by humans, e.g. destruction of fauna and flora by pollutants in streams, rivers, or the sea; eutrophication of rivers; impact of acid rain on ecosystems, deforestation on producers and consumers, insecticides and culling on consumers, and overpopulation on producers and consumers. Introduction of invasive alien species into South Africa, impact on biodiversity, and mechanisms of control. Exploitation of local indigenous resources, e.g. devils claw, rooibos, fynbos, African potato, Hoodia, pepper-bark tree vs sustainability Sustaining our environment, e.g. management and treatment of domestic waste and effluents from industry; reduction of emissions through more sustainable use of resources.	Historical developments: • the ozone story – a success story? • global warming, climate change, the Kyoto protocol, politics and economics - future scenarios • introduction and control of invasive alien species Management, use and abuse of resources, e.g. fossil fuel usage Ecotourism Rehabilitation of the environment Pollution and political, legal, economic, ethical, and other influences with regard to environmental issues Environmental lobbying and the importance of evidence. Briefly discuss the case study of St Lucia.
Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.		

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ASSESSMENT SYLLABUS FOR LIFE SCIENCES – GRADE 12

STRAND: Environmental studies

Grade 12: Population and community ecology

Groups of different species of organisms that interact with each other and with the environment in different ways constitute an ecosystem. A group of different species that inhabit a particular area is called a **community**. Each species present in a community forms a **population**, and the population size is governed by a number of factors, both physical and social. Populations of animals exhibit different social organisations that enhance their survival within the community.

AIM 2: ***INVESTIGATING PHENOMENA IN LIFE SCIENCES***	***AIM 1:*** ***KNOWING LIFE SCIENCES***	***AIM 3:*** ***APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
	Population Ecology	
Opportunity to demonstrate Research Skills *Investigative Research* *Ecosystem Study or Study of a Local Environmental issue* *Investigate community structure within a habitat and changes to this structure as habitat changes.* *These research skills could include the following activities/steps:* • *Observation/Identification (using keys) and recording of data in an appropriate manner* • *Sampling/collection of data* • *Analysis and Interpretation of data* • *Written Report of findings with possible solutions (if a problem is encountered)* Use of field guides for identifying species.	Candidates should know: 1. the definition of individual, population, community and ecosystem. 2. that the size of a population is affected by immigration, emigration, mortality and births. Population size fluctuates seasonally and annually, depending on resource availability. 3. the effects of limiting factors on population growth i.e. density dependant/independent factors and environmental resistance; the concept of carrying capacity and its implication for a species. 4. sampling methods: • Mark-recapture – method, precautions, calculation of population size • Quadrats – method, precautions, calculation of population size • Census – method, limitations 5. the importance of random sampling. 6. the definition of predator-prey relationships. • Study TWO examples of predator-prey relationships from the South African context to show how these operate as a mechanism for regulating populations, e.g. lion – zebra; aphid – ladybird; shark – fish.	Debate decision to intervene and control community structure, e.g. culling of elephants. Environmental impact assessments: Role of population studies in these assessments, e.g. indicator species

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Sampling methods Mark-recapture as a technique for determining population movements and demographics. A simulation exercise may be used to assess understanding of this technique. Interpret data on population size and fluctuations. Use at least ONE other sampling method, e.g. quadrats, transects, traps, direct observation. Population Graphs (Age/Sex graphs) The candidate must understand how these are used but not have to draw these from raw data given.	7. the impact of food webs and social organisation on populations 8. that species compete with each other for resources, e.g. light, space, water, shelter, food, and that this results in specialisation for particular modes of life. • Interspecific and intraspecific competition for food, space, shelter, water, access to mates. • Survival is determined by successful access to resources. • Ecological niche defines resources and conditions necessary for survival of each species. 9. ways of reducing competition: • ONE strategy among plants, e.g. resource partitioning as in a forest ecosystem • ONE strategy among animals, e.g. coexisting shorebirds; coexisting large herbivores in African savanna; coexisting predators, e.g. lions and leopards 10. the concept of ecological succession: the sequence of organisms that occupy a new habitat (primary succession) or a disturbed habitat (secondary succession). Pioneers are replaced by a succession of species; numerous possible end points, depending on environmental fluctuations; variety and number of species determined by constraints of succession. 11. that social organization enhances survival: • benefits of herds or flocks as a predator avoidance strategy as in zebra • packs as a successful hunting strategy as in wild dogs • animals with a dominant breeding pair as in wild dogs • division of tasks among castes as in termites 12. the application of population dynamics to human populations. • Reasons for exponential human population growth. • Forecasts of human population growth in South Africa over the next twenty years.	Discuss these concepts in terms of populations (including human) and the consequences for ecosystems/the environment. Debate human influences on succession, e.g. fire Human demands versus conservation of natural environment: Tensions and issues for debate Choose at least ONE current debate, e.g. human requirements for land versus conservation of the natural environment; the hunting industry; sustainable harvesting of natural resources; creation and management of game reserves. Reflect on the aesthetic value placed on South Africa's biodiversity by South Africans. Implications of further human population growth for the natural environment: Ecological footprint of people in 'developed world' vs people in 'developing world'. *[Link to Grade 11].*
Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.		

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STRAND: Life processes in plants and animals

Grade 12: Chemical Co-ordination and reproduction

In Grade 10 and Grade 11 some of the life processes that enable plants and animals to survive have been covered and related to the different and changing environments of organisms. Plants and animals have a variety of ways of detecting stimuli and responding to their environments; chemical co-ordination in the human is one example of these. Reproduction is the one life process that is not necessary for the survival of the individual but is concerned with continuation of the species.

AIM 2: INVESTIGATING PHENOMENA IN LIFE SCIENCES	***AIM 1: KNOWING LIFE SCIENCES***	***AIM 3: APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
	Human Endocrine System	
Interpretation of given data: Observation/Interpretation of graphs, tables, drawings, micrographs, microscope slides, bioviewers, etc. Pancreatic tissue: Identify and label/draw (exocrine vs. endocrine cells/tissues) Investigate: Cortisol/Adrenalin related to Sports Science; steroids; stress	The nervous system and hormones enable animals to respond to external changes and to control conditions inside their bodies Candidates should know: 1. the location of the endocrine glands listed below and the role of the hormones in body functions. These should be learnt in their context in the FET phase. • Hypothalamus (ADH), pituitary gland (TSH, FSH, LH, Growth hormone), thyroid gland (thyroxin), pancreas (insulin & glucagon), adrenal gland (adrenalin), gonads (testosterone & oestrogen, progesterone). Other reproductive hormones (oxytocin and prolactin) 2. the disorders of the endocrine system: diabetes, thyroid disorders, growth disorders, infertility. 3. the concept of homeostasis as a means of maintaining a stable internal environment. [Link to Grades 10 and 11] 4. the general role of *negative feedback* in homeostasis, drawing on glucose and reproductive hormones.	Debate current uses of hormones in, e.g. sports medicine, infertility and diabetes control.

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	Reproduction in Flowering plants	
Design and carry out a germination study on a suitable plant, e.g. bean, emphasising the scientific method. Understand sectional views i.e. T/S vs. L/S Application of food tests to seeds, e.g. proteins, carbohydrates, oils, etc. [Link to Grade 10] Determine the energy in a peanut	Candidates should know: 1. the similarities and differences between asexual and sexual reproduction. 2. the advantages and disadvantages of asexual and sexual reproduction. 3. the male (stamen, anther, filament, pollen grain, gametes) and female (stigma, style, ovary, ovule, seed) parts of flowers and their functions. Further detail is not required. 4. that fertilised ovules develop into seeds and the ovary into fruit. 5. the difference between pollination and fertilisation. 6. how asexual/sexual reproduction has historically led to improved food crops. 7. how asexual reproduction/genetic engineering techniques are of benefit to food production and solving current food crises. Exposure to examples but no knowledge of actual cultivars is expected. 8. that sexual reproduction is used in the production of new and improved varieties of food crops including polyploidy	The role of asexual reproduction in the propagation of plants. The significance in agriculture and food production. Debate issues of genetic engineering, artificially produced plant varieties and cloning. The use of seed banks to maintain biodiversity. The importance of seeds as a food source The use of growth regulators in modern agricultural practices
	Diversity of reproductive strategies in some animals	
Compare the reproductive strategies and analyse how effective these are to the survival of an r-strategy, e.g. turtle and a k-strategy, e.g. lion, elephant. Candidates should be familiar with a variety of survivorship curves.	Candidates should know how reproductive strategies maximise reproductive success in different environments. [Link to population dynamics] Study appropriate South African examples to illustrate each of the following; Courtship (one example) • External fertilisation vs internal fertilisation (one example of each) • Ovipary, ovovivipary and vivipary (one example of each) • Amniotic egg (one example - no details of structures) • Parental care (one example)	

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	Human reproduction	
Opportunity to demonstrate Research Skills *Evaluate the effectiveness of a variety of different methods of Contraception (minimum of three)* *Choose from: Condom, femdom, diaphragm (Dutch Cap), IUD (Copper 'T' or Loop), rhythm method, vasectomy, tubal ligation* *This research may be carried out using Internet-based, book-based and/or questionnaire-based research.* *This type of research could involve:* *Accurate data collection* *Recording of data in an appropriate way* *Analysis and Interpretation of data* *Report summarising findings and commenting on findings*	Candidates should know: 1. the structure and function of human male and female reproductive systems. 2. the male reproductive parts and their functions: testes, scrotum, germinal epithelium and seminiferous tubules, epididymis, sperm duct, penis, prostate gland ,seminal vesicle, foreskin. 3. the distinction between sperm/semen and erection/ejaculation. 4. the female reproductive parts and their functions: ovary including follicles and corpus luteum, oviduct, uterus, endometrium, cervix, vagina, clitoris. 5. the changes in the structures mentioned above and other physiological changes that occur during puberty. 6. that sperm and egg cells are produced in the germinal epithelium by meiosis. This is controlled by hormones (no further details). 7. the structure of a sperm and functions of the parts. 8. the menstrual cycle emphasising the roles of FSH, LH, oestrogen and progesterone and the negative feedback mechanisms. [Link to endocrine system] 9. the development of primary follicle into Graafian follicle and ovulation, subsequent events and hormonal changes, and implantation. 10. the concept of fertilisation: where it occurs, that the zygote becomes an embryo and then a foetus by mitosis (no further details). 11. the structure and functions of the placenta, umbilical cord, amnion and amniotic fluid. 12. the initiation of labour and birth by changing hormones and other factors. The role of the mammary gland. 13. the following contraceptive methods: condom, diaphragm, contraceptive pill, hormone injections, IUD and rhythm methods and features of each.	Contraception. Discuss attitudes and beliefs of different cultures on the use of contraceptives. Sexually transmitted diseases; the effect of multiple partners. Foetal Alcohol Syndrome and HIV as issues related to human reproductive system. Infertility treatment for males and females. A discussion of the possibilities Surrogacy Circumcision: health, cultural and religious issues related to this procedure
Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.		

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STRAND: Life at the molecular, cellular and tissue level

Grade 12: DNA, genetics and genetic engineering

In grade 12, we examine life at the molecular level, and focus on DNA and its role in the cell and in heredity. DNA forms part of the chromosomes in the nuclei of cells and it contains the genetic code that provides information about what a living organism looks like and how it functions. The code is found in sections of DNA called genes. The genes are carried in the sex cells to the offspring, contributing to their characteristics. When the DNA code changes, whether naturally or by human interference, e.g. radiation or genetic engineering, then some structure or life process may change in an organism.

AIM 2: ***INVESTIGATING PHENOMENA IN LIFE SCIENCES***	***AIM 1:*** ***KNOWING LIFE SCIENCES***	***AIM 3:*** ***APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
	DNA – the code of life; and RNA	
• Modelling nucleic acids and commenting on accuracy • Pen-and-paper or modelling of protein synthesis • Compare two methods of DNA extraction and justify which is better. • Interpret bar graphs and numerical data based on nucleotide frequencies. [Refer to Nature of Science Grade 10]	**Candidates should know:** **DNA structure and coding** 1. how the work done by many scientists allowed Watson and Crick to unravel the genetic code (1953) and, in the 1960s, the mechanism of protein synthesis and DNA replication. 2. the structure and location of DNA and RNA (mRNA, tRNA only) in a cell. 3. the simple structure of nucleotides, including the names of the four nitrogenous bases of DNA (adenine [A], thymine [T], cytosine [C] and guanine [G]) and that uracil replaces thymine in RNA, and which bases are complementary. 4. that mitochondrial DNA also exists, and remains unaltered from mother to child. That this is used to determined relatedness. **Protein synthesis** 5. the process of transcription of mRNA from DNA and where it takes place in a cell. Refer to role of polymerase. 6. the translation of mRNA (including the role of tRNA and amino acids) into specific proteins and where this takes place in a cell. Reference to other types of RNA is not required. The terms 'codon' and 'anticodon' should be familiar. 7. how aberrations occur: the definition and effect of point and frameshift mutations: Refer only to insertion, deletion and substitution mutations. Mutations can be caused by mutagens and chance.	• How and why Watson and Crick cracked the code. Competition over scientific ideas • How DNA has become an everyday concept • How pharmacological drugs interfere with protein synthesis to act as antibiotics, etc. How did DNA manage to get into mitochondria and why is it there?

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How 'fingerprints'/DNA profiles are interpreted	**Application of DNA technology** 8. that highly variable, non-coding DNA is used for 'fingerprinting' and the significance of 'fingerprinting'. The role of PCR (Polymerase Chain Reaction) in making this possible from small DNA samples. Interpretation and importance of a DNA 'fingerprint' is required but not detail of the process.	Evaluate how *efficient* the code is. • How DNA 'fingerprints' are used to determine familial relatedness, in criminal forensics, to identify human remains, fight illegal trading by identifying origin of timber, etc. • Reliability of DNA 'fingerprinting' vs other techniques • Ethics of obtaining DNA samples
	Meiosis	
• Model replication and meiosis and comment on accuracy • Look at microscope slides of phases of division • Draw other phases from a reference diagram • Use karyotypes to deduce information • Meiosis in flow diagrams and life cycles	Candidates should know: 1. the location of chromosomes in cells and their structure. 2. the significance of chromosomes in cell division. 3. the difference between haploid and diploid number and understand the significance of each 4. where, when and why meiosis takes place in animals and flowering plants 5. the process of DNA replication as part of interphase. (suggest covering here to avoid confusion with protein synthesis) 6. the process and terminology of meiosis. Only names of basic phases (e.g. Prophase I) are required. 7. about chromosomal mutations that can arise as a result of abnormal meiosis,(use Down syndrome as an example). 8. how to work with karyotypes.	Attitudes towards those with genetic abnormalities. Consider case studies of chromosomal abnormalities – range of XY conditions (Klinefelter's syndrome, etc.). Debate: What is male/female. Distinguish cause from effect, diagnosis, prognosis. Interview speakers from involved organisations.

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	Genetics and genetic engineering	
	Candidates should know: **Inheritance**	
• How Mendel experimented and made deductions from experiments. The relationship between accuracy of data and sample size • Do worked examples of monohybrid crosses and predict expected ratios. • Interpret family pedigrees	1. of Mendel, the gene as a unit of inheritance, how it relates to chromosomes and the terms allele and locus, and gene pool. 2. the terms, genome, filial generations, gametes, phenotype, genotype, homozygous, heterozygous, dominant and recessive, hybrid. 3. how monohybrid crosses occur, and how expected and actual phenotypic/genotypic ratios are derived. Monohybrid crosses in terms of complete dominance only (no partial dominance), but including inheritance of sex (using X and Y chromosomes) and sex-linked traits (use haemophilia or red-green colour blindness). The mechanism for sex-linkage should be understood. The terms gonosomes (X and Y) and autosomes should be familiar. 4. that continuous characteristics tend to be polygenic in origin and are controlled by a few alleles and/or one locus. 5. how gene mutation may lead to speciation by producing variation: These can be harmful, beneficial and neutral gene mutations – what these mutations are, how they are caused and what their impact is. 6. what the Human Genome Project (HGP) is and its impact. 7. how pedigrees (family trees) work. **Genetic Engineering** 1. the meaning of the terms genetic engineering, recombinant DNA technology, transgenic, Genetically Modified Organisms (GMOs), biotechnology. 2. that modifications take place using restriction and ligase enzymes by adding, modifying and deleting genetic material (refer to mutations). 3. how bacterial plasmids for instance, are used in medical applications such as artificial hormone production. 4. about gene therapy as a means of correcting the cause of disorders. The use of bacterial/viral vectors in this process. 5. about GMO crops and the process/terminology of plant tissue culture/cloning. Impacts/uses thereof. The use and impact of polyploidy in plant biology.	• How knowledge is accepted or rejected based on preconceived ideas. Mendel's work first rejected then later shaped scientific knowledge. • How changes in single nucleotides affect our understanding of inheritance. Case studies in HGP with ethical impacts • Cultural/historical beliefs about, and attitudes towards, people suffering from conditions. How scientific thinking should shape these. • What is male/female? • Role of genetic counselling for sufferers/carriers of conditions. How knowledge affects our decisions of marriage, child-bearing, etc. • Debate whether genetic engineering and biotechnology are modern developments or based on Indigenous Knowledge. • Investigate the trials process for human drugs and success rates. • The GMO issues: influence on traditional/ indigenous methods/culture, increasing reliance on monocultures and multinationals. Human rights and safety – labelling, bio-security. Are proponents/ opponents in the debate credible, objective, etc. • CRISPR – genome editing technology. Allows researchers to permanently modify genes. Can be used, for example, in gene therapy to target, remove and repair mutated/unwanted sections of DNA and to sterilize disease causing parasites such as malaria. Ethics and implications of genetically manipulating human genome • Research environmental watchdogs such as Biowatch, SafeAge. Whose role is this?

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	6. what transgenic organisms are; the process by which they are made and their use. 7. what clones are and the process of animal cloning. Terms to include donor, surrogate, somatic cell, embryo, SCNT (somatic cell nuclear transfer). How plant cloning compares to animal cloning. (No reference to organs is needed). 8. about artificial selection and selective breeding and their impact. 9. about hybrid vigour and the tendency of a cross-bred individual to be more resilient.	• Ethics and legislation of advancements. • How advancing technology solves one problem to create another, e.g. questions of guardianship in surrogacy, affordability and equal access.
Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.		

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STRAND: Diversity, change and continuity

Grade 12: Evolution

Underlying concepts: Evolution by natural selection explains evidence provided by the fossil record, similarities within groups and differences between groups, biogeography and many other kinds of evidence. Evolution by natural selection results in adaptation to an environment, or speciation, if it coincides with geographic isolation of a small population. Genetics aids our understanding of evolution at a molecular level.

AIM 2: ***INVESTIGATING PHENOMENA IN LIFE SCIENCES***	***AIM 1:*** ***KNOWING LIFE SCIENCES***	***AIM 3:*** ***APPRECIATING AND UNDERSTANDING THE HISTORY, IMPORTANCE AND APPLICATIONS OF LIFE SCIENCES IN SOCIETY***
	Origin of an idea about origins	
Skills of developing an opinion by investigating and discussing cultural and religious explanations for the origin and development of life on earth. [Refer to Nature of Science Grade 10]	Candidates should know: 1. that the scientific theory of evolution emerges from different lines of evidence, e.g. fossil record (grade 10), modification by descent, and the evidence from biogeography (grade 11), genetics (grade 12) as well as other forms of evidence. 2. the role of Erasmus Darwin, Lamarck, Charles Darwin and Alfred Wallace in the development of the theory of evolution.	Discuss how new scientific evidence is introduced, presented, and accepted by society and how it impacts on society. Consider • the acceptance of scientific theory by society in relation to belief systems; • the historical time at which it is presented; • the manner in which it is presented; and • to whom it is presented. Alternatives to Darwin's explanation: People have different ways of understanding the history of life and the place of humans in life. Science has limits: it can explain physical structures and events, but not spiritual or faith-based matters. Both are important to humans, but in different ways.
	Fundamental aspects of evolution	
Demonstration of principles of natural selection through camouflage and avoidance of predation, using, e.g. games, models.	Candidates should know: 1. macroevolution as patterns, trends and rates of change over time (punctuated equilibrium/gradualism) 2. Darwin's theory of evolution by natural selection: Life forms have evolved from previous life forms by natural selection (link to Genetics). Most species are unable to survive in a new environment, and become extinct, but a few species may successfully adapt to a new environment. 3. that natural selection only operates on variation in inherited characteristics (link with Genetics). Explain ONE example, e.g. peppered moth in UK, how leopard got its spots, etc. 4. that artificial selection mimics natural selection. Artificial selection as illustrated by at least ONE domesticated animal species and ONE crop species.	

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	Formation of new species	
Analysis and Interpretation of cladograms (Note: Candidates need not draw these from scratch but only work with given cladograms)	Candidates should know: 1. the concept of a biological species: a group of organisms of common ancestry that closely resemble each other and that can interbreed and produce viable offspring. 2. the two main causes of variation in organisms: mutations caused by changes in base sequences of DNA/chromosome breakage and rejoining; mutations can be neutral, lethal or beneficial and genetic recombination occurring during meiosis and sexual reproduction. 3. that mutations lead to genotypic variations in populations which may or may not appear in the phenotype. Give examples of variations in populations, e.g. Galapagos finches, white lions, etc., and explain the significance of these mutations to individual organisms and the population. 4. Cross breeding methods; the importance of inbreeding (increase in homozygosity) and outbreeding (promotes heterozygosity) within a species; problems associated with these breeding methods. Study ONE example of inbreeding and ONE example of outbreeding. One of these should involve humans and the other, plants. 5. the founder effect using ONE example relevant to South Africa. 6. the concepts of convergence and divergence in the evolution of species. 7. mechanism of speciation for producing new species: Geographic speciation due to isolation and geological events, e.g. erosion, earthquakes, volcanism and continental drift that separate populations of a species to the point where they can no longer interbreed (allopatric); or it may occur in populations that occupy the same geographical area (sympatric). Study ONE example, e.g. cichlid fishes in Lake Malawi, Galapagos finches, mammals on different land masses. 8. mechanisms of reproductive isolation: • breeding at different times of the year • species-specific courtship behaviour (animals) • adaptation to different pollinators (plants)	

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	Hominid Studies	
• Be able to compare and sequence pictures based on anatomical features. • Match pictures to descriptions. • Identify bones	Candidates should know: 1. that the science of hominid study depends on fossilised remains, genetic evidence (especially mitochondrial DNA passed only through mother's line) and archaeology. The classification of hominids remains a matter of scientific debate. 2. that hominids are (in this context) bipedal animals in the fossil record showing a mixture of ape-like and human-like features. 3. the hominid sequence proposed by scientists, rough dates, trend in physical features (skull: brow ridge, optical plane, foramen magnum, teeth and jaws, cranial capacity; skeleton: overall size and posture, arm length, features of feet and hands), trend in habits, and fossil locations of the following only: • *Australopithecus afarensis* As examples 'Lucy' from Awash Valley, (Ethiopia), • *Australopithecus africanus* As examples: Taung child discovered by Raymond Dart, Mrs Ples from Sterkfontein Caves in Cradle of Humankind. • Latest South African finds; *Australopithecus sediba* possibly placed between Australopithecus and Homo species; *Homo naledi*, a possible candidate for earliest Homo species • *Homo habilis* The 'handy man' or first tool maker. From Lake Turkana (Kenya) and Olduvai gorge (Tanzania) • *Homo erectus* the disputed ancestor of humans and *Homo neanderthalensis* found in Europe • *Homo sapiens* Examples from Border cave in KZN, Klasies river mouth. Earliest use of fire to make ochre artefacts at Blombos cave and Pinnacle Point cave (Mossel Bay). • San as the world's oldest extant peoples. 4. how bipedalism, fire-making, tool-making, language and culture can be seen as interdependent. 5. the out of Africa hypothesis and evidence for African origins of all modern humans (wave of *Homo erectus* that led to dead end in *Homo neanderthalensis* followed by 2nd wave of *Homo sapiens* from Africa) vs Multiregional model (*Homo erectus* developed into *Homo sapiens* in various locations, including independently in SA.) 6. that all modern humans are genetically very closely related to each other and to primates.	• African fossils have made a huge contribution to understanding hominid evolution, e.g. Cradle of Humankind at Sterkfontein; Great Rift Valley. • How new evidence causes revisions in scientific interpretation, e.g. Laetoli footprints and Little Foot being reclassified as *Australopithecus prometheus* by Ron Clarke • How physical constraints affect cultural development.

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	Evolution in present times	
Investigate statistics related to new disease-causing organisms and their control, e.g. new strains of influenza	Candidates should know: that there are examples of evolution in progress, e.g. the development of resistant strains of tuberculosis (MDR/XDR). Can only be seen where unusually rapid change is occurring.	• Debate occurrences of current evolution and its impact on the control of diseases in humans, other animals and plants. • What impact will climate change have on evolution?
Candidates should be able to use the knowledge gained in this section to demonstrate skills in unfamiliar/unrehearsed contexts and to solve problems.		

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D. ADMINISTRATIVE DOCUMENTS AND APPENDICES

1. ADMINISTRATIVE DOCUMENTATION FOR SBA

1.1 Cover Sheet for Teacher's File

1.2 Cover Sheet for Learner's File

1.3 Teacher's Record of SBA Marks

1.4 Rank Order List

1.5 Regional and National Moderation Tool

1.6 Final Moderation Feedback form to IEB

1.7 Example of Letter of Authenticity

1.8 Example of Declaration of Omissions

2. APPENDICES

2.1 Appendix A: Skill Areas for AIM 2

2.2 Appendix B: Recommended General Equipment List

2.3 Appendix C: Rubric for assessing Controlled Writing Task

2.4 Appendix D: Examples of Design Grids

2.5 Appendix E: Life Sciences Examination Paper II: Essay Rubric

2.6 Appendix F: Examples of Rubrics for the Research Project

2.7 Appendix G: Rubric for assessing Scientific Method in the PAT

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1.1 TEACHER'S SBA COVER SHEET

NATIONAL SENIOR CERTIFICATE EXAMINATION

LIFE SCIENCES

COVER SHEET FOR TEACHER'S FILE

School:
Teacher's Name:

SUPPORTING DOCUMENTATION		Evidence provided
1	IEB Moderation Selection List (where Learner Files have been requested)	
2	Teacher's Record of SBA Marks	
3	Rank Order List for ALL candidates in the grade	
4	Evidence of School (or External if one person department) Moderation	
5	Evidence of Cluster Moderation Activities	
6	Evidence of Regional Moderation (Feedback Form to School)	

EVIDENCE OF SBA ITEMS

This Section must contain:

- All assessments done by candidates. If candidates have been allowed to select their best evidence, the full range of assessments done by all candidates must be provided.
- Design grids for the Summative Practical Task/s, Case Study, exams and tests
- Marking Guidelines for each assessment (Memoranda, Rubrics etc.)

Preliminary Examination that includes Papers I and II	
Controlled Test 1	
Controlled Test 2	
Compulsory Summative Practical Task	
TWO OF THE FOLLOWING:	
Research Project	
Controlled Writing Piece	
Case Study	
Summative Practical Task	

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1.2 CANDIDATE'S SBA COVER SHEET

NATIONAL SENIOR CERTIFICATE EXAMINATION

LIFE SCIENCES

COVER SHEET FOR LEARNER'S FILE

(To be filled in by the candidate and controlled by the teacher)

Centre Number		Candidate's Examination number	

		Topic/Heading	Date	Raw Score	Weighted Mark
Preliminary Examination		Paper I			
		Paper II			
		Total		/300	/25
Controlled Test 1					/15
Controlled Test 2					/15
Compulsory Summative Practical Task					/15
TWO OF THE FOLLOWING:					
Research Project					/15
Controlled Writing Piece					/15
Case Study					/15
Summative Practical Task					/15
				TOTAL out of 100	

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1.3 TEACHER'S RECORD OF SBA MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION

LIFE SCIENCES

TEACHER'S RECORD OF SBA MARKS

EXAM NO.	NAME	PRELIMINARY EXAMINATION	CONTROLLED TESTS		COMPULSORY SUMMATIVE PRACTICAL TASK	RESEARCH PROJECT	CONTROLLED WRITING PIECE	CASE STUDY	SUMMATIVE PRACTICAL	TOTAL
		25	15	15	15	15	15	15	15	100

Signature of Teacher: _____ Date: _____

Signature of Principal: _____ Date: _____

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1.4 SBA RANK ORDER SHEET

NATIONAL SENIOR CERTIFICATE EXAMINATION

LIFE SCIENCES

SBA RANK ORDER LIST

CENTRE NO | | | | |

CANDIDATES LISTED IN RANK ORDER OF MARKS (HIGHEST TO LOWEST)

	EXAMINATION NUMBER													MARK – 100
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														

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1.5 REGIONAL AND NATIONAL MODERATION TOOL

NATIONAL SENIOR CERTIFICATE EXAMINATION

LIFE SCIENCES

REGIONAL AND NATIONAL MODERATION TOOL FOR SBA

SCHOOL	**DATE**
TEACHER'S NAME	**CENTRE NO:**
MODERATOR	

Compliance	**Completed Teacher's SBA Cover Sheet included**	**IEB Selection List included (if applicable)**	**Mark Schedule completed correctly and signed by the Principal**	**Completed Rank Order List included**		**Proof of School/External Moderation provided (Purple Pen)**	**Proof of Cluster Moderation Activities provided**	**Irregularities clearly documented**
	This row applies to Learner's SBA only	**Suitable file used**	**Completed and correct Learner's SBA Cover Sheet included**	**Declaration of Authenticity provided**	**Declaration of Omissions provided**			
Comments								

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	Rating Scale 1. Does not meet the requirements at all. 2. Some important omissions. 3. Some minor omissions. 4. Meets the requirements fully.							
Quality	**Evidence of …**	Clear instructions/ question papers provided	Task of required rigour	Completed Design Grid to justify design	Appropriate and clear Marking Guidelines	Consistent assessment against marking guidelines	Constructive feedback to candidates	**Comments with regards to compliance with SAGs**
	Preliminary Examination							
	Controlled Test 1							
	Controlled Test 2							
	Compulsory Summative Practical							
	Research Project							
	Controlled Writing Piece							
	Case Study							
	Summative Practical							

Moderator's Signature: _____ **Date:** _____

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1.6 FINAL MODERATION FEEDBACK FORM TO IEB

NATIONAL SENIOR CERTIFICATE EXAMINATION

LIFE SCIENCES

FINAL MODERATION FEEDBACK FORM FOR SBA

To be completed and retained by the IEB

Examination Centre Number: _____ **Date:** _____

The candidates required to submit Learner Files for moderation (candidates supplied by IEB)

Examination number	School Mark (%)	Moderated Mark (%)	Examination number	School Mark (%)	Moderated Mark (%)

Comments:

Recommendations:

SBA MARKS SHOULD BE ACCEPTED WITHOUT ALTERATION	***Yes***	***No***

Change recommended by moderator:

Change to be implemented:

SBA Moderator's signature _____ Date: _____

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1.7 LETTER OF AUTHENTICITY

NATIONAL SENIOR CERTIFICATE EXAMINATION

LIFE SCIENCES

LETTER OF AUTHENTICITY

School Letterhead

DECLARATION BY THE CANDIDATE

I hereby declare that all the work contained in this SBA is my own, original work and that if I have made use of any source, I have acknowledged this.

_____ _____

LEARNER NAME DATE

I agree that, if it is determined by the competent authorities that I have engaged in any fraudulent activities whatsoever in connection with the contents of my SBA, I shall forfeit completely the marks gained for this assessment.

_____ _____

LEARNER NAME DATE

DECLARATION BY THE CANDIDATE'S TEACHER

As far as I know, the above statement by the candidate is true and I accept that the work offered is his/hers.

_____ _____

TEACHER DATE

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1.8 DECLARATION OF OMISSIONS

NATIONAL SENIOR CERTIFICATE EXAMINATION

LIFE SCIENCES

DECLARATION OF OMISSIONS

To be included in place of a missing SBA piece

School letterhead

LIFE SCIENCES
SBA OMISSIONS

Learner Name: _____ **Grade:** _____

SBA Task: _____

The learner has failed to include the set SBA task for the following reason:

	Illness. *Doctor's note attached*.
	The completed task is lost, but a mark is recorded.
	Absenteeism. *I hereby acknowledge the fact that I have failed to report on an alternate date to complete my Life Sciences SBA Task. This means I will receive 0% for the task. I am completely to blame for my own failure to complete the task on time or not at all.*
	Failed to hand in the task. *I hereby acknowledge the fact that I have failed to hand in a Life Sciences SBA Task. This means I will receive 0% for the task. I am completely to blame for my own failure to hand in the task on time or not at all.*
	Other:

The learner will have the following assessment reflected on the mark sheet for the task _____

_____ _____
Teacher's Signature DATE

_____ _____
Learner's Signature DATE

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2.1 APPENDIX A: SKILL AREAS FOR AIM 2

NATIONAL SENIOR CERTIFICATE EXAMINATION

LIFE SCIENCES

APPENDIX A: SKILL AREAS FOR AIM 2

(It is expected that the teaching of these skills, see below, will have started in Grade 10 or even earlier, so that by Grade 12 candidates will be familiar with them and will not need to develop them from scratch.)

Skill Area 1: OBSERVATIONAL SKILLS

1. Identify coloured substances (e.g. in nutrient tests and pH indicators).
2. Observe and describe (in words) changes in colour, shape or level (e.g. in enzyme experiments, nutrient tests, respiration and photosynthesis, etc.)
3. Match similar items and identify small differences (e.g. in cytology).
4. Match an observed object from given information (e.g. drawings and photographs with an object under the microscope).
5. Classify an object from given information (e.g. using keys).
6. Observe gross and fine features and differences in a given situation with minimal cueing (e.g. in plant and animal anatomy).

Skill Area 2: MEASUREMENT SKILLS

1. Recognise, or supply the correct units for common measurements, e.g. microns, $m.sec^{-1}$ (*in all quantitative work*).
2. Read the scale of common measuring instruments (*e.g. thermometer, metre rule, measuring cylinder, balance, stop clock*) and take appropriate measurements, including fractional measurements, taking meniscus and parallax into account (*e.g. in potometer experiments, on syringes, etc.*).
3. Use a grid to estimate areas (*e.g. of leaf surface, mapped area in ecology, etc.*).
4. Make rough estimates of relative weight, time, length, etc. (*in all quantitative work*).
5. Make valid measurements of variables, repeating measurements to obtain an average where appropriate (*in all quantitative work*).

Skill Area 3: RECORDING SKILLS

1. Record simple information that has been presented (*e.g. counting populations, measuring lengths, etc.*).
2. Makes a brief spoken or written summary of some information which has been presented (*e.g. discuss the variables in an experiment*).
3. Make a correct biological drawing and label it clearly (*e.g. in flower drawings, anatomy, etc.*).
4. Arrange information in the form of a suitable table with appropriate headings (*e.g. most quantitative practical work*).
5. Construct a chart, line graph, histogram or bar chart as suited to the data, choosing suitable axes and scales and with decimal and negative values (*e.g. in growth and enzyme experiments*). Candidates should be given explicit instructions, e.g. the type of graph to use, or which axes are which.

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Skill Area 4: MANIPULATIVE SKILLS

Demonstrate fine motor control in confidently using apparatus and materials such as: compound microscope, hand lens, scalpel, scissors, potometer, test tube and racks, respirometer, stopclock, clamps, tripod and gauze, spatula, tongs, beakers, measuring cylinders, syringes, balance, thermometer, living and dead specimens, glass slides, coverslips and stains.

Skill Area 5: PROCEDURAL SKILLS

1. Identify all commonly used items of laboratory apparatus and select appropriate items for given task (*e.g. when provided with some apparatus*).
2. Adopt procedures that minimise specific laboratory hazards, e.g. protective gear with caustic substances (*e.g. when boiling liquids, etc.*).
3. Carry out simple procedures as instructed such as using a syringe to produce desired volumes (*e.g. enzyme experiments*).
4. Set up apparatus or carry out a procedure from demonstration, verbal and written instructions or diagrams (*e.g. in all practical situations*).

Skill Area 6: SKILLS OF INFERENCE

1. Able to make calculations involving data, e.g. averages, percentages, number of stomata per mm^2, etc.
2. Recognise patterns in data, extract information from results, interpolate and extrapolate.
3. Distinguish observations (statements describing what has been seen, heard, etc. whether qualitative or quantitative) from inferences (statements made concerning the interpretation of observations).
4. Make plausible generalisations (inferential statements which attempt to relate several observations, using particular properties or events evident in the task in hand) from observations.

Skill Area 7: INVESTIGATIVE SKILLS

(*Some of these apply to most quantitative and experimental work*)

1. Identify investigative aspects of a problem, demonstrating understanding of relevant concepts.
2. Suggest a broad strategy to adopt in the investigation.
3. State the aim of the investigation.
4. Identify an appropriate procedure and select suitable apparatus or scale of suitable range to measure effectively.
5. Plan a suitable procedure to test a hypothesis, taking account of all variables to be controlled.
6. Identify the independent (input) variable and alter over a suitable range.
7. Identify the dependent (outcome) variable and measure it.
8. Identify other relevant variables and suggest ways to control them.
9. Collect relevant data and select an appropriate form for the presentation of results for any given procedure.
10. Combine observations and given information to formulate reasonable hypotheses (inferential statements which go beyond generalisations by proposing in testable form, relationships between variables in an attempt to interpret observations and the information to hand).
11. Make deductions from hypotheses (inferential statements which are logical consequences of hypotheses and which refer to the proposed testing implicit in those hypotheses).

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12. Use observations to confirm or refute existing hypotheses (*i.e. to make conclusions*).
13. Modify hypotheses to accommodate new observations.
14. Make a formal written description of the apparatus, materials and procedures adopted in an investigation.

Skill Area 8: EVALUATION OF PROCEDURES

1. Identify potentially hazardous situations (e.g. using caustic chemicals, boiling test tubes, etc.).
2. Anticipate hazards and adopt appropriate safety precautions and procedures for all proposed laboratory investigations.
3. Recognise that results may be incomplete or inconclusive.
4. Make constructive criticism of the design of a set of apparatus or experiment.

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2.2 APPENDIX B: **RECOMMENDED GENERAL EQUIPMENT LIST FOR LIFE SCIENCES**

Recommended General Equipment List for Life Sciences

Glassware and Plastic

- Measuring cylinders (50 ml and/or 100 ml)
- Beakers (50 ml, 100 ml and/or 500 ml)
- Syringes (1 ml, 5 ml, 10 ml and 20 ml)
- Droppers and/or plastic pipettes
- Plastic Petri dishes
- Paper/plastic cups/yoghurt cups
- Sample bottles (plastic and/or glass)
- Stirring rods/kebab sticks
- Forceps/tweezers
- Measuring spoons (5 ml)
- Spatulas
- Knives for cutting
- scalpels
- Ceramic tiles/wooden boards for cutting/dissecting
- Dropper bottles (with bulb on plastic/glass dropper)
- Test tubes (to hold 20 ml and 40 ml)
- Test tube racks
- Funnels (glass or plastic)

Reagents/Solutions

- Iodine Solution (2%)
- Benedict’s solution
- Bromothymol blue indicator
- Bromocresol green indicator
- Methylene blue
- Hydrochloric acid
- Lemon juice
- Acetic acid
- Vinegar
- Bicarbonate of soda
- Glucose
- Yeast (dried)
- Starch (soluble)
- Sucrose
- Protein powder (whey)
- Copper sulphate (hydrated)
- Potassium hydroxide
- Sodium hydroxide
- Ethanol (70-90%)
- Salt (sodium chloride)
- Universal pH indicator strips

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- Blue litmus paper
- Red litmus paper
- Distilled water
- Agar
- Gelatine
- Ammonia
- Beans and seeds for germination/extraction of DNA practicals
- Oil (sunflower oil)
- Dishwashing liquid
- Milk powder

General

- Weighing balance (mass of 0.1 g upwards)
- Bunsen burners, tripods, gauze mats, matches or portable gas/spirit burners
- Thermometers (preferably alcohol thermometers)
- Sticky labels
- Marking pens (permanent)
- Cotton wool
- Kettle/urns/flasks for boiling water
- Microscopes
- Microscope slides, cover slips
- Cello tape
- Scissors
- Filter paper
- Lab paper/paper towel
- Rulers
- Calculators
- Pens
- Pencils
- Erasers
- Fire extinguisher
- First aid kit
- Plasters
- Burnshield
- Apple corers
- Timers/stopwatch/clock
- Dissecting needles
- Mortar and pestle
- Evaporating dish
- Test tube tongs
- Small budget for buying “fresh produce” such as: pineapple, kidneys, liver, fruit/vegetables, milk, hearts/lungs etc. from local supermarket.

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2.3 APPENDIX C: RUBRIC FOR THE ASSESSMENT OF THE CONTROLLED WRITING TASK

NATIONAL SENIOR CERTIFICATE EXAMINATION
LIFE SCIENCES
RUBRIC FOR THE ASSESSMENT OF THE CONTROLLED WRITING TASK

	2–1 marks	4–3 marks	6–5 marks	8–7 marks	10–9 marks
CONTENT & COMPLETION The candidate's ability to provide sufficient and appropriate facts which are biologically accurate.	Incomplete. Little attempt to use the facts needed. Riddled with biological untruths and errors.	Significant important information missing. Facts not related closely to the question. Some serious factual errors.	OK but some vital information missing. Not all facts given are appropriate to the topic. Errors affecting the quality of the essay.	Slightly flawed in that insufficient facts provided. Facts mostly appropriate to topic. Few errors if any.	Sufficient facts provided to support the response. Facts appropriate to the topic. No biological errors.
	3–1 marks	**6–4 marks**	**9–7 marks**	**12–10 marks**	**15–13 marks**
WRITING SKILL The candidate's ability to select information and use it to synthesise a response.	Clearly missed the point of the question. Arguments inconclusive. Unfocussed work with no sign of linkage	Little attempt to answer the question or organise thoughts coherently. Lots of irrelevant information and concepts poorly linked	Understands the question but there are gaps in the logic or flow and some lack of relevance. Concepts not well-linked.	Understands the question and has made a sensible, but ordinary answer. Some irrelevant information or poorly linked concepts.	Has a thorough control of the subject matter which is displayed in a cohesive written piece. Sustained logical progression. Concepts well-linked.
	1 mark	**2 marks**	**3 marks**	**4 marks**	**5 marks**
PRESENTATION The candidate's ability to set out the essay properly and communicate ideas clearly.	Poorly set out, illegibly written and riddled with grammatical/ spelling errors	Poorly set out or illegible or answers in point form	Weakness in TWO of three areas	Weakness in ONE of three areas	**Structure:** Sentence construction, use of paragraphs, introduction and conclusion **Grammar:** Correct use of Biological language **Neatness:** Legibly written

MAXIMUM TOTAL MARK [30 MARKS]

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2.4 APPENDIX D: EXAMPLES OF DESIGN GRIDS

NATIONAL SENIOR CERTIFICATE EXAMINATION

EXAMPLE OF DESIGN GRID FOR THE SUMMATIVE PRACTICAL TASK

QUESTION NUMBER	SKILL AREAS (insert mark)								COGNITIVE LEVEL (insert mark)					
	1	2	3	4	5	6	7	8	Know	Comp	App	Ana	Syn	Eva
TOTALS														
%														
													60% at least	

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NATIONAL SENIOR CERTIFICATE EXAMINATION

EXAMPLE OF DESIGN GRID FOR PAPER I

		Assessment outcomes			Content focus	Cognitive level					
Q#	**Content/Skill description**	**AIM 1**	**AIM 2**	**AIM 3**		**Know**	**Comp**	**App**	**Ana**	**Syn**	**Eval**
		120 marks	40 marks	40 marks		60 marks	40 marks	20 marks	20 marks	30 marks	30 marks
Total											
%											

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NATIONAL SENIOR CERTIFICATE EXAMINATION

EXAMPLE OF DESIGN GRID FOR PAPER II

		ASSESSMENT OUTCOMES				COGNITIVE LEVELS					
	Content / Skill Description	AIM 1	AIM 2	AIM 3		Know	Comp	App	Ana	Syn	Eval
Question #											
Total marks											
Targeted marks		30	10	60		20	10	10	15	20	25
Actual %											
Targeted %						40%			60%		

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2.5 APPENDIX E: LIFE SCIENCES EXAMINATION PAPER II: ESSAY RUBRIC

NATIONAL SENIOR CERTIFICATE EXAMINATION: LIFE SCIENCE

APPENDIX D: LIFE SCIENCES EXAMINATION PAPER II: ESSAY RUBRIC

Note that essay length should be 2½ to 3 pages in length. Time allocation suggestion: Reading of sources 10 min; Planning 10 min; Writing essay 40 min.

					Possible mark (40)
Planning	• Decision given • Key points present (important facts from sources listed in plan/grouped into key areas of importance) • Key points developed (short phrases/sentences to support the key points) • Sources referenced (e.g. source A) • Counter arguments provided • Own information provided and indicated (must support argument)				6
	• **1 mark**	• **2 marks**	**3 marks**	**4 marks**	
Decision	• Vague • Changed position within essay	• Clear decision made			2
Use of knowledge from sources **X2**	• Up to ⅓ of potential detail in sources used to support argument	• Up to ½ of potential detail in sources used to support argument	• Up to ¾ of potential detail in sources used to support argument	• Source detail very close to full potential used to support argument	8
Use of own knowledge	• Some facts given beyond the source to support argument	• Many facts given beyond the source to support argument	• Some facts given beyond the source to support argument • Facts integrated into the argument	• Many facts given beyond the source to support argument • Facts integrated into the argument	4
Content Relevance	• Repetition mostly avoided • Some minor digression • Supporting argument relevant	• Repetition mostly avoided • Some minor digression • Supporting argument relevant • Quality of source extracts acknowledged			2
Quality of argument supporting decision **X2**	• Writing consists of facts with little linkage or reasoning • Reasoning incorrect	• **Maximum if no clear decision in support** • Reasoning correct, but hard to follow • Ordinary: some linkage evident	• Supports the position • Reasoning is clear • Minor errors in flow • Linkage sometimes missed	• Strongly supports a clear position • Reasoning is very clear and succinct • Flow is logical • Compelling with regular linkage • Well integrated argument	8
Fairness-counter opinions to decision	• One to two counter opinions given from the sources	• Three – four counter opinions given from the sources	• Integration of one to two counter opinions from the sources into argument	• Integration of three – four counter opinions from the sources into argument	4
Presentation	• Writing is almost unintelligible • Tone, language, terminology unscientific and very weak • Introduction **and/or** conclusion **not** present	• Tone, language, terminology weak • Introduction **and** conclusion present	• Tone is consistent and suited to scientific language • Good and appropriate language and terminology • Mostly appropriate paragraphing • Introduction and conclusion have merit	• Tone is mature and suited to scientific language • Excellent and appropriate language and terminology • Correct paragraphing with good transitions • Interesting introduction, satisfying conclusion	4
Scientific merit	Essay shows academic rigour, accurate reasoning, insight and cohesiveness.				2

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2.6 APPENDIX F: EXAMPLES OF RUBRICS FOR THE RESEARCH PROJECT

ASSESSMENT RUBRIC FOR RESEARCH TASK (PRIMARY / MIXED)				
CANDIDATE'S EXAM NO:	**TOPIC:**			
TASK COMPONENT	**LEVEL 4**	**LEVEL 3**	**LEVEL 2**	**LEVEL 1**
	5 marks	**4–3 marks**	**2 marks**	**1–0 marks**
Research Question (5)	A thoughtful, creative question that has engaged learner in challenging or provocative research. The question breaks new ground or contributes to knowledge in a focused, specific area.	A focused question involving learner in challenging research.	Question constructed by learner lends itself to readily available answers	Learner relied on teacher-generated questions or developed a question requiring little creative thought.
	10–8 marks	**7–6 marks**	**3–5 marks**	**2–0 marks**
Introduction (10)	Outline/scope of research has been well communicated. Research question/hypothesis has been clarified/addressed. Aims have been clearly stated. The context of the research question/hypothesis has been clearly explained. Shows insight and integration.	Brief outline/scope of research has been provided. Research question/hypothesis has been clarified/addressed. Aims have been stated. The context of the research question/hypothesis has been explained.	Brief outline/scope of research has been attempted. Research question/hypothesis is not clear. Aims are provided but vague or do not relate to research question/ hypothesis is weak. An attempt at explaining the context of the research question/hypothesis is given.	Introduction of poor quality, irrelevant to research. Research question/hypothesis is not stated or is poorly stated. Aims are not provided.
	10–8 marks	**7–6 marks**	**5–3 marks**	**2–0 marks**
Data collecting, recording and presentation (10)	Relevant data has been collected. Methods are described and any problems of data collection have been explained. Data is collected and presented for each factor in a relevant, meaningful manner. Evidence of data collection in the Appendix and the sample size is large enough to collate meaningful information. Data selected for presentation represents the purpose of the study and has been presented correctly in a meaningful and appropriate manner.	All relevant data has been collected for question posed. A clear description and explanation of enquiry process given. Problems of data collection have been explained. Most evidence of data collection in the Appendix. A small sample used, but with justification. The presentation of data and methods used are relevant to the enquiry. The information is accurately and neatly displayed.	The information collected is reasonably ordered and is relevant enough for a basic enquiry. A reasonable description and explanation of methods used to collect the data. One or two problems may be referred to concerning the collection of data. Data collection limited. The presentation of data and methods used are not always relevant to the enquiry with a fair amount of accuracy and appropriateness.	The data presented is haphazardly recorded with little understanding of the importance of the set of information. Little or no attempt has been made to describe and explain the methods used to collect the data. No mention of problems is made. Data collection very limited. Skills of presentation are weak. Many of the factors stated in the introduction not present and/or much data presented that is not related to the factors given.

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	10–8 marks	6–7 marks	3–5 marks	2–0 marks
Analysis, Interpretation and Discussion of Findings (10 × 2 = 20)	Discussion is well planned and carefully structured. Thorough and detailed analysis and interpretation of findings is evident making reference to specific collected data. Clear understanding of the significance of the findings in relation to the research question/hypothesis is evident. Reference has been made to literature.	Discussion is planned and structured for the most part. Analysis and interpretation of findings is sound for the most part. Adequate reference has been made to literature.	Discussion is provided with some detail and some reference to the purpose of the investigation but poorly structured. Attempt at analysis and interpretation of findings is evident but superficial / simplistic/ incomplete / inaccurate. Cursory reference has been made to literature.	Discussion lacks structure, with brief statements referring to the data presented. Analysis and interpretation makes little or no sense. Incorrect or no reference to literature.
	5 marks	**4–3 marks**	**2 marks**	**1–0 marks**
Conclusion (5)	A concise conclusion has been provided that relates directly to the research question/hypothesis. Main points and findings have been re-emphasised. Limitations of the research have been pointed out.	A clear conclusion has been provided that relates to the research question/hypothesis. Main points and findings have been re-emphasised. Limitations of the research have been briefly pointed out where relevant.	A conclusion has been provided that relates to the research question/hypothesis to some extent. Some of the main points and findings have been stated. Relevant limitations are not provided.	Conclusion vaguely relates/does not relate to the research question/hypothesis. Main findings and points have not been restated. No reference to relevant limitations.
	5 marks	**4 marks**	**3–2 marks**	**1–0 marks**
Referencing (5)	A complete Bibliography is provided with no omissions. All the technical criteria pertaining to a recognised system of referencing, citation and quoting fully adhered to (e.g. Harvard or Chicago) throughout the report, including the Bibliography. In-text citations/references well integrated.	A complete Bibliography is provided with minor omissions. Technical criteria pertaining to a recognised system of referencing, citation and quoting adhered to (e.g. Harvard or Chicago) throughout the report, including the Bibliography with minor errors. In-text citations/references evident.	A Bibliography is provided but has some omissions. Technical criteria pertaining to a recognised system of referencing, citation and quoting adhered to (e.g. Harvard or Chicago) through most of the report, including the Bibliography with some important errors. In-text citations/references attempted.	A Bibliography is provided with significant omissions. The technical criteria pertaining to a recognised system of referencing, citation and quoting not adhered to (e.g. Harvard or Chicago). In-text citations/references not attempted.
Organisation of task and layout (5)	All technical criteria have been met. Exemplary presentation.	Almost all technical criteria have been met, minor flaws.	Some technical criteria have been met, major flaws.	Disorganised, minimal criteria met.
Teacher's Comment:			**TOTAL MARK: 60**	
Moderator's Comment:			**TOTAL MARK: 60**	

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ASSESSMENT RUBRIC FOR RESEARCH TASK (SECONDARY)				
CANDIDATE'S EXAM NO:	**TOPIC:**			
TASK COMPONENT	**LEVEL 4**	**LEVEL 3**	**LEVEL 2**	**LEVEL 1**
	5 marks	**4 marks**	**3–2 marks**	**0–1 marks**
Research Question (5)	A thoughtful, creative question that has engaged learner in challenging or provocative research. The question breaks new ground or contributes to knowledge in a focused, specific area.	A focused question involving learner in challenging research.	Question constructed by learner lends itself to readily available answers	Learner relied on teacher-generated questions or developed a question requiring little creative thought.
	10–8 marks	**7–6 marks**	**5–3 marks**	**0–2 marks**
Introduction (10)	Outline/scope of research has been well communicated. Research question/hypothesis has been clarified/addressed. Aims have been clearly stated or essential argument is clearly outlined. The context of the research question/hypothesis has been clearly explained. Shows insight and integration.	Brief outline/scope of research has been provided. Research question/hypothesis has been clarified/addressed. Aims have been stated or essential argument is outlined. The context of the research question/hypothesis has been explained.	Brief outline/scope of research has been attempted. Research question/hypothesis is not clear. Aims are provided but vague or do not relate to research question/hypothesis / essential argument is weak. An attempt at explaining the context of the research question/hypothesis is given.	Introduction of poor quality, irrelevant to research. Research question/hypothesis is not stated or is poorly stated. Aims are not provided.
	10–8 marks	**7–6 marks**	**5–3 marks**	**2–0 marks**
Analysis, Interpretation and Discussion of Findings (10 × 2 = 20)	Discussion is well planned and carefully structured. Thorough and detailed analysis and interpretation of findings is evident making reference to specific collected data. Clear understanding of the significance of the findings in relation to the research question/hypothesis is evident. Reference has been made to literature.	Discussion is planned and structured for the most part. Analysis and interpretation of findings is sound for the most part. Adequate reference has been made to literature.	Discussion is provided but poorly structured. Attempt at analysis and interpretation of findings is evident but superficial / simplistic/ incomplete / inaccurate. Cursory reference has been made to literature.	Discussion lacks structure. Incorrect or no reference to literature. Analysis and interpretation makes little or no sense.

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TASK COMPONENT	LEVEL 4	LEVEL 3	LEVEL 2	LEVEL 1
	5 marks	**4 marks**	**3–2 marks**	**1–0 marks**
Conclusion (5)	A concise conclusion has been provided that relates directly to the research question/hypothesis. Main points and findings have been re-emphasised. Limitations of the research have been pointed out.	A clear conclusion has been provided that relates to the research question/hypothesis. Main points and findings have been re-emphasised. Limitations of the research have been briefly pointed out where relevant.	A conclusion has been provided that relates to the research question/hypothesis to some extent. Some of the main points and findings have been stated. Relevant limitations are not provided.	Conclusion vaguely relates/does not relate to the research question/hypothesis. Main findings and points have not been restated. No reference to relevant limitations.
	5 marks	**4 marks**	**3–2 marks**	**1–0 marks**
Referencing (5)	A complete Bibliography is provided with no omissions. All the technical criteria pertaining to a recognised system of referencing, citation and quoting fully adhered to (e.g. Harvard or Chicago) throughout the report/essay, including the Bibliography. In-text citations/references well integrated.	A complete Bibliography is provided with minor omissions. Technical criteria pertaining to a recognised system of referencing, citation and quoting adhered to (e.g. Harvard or Chicago) throughout the report/ essay, including the Bibliography with minor errors. In-text citations/references evident.	A Bibliography is provided but has some omissions. Technical criteria pertaining to a recognised system of referencing, citation and quoting adhered to (e.g. Harvard or Chicago) through most of the report/essay, including the Bibliography with some important errors. In-text citations/references attempted.	A Bibliography is provided with significant omissions. The technical criteria pertaining to a recognised system of referencing, citation and quoting not adhered to (e.g. Harvard or Chicago). In-text citations/references not attempted.
	5 marks	**4 marks**	**3–2 marks**	**1–0 marks**
Organisation of task and layout (5)	All technical criteria have been met. Exemplary presentation.	Almost all technical criteria have been met, minor flaws.	Some technical criteria have been met, major flaws.	Disorganised, minimal criteria met.
Teacher's Comment:			**TOTAL MARK: 50**	
Moderator's Comment:			**TOTAL MARK: 50**	

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2.7 APPENDIX G: Method Rubric for the PAT

Method Rubric Criteria	5	4	3	2	1	0
L Layout – appearance of method					Layout meets criteria below: neat and tidy and bulleted/ numbered.	Layout is untidy and hard to read. **OR** Method is not formatted correctly with bullet points or numbers.
A Aim – method relates to prescribed experiment				Method clearly tests an aim that relates to the prescribed experiment and achieves the required result.	Method relates to the prescribed aim given, but is a little confusing and does not achieve the required result.	Method does not relate to the prescribed aim or achieve the desired result. Method given is the same as the given experiment.
M Method – this needs to be appropriate and relevant to the aim, clear, logical and sequential. If apparatus is given in the examination paper, the method should resemble the one given in the marking guidelines	All 5 criteria given below are met: 1. An original experiment provided. 2. Equipment is appropriate and used correctly. 3. Measuring of solutions, reagents and marking of equipment are explained and this assists in the control of variables. 4. Instructions are scientifically valid and ordered. 5. Instructions are complete to produce measurable results that are recorded.	An original experiment provided. Plus 3 of 5 criteria are met.	An original experiment provided. Plus 2 of 5 criteria are met.	An original experiment provided. Plus 1 of 5 criteria is met.	An original experiment provided.	None of the 5 criteria are met. **OR** Method a copy of the original, given experiment.

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