Biology

Upper Secondary

Teacher Guide

Papua New Guinea
Department of Education

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Acknowledgments

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Contents

Secretary's message

This Biology teacher guide is to be used by teachers of Biology when implementing the Upper Secondary Biology Syllabus (Grades 11 and 12) throughout Papua New Guinea. The Biology syllabus states the learning outcomes and outlines the content to be taught. This teacher guide gives practical ideas about ways of implementing the syllabus: suggestions about what to teach, strategies for facilitating teaching and learning, how to assess and suggested assessment tasks.

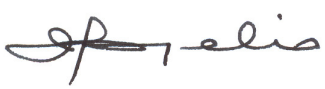
A variety of suggested learning and teaching activities provide teachers with ideas to motivate students' learning, and to make learning of Biology relevant, interesting and fun.

Teachers of Biology are encouraged to relate learning in Biology to real life, real issues and the local environment. Teaching that uses meaningful contexts and makes sure that students participate in appropriate practical activities assists students to gain deeper knowledge and understanding, and demonstrate more scientific skills in Biology.

As teachers of Biology, you are expected to recognise the different needs and interests of students who have had substantial achievement already and appropriately involve them working individually and with others in practical, field and interactive activities that are related to theoretical concepts, by applying investigative and problem solving skills. Encourage students to effectively communicate research based evidence of biological information, and appreciate the contribution that biology makes to their understanding of the world, living things, and the influence of society on the environment.

Teachers of Biology must ensure safety measures are taken when handling equipment, chemicals, live animals and plants or dead matter by students.

I commend and approve the Biology Teacher Guide for use in all schools with Grades 11 and 12 students throughout Papua New Guinea.



DR JOSEPH PAGELIO

Secretary for Education

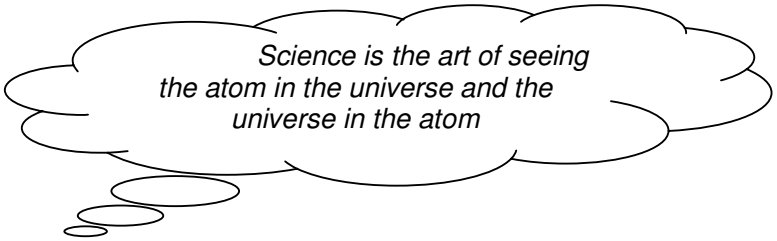
Introduction

The purpose of this teacher guide is to help you, the teacher of Biology to implement the Biology syllabus. As the name suggests, this is a guide providing you with some samples of teaching programs and suggested activities and assessment tasks. The samples will assist you to create your own exciting and constructive teaching programs, and assessment activities. The Biology syllabus specifies the particular learning outcomes that students achieve at the end of each unit.

The Biology teacher guide supports the syllabus. The syllabus states the learning outcomes for the subject units, and outlines the content and skills that students will learn, and the assessment requirements.

The Biology teacher guide provides direction for you in using the outcomes approach in your classroom. The outcomes approach requires you to consider the assessment requirements early in your planning, and to develop appropriate and relevant activities that assist students to achieve particular learning outcomes. This is reflected in the teacher guide. As a teacher of biology, the ideas, teaching strategies and activities that you use must be accompanied by clear directions for students to achieve learning outcomes.

This teacher guide provides examples of learning and teaching strategies. It also provides detailed information on criterion-referenced assessment and the resources needed to teach Biology. The section on recording and reporting shows you how to record students' marks and how to report against the learning outcomes.



The outcomes approach

Papua New Guinea's Lower Secondary and Upper Secondary syllabuses use an outcomes approach. The major change in the curriculum is the shift to what students know and can do at the end of a learning period, rather than a focus on what the teacher intends to teach.

An outcomes approach identifies the knowledge, skills, attitudes and values that all students should achieve or demonstrate at a particular grade in a particular subject (the learning outcomes). The teacher is responsible for identifying and selecting essential content/context and using the most appropriate teaching strategies and resources to facilitate students' learning to achieve these learning outcomes.

Education can be seen as the process of preparing a student for adult life. Therefore, the student is on a learning journey, heading to a destination. The destination is the learning outcome that is described in the syllabus. The learning experiences leading to the learning outcomes are to be determined by the teacher. This means that the teacher of Biology must use curriculum materials such as the syllabus and teacher guide, relevant textbooks or electronic media and assessment guidelines to plan hands on activities that will assist students achieve the learning outcomes.

The outcomes approach has two main purposes. These are to:

- equip all students with knowledge, understandings, skills, attitudes and values needed for future success
- implement diverse programs and opportunities that maximise learning.

Three positive assumptions of outcomes-based learning are that:

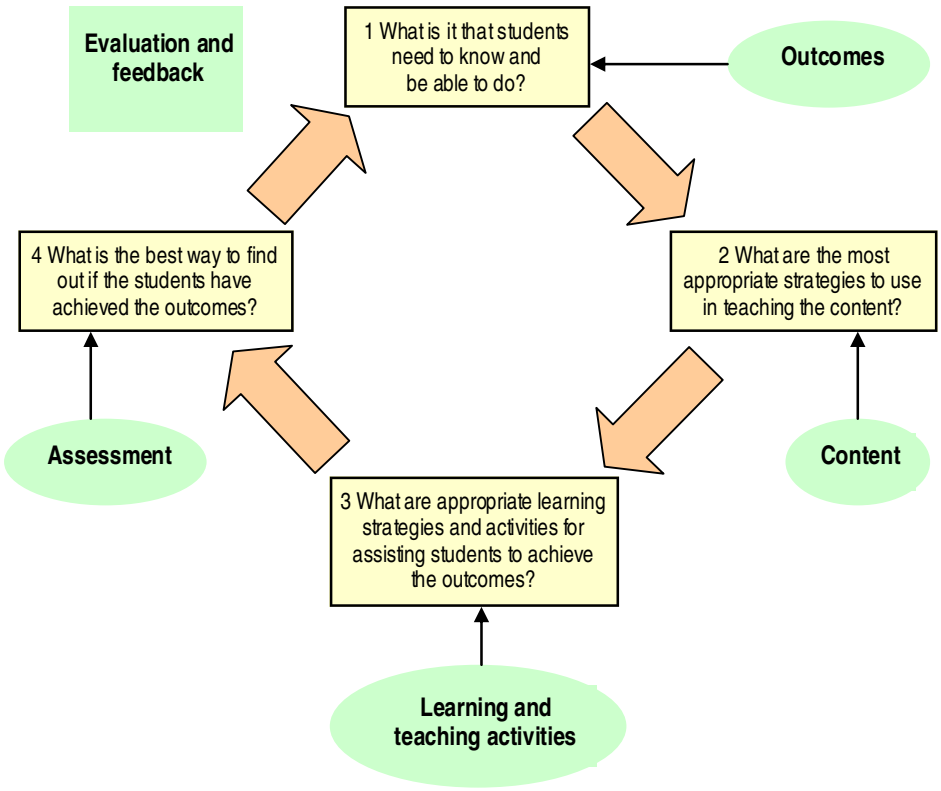
- all students can learn and succeed but at their own pace
- success breeds further success
- schools can make a difference by providing student friendly learning environments.

The four principles of Papua New Guinea's outcomes approach are:

1. *Clarity of focus through learning outcomes*
   This means that everything teachers do must be clearly focused on what they want students to ultimately be able to do successfully. For this to happen, the learning outcomes should be clearly interpreted. If students are expected to learn something, teachers must tell them what it is and create appropriate opportunities for them to learn it and demonstrate their learning. Therefore, when framing tasks use cognitive terminology such as 'classify', 'analyse', 'predict', and 'create'.
2. *High expectations of all students*
   This means teachers embrace criterion-referenced approaches. The principle of high expectations is about insisting that work be at a very high standard before it is accepted as completed. This means students are given ample time and the support they need to reach this standard. Students begin to realise that they are capable of far more than before when they are challenged with higher order thinking, open-ended questions as well as being encouraged and given time to ask questions of each other.

3. *Expanded opportunities to learn*
   This is based on the idea that not all students can learn the same thing in the same way in the same time. Some achieve the learning outcomes sooner and others later. However, most students can achieve high standards if they are given appropriate opportunities for learning. Therefore provide expanded opportunities for all students by nurturing students' natural curiosity through frequent use of the learning cycle model such as discovery/inquiry, concept introduction and concept application.
4. *Planning and programming by designing down*
   This means that the starting point for planning, programming and assessing must be the learning outcomes-the desired end results. All decisions on inputs and outputs are then traced back from the learning outcomes. The achievement of the outcome is demonstrated by the skills, knowledge and attitudes gained by the student. The syllabus states the content and the teacher guide describes a variety of ways in which students can demonstrate the achievement of learning outcomes.

The diagram below shows the cycle of the outcomes-based approach to teaching and learning



Learning outcomes provide teachers with a much clearer focus on what students should learn. They also give teachers greater flexibility to decide what is the most appropriate way of achieving the learning outcomes and meeting the needs of their students by developing programs to suit local context and involve the community.

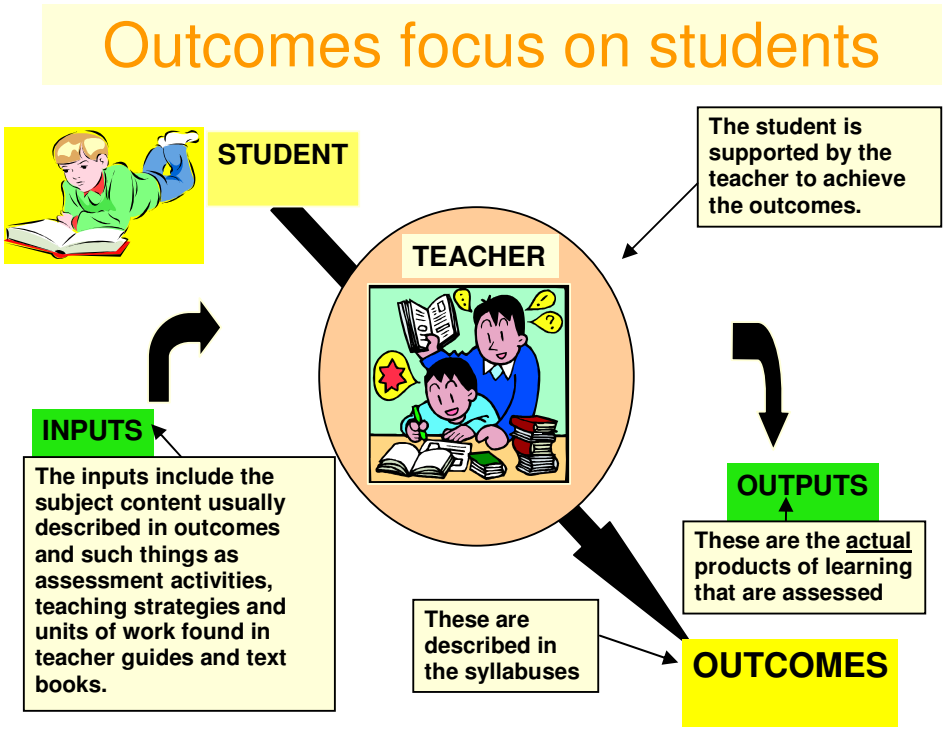
The outcomes approach promotes greater accountability in terms of student achievement because the learning outcomes for each grade are public knowledge-available to teachers, students, parents and the community. It is

what students know and can do as they progress through each grade that is important and must be supported by appropriate resources and a variety of learning strategies.

The outcomes approach means that learning:

- has a clearer purpose
- is more interactive - between teacher and students, between students
- has a greater local context than before
- is more closely monitored and acted upon by the teacher
- uses the teacher as a facilitator of learning as well as an imparter of knowledge.

*The diagram below summarises what the reform curriculum simply means, that it is student - centred and the teacher is **mainly** the facilitator.*



Learning outcomes

The Biology syllabus learning outcomes describe what students are able to know and can do at the end of Grade 12 and beyond. The level of achievement of the learning outcome should progressively improve during the two years of Upper Secondary study. At the end of Grade 12, students have an external examination, the summative form of assessment on the achievement of the learning outcomes. The learning outcomes for Biology are listed below.

Students can:

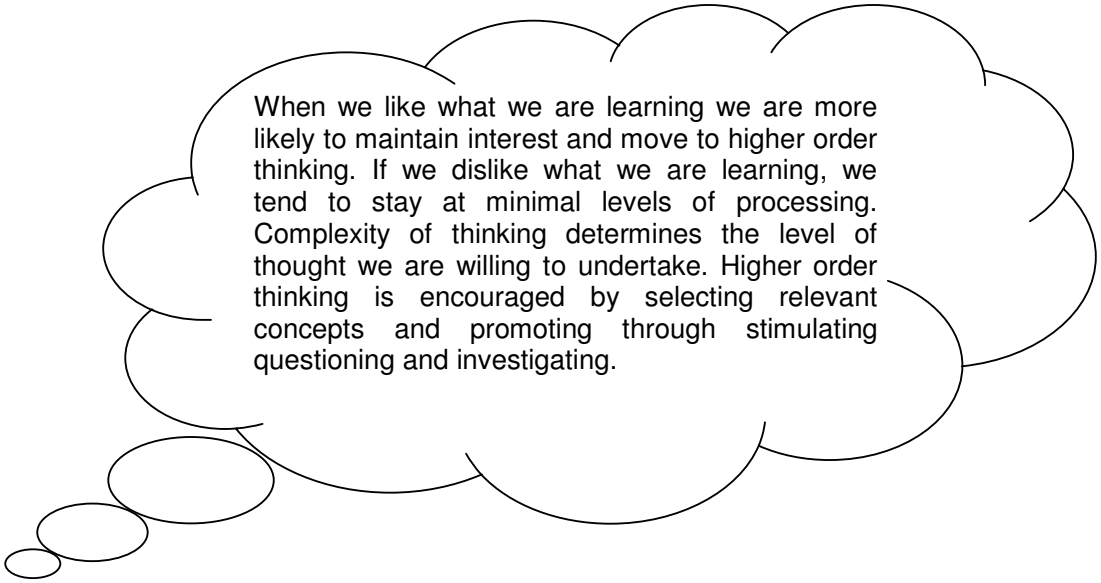
1. demonstrate an understanding of fundamental principles and models of biology
2. investigate and explain plant and animal physiology
3. describe and explain interactions between organisms and their environment
4. analyse and interpret data, graphics and other forms of information
5. undertake investigations using scientific methodologies to solve biological problems
6. communicate biological investigations and findings in various ways using biological terms and conventions
7. analyse and evaluate past and present biology-related developments and their impacts on human beings and environment and be able to make informed and ethical decisions
8. evaluate traditional biological knowledge and practices and their relevance today.

Note

These learning outcomes together with the numbers are carried over to the units they are applied. Therefore, the teachers of Biology are reminded not to change the numbers of the learning outcomes.

Learning and teaching

You as the teacher of Biology, need to ensure that the content specified in the syllabus is covered adequately. Before you teach what students should know, you must also be able to interpret content for students in a way that makes it relevant to them, and enables them to begin to acquire skills of analysis and problem solving, which will support further learning and teaching. Doing experiments is integral to teaching Biology. By all means give students some opportunities to apply their knowledge, to be creative and to solve problems using scientific investigative processes and procedures.



Learning and teaching strategies

There's now a changing emphasis in teaching of science, thus the teaching of Biology. The teacher of Biology is expected to provide opportunities to students to carry out laboratory activities which are more open-ended type of investigations. Laboratory work is not restricted only to following instructions, and reaching pre-determined knowledge but includes identifying real life problems and issues and finding solutions through the scientific method. Enabling students to do practical laboratory or field work and projects is all about 'I do and I understand'.

Provide a variety of learning and teaching strategies for motivation and to assist all students with different learning opportunities. The auditory learner prefers to use listening as the main way of learning new material whereas a visual learner prefers to see things written down. Students should be actively involved in their learning, so you need to design appropriate practical activities or experiments using resources that can be found in your location.

In Grades 11 and 12, students will already have had a wide variety of experiences. You need to make use of your students' experiences when designing and conducting learning in class; learning that is connected to your students' world.

To assist and encourage students to learn, you perform certain tasks. These are referred to as 'teaching strategies'. You need to engage students directly

in learning, but there are times when you have to take charge of the learning in the class and teach particular concepts or ideas.

There are many learning and teaching strategies described in the Lower Secondary teacher guides. These include:

- experiments, investigative processes
- scientific surveys
- research assignments
- group activities
- field work
- projects
- class discussions and debates
- presentations: written, oral, visual
- teachers discussions and lectures
- hand outs and work sheets
- textbook activities
- unit or topic assignments
- demonstrations and modelling
- guest speakers
- classroom displays.

The most efficient and long-lasting learning takes place when the teacher of Biology encourage the development of higher-order thinking and critical analysis skills, which include applying, analysing, evaluation and creating. You should also pay attention to developing students' affective and psychomotor skills. To make sure this occurs, encourage deep or rich, rather than shallow, coverage of knowledge and understandings.

Developing Biology skills

Teachers of Biology must strive to provide opportunities for students to continue to develop scientific skills-which can also be relevant to life skills. Suggested student activities are designed to address the specific content knowledge that general science strands usually cannot offer.

The broad areas covered in Biology include knowledge, skills, attitudes and values. The knowledge must be relevant to bring about positive changes in attitudes and values, which in turn will impact on society. The opportunities provided through activities, such as laboratory experiments, field work and research; will lead to acquiring applicable knowledge and skills.

The acquisition of this knowledge and skills should enable individuals to participate effectively in further Biology studies and contemporary society.

What do students do in Biology?

Safety

Teachers of Biology must be safety conscious at all times. It is your responsibility for making the laboratory a place where students can work safely. Teachers of Biology must take this responsibility extremely seriously.

You must let students know of any potential dangers of laboratory work, and must explain what safe practices are required. You must carefully monitor students' practices, and take actions when students behave in an unsafe manner without causing unnecessary fear in students.

The most common types of accidents in the laboratory are:

- chemicals in the eye, on the body, in the mouth and inhalation
- cuts
- burns and scalds
- fainting
- allergies
- electric shocks
- explosions.

Extra care must be taken when handling live animals and plants, both macro and micro organisms.

You as a Biology teacher therefore must demonstrate:

- management skills
- appropriate knowledge
- awareness
- an appropriate attitude to safety.

Safety equipment in the laboratory should include:

- a well stocked first aid kit/box/cupboard
- fume cupboards
- a fire extinguisher
- a fire bucket with sand
- fire blanket
- student safety glasses
- disposable gloves
- bottles of eye wash
- separate waste bins for chemicals/biological wastes.

Laboratory experiments, fieldwork, and research

Laboratory experiments, fieldwork and research are essential parts of the study of Biology that increase meaningful student learning. They facilitate the understanding of scientific inquiry processes and procedures. They can enhance learning opportunities for a wide range of students catering for a variety of learning and teaching approaches.

Laboratory experiments enable students to:

- identify problems; predict; test hypotheses by conducting experiments, observe, record and analyse data
- draw conclusions, recognise errors and make recommendations for improvement
- communicate findings based on evidence
- improve manipulative skills.

Fieldwork enables students to:

- acquire knowledge about environments through hypothesising, observing, experimenting, measuring and recording phenomena in the real world in a variety of places, including the school
- explore the scientific processes that inform and transform lifestyles
- use different kinds of scientific tools and approaches, including information and communication technology (ICT), to assist in the interpretation of, and decision-making about, scientific phenomena
- locate, select, organise and communicate scientific information
- explore different perspectives on scientific issues and discern between substantiated facts and opinions.

Research enables students to:

- explore various media and sources of obtaining information
- select relevant information and issues and make informed choices
- improve research writing and communication skills
- design and develop models or experiments.

Developing a program

A teaching program outlines the sequence of learning and teaching necessary for students to demonstrate the achievement of the learning outcomes. The content of the syllabus describes the knowledge and the learning context. The relevant learning outcomes for each unit are stated at the beginning of the unit followed by the elaborated content of the outcomes.

Teachers of Biology need to develop programs that include appropriate learning activities to enable students to acquire the knowledge and skills identified in the outcome statements. The illustration on page 3 gives the cycle of planning that you can follow.

The content prescribed in the units is an indication of the breadth and depth with which topics should be treated. The sequence of teaching is prescribed by the sequence of content on page 7 of the Biology syllabus. The learning outcomes and assessment, however, must be central to the planning of the teaching program.

Planning and programming units

The main purpose of planning and programming is to help you to arrange the presentation of the unit in an organised manner. This will help you to know what to teach and when to teach. You must also plan when and what type of assessment will be given in the program. It is strongly recommended that you plan with the other teachers who teach the same subject. By planning together, you will *all* have better lessons and make better use of your limited resources.

Points to consider when programming

- Which particular outcomes are students working towards?

- What is the essential learning experience that will assist students to develop their knowledge and understandings, skills, and values and attitudes in the subject?
- How can the learning experiences be sequenced?
- How do the learning experiences in the unit relate to students' existing knowledge and skills?
- How are individual learning needs be catered for?
- How can school events and practices be incorporated into the program?
- Do the assessment methods address the outcomes and enhance the learning?
- How can the assessment be part of the learning and teaching program?

The planning process

In this teacher guide, ideas for learning and teaching activities and samples of assessment tasks have been provided to help you teach the units. You are strongly advised to begin with your yearly plan. From the yearly plan, you can develop your plans for the Terms, week and the daily lesson plan. To plan a unit, follow these steps.

Step 1: Interpreting the learning outcomes

The first step is to read the unit description in the syllabus to set the context and study the learning outcomes. Ask what students can do to achieve the learning outcomes of the unit, and determine what students will know and be able to do by the end of the unit.

The action verb, concept and context of each learning outcome should help you see what skills and knowledge are embedded in the outcome.

An example below shows you how you can break up a learning outcome to help you plan your lesson.

Learning outcome:

Students can: describe and explain interactions between organisms and their environment.

The learning outcome is written with the main components

1. the action verb - *describe and explain*
2. the concept - *interactions*
3. the context - *between organisms and their environment.*

Step 2: Programming a learning sequence

This step requires you to develop a program outlining a sequence of topics and the time spent on each topic. If the unit involves a project, for example, you may plan to teach some theory at appropriate stages during the project, rather than teaching all theory before students start the project.

Before you develop your program, study the topics listed in the syllabus and think about the learning activities that will best provide students with the opportunity to learn the content and practice the appropriate skills. Decide how long the activities will take. Some major activities can last several weeks and smaller activities may be completed in a single lesson.

Step 3: Planning for assessment

It is necessary to decide early how assessment is going to be done and what type of assessment tasks will be given for each unit. For example, in Unit 1 you may plan for a test, an assignment and practical work. For the next unit you may plan a research project. Once, the overall or yearly planning is done, you can then teach necessary content and skills.

You will also need time to mark the task and provide feedback. Practical tasks may, for example, be broken into a series of stages that are marked over several weeks as students progress with their task. It is not appropriate to leave all assessment until the end of the unit.

This teacher guide provides performance standards and examples of marking guides. You should develop marking criteria prior to your marking of the tasks to ensure consistency in your assessment. It is also advisable that you develop clear and detailed instructions for completing the task and ensure all students know exactly what they have to do.

Step 4: Elaboration of activities and content

Once you have mapped out your program for the term, you then develop more detailed plans for each topic in the unit. All units require students to be actively engaged in learning, not just copying from the board. Make sure you develop a range of activities that suit all learning needs-some reading and writing, some speaking and listening, some observing and doing.

This teacher guide gives some suggested learning and teaching activities for each unit and some suggested assessment tasks, and standard rubrics which you might like to use to ensure active learning.

Biology requirements

There are six units in Grade 11 and four units in Grade 12, which all students must complete.

Biology requirements

Grade	Weeks	Term	Unit	Essential resources for activities and assessment
11	4–5	1	Living things	Plant and animal specimens, round onions, models of plant and animal cells, microscopes, charts, posters
11	8–10	1–2	Nutrition	Food test solutions, food samples, human torso, dissection kit, stains and dyes, charts and posters, microscope, alcohol, model of leaf structure, media articles
11	6–8	2	Transport systems	Eosin dye, microscope, slides, tadpoles, mammalian heart, human torso, food colouring, pok choy
11	4–6	2–3	Respiration and Gas Exchange	Models of organisms, mammalian lungs, fish gills, model of leaf structure
11	6–8	3–4	Response to Stimuli	Hormones (auxin, florigen, rootagen), live plant specimens, human torso, charts and posters
11	6–8	4	Reproduction	Charts, posters, a small mammal, models, HCl, flower, cuttings of plants, seeds. Hospital data, internet, library books
12	8–10	1	Ecology	Soil testing kit, water quality testing kit, soil samples, visking tubing (dialysis tubing), posters, flow charts
12	4–6	2	Population	Quadrats, animal and plants population species
12	8–10	2–3	Genetics	Models, charts, plant tissues (carrots or others)
12	6–8	3–4	Evolution	Fossils, styrofoam, cardboard, modelling clay, paint, wire, glue, plasticene

Assessing Biology

Assessment measures students' achievement of the learning outcomes described in the syllabus. Assessment is an integral part of learning and teaching. It is used to:

- evaluate and improve learning and teaching
- report achievement
- provide feedback to students on their progress
- provide feedback to stakeholders.

Criterion-referenced assessment

Assessment in Biology is criterion-referenced. In criterion-referenced assessment, particular knowledge, skills or abilities are specified as criteria which must be achieved.

Criterion-referenced assessment often takes on a problem-centred orientation, rather than a knowledge-based orientation. Assessment is more than just a means of judging knowledge and performance-it becomes an integral part of the learning process itself. Criterion-referenced assessment is:

- standards or criterion-referenced; outcomes are judged against pre-defined standards (see table below)
- direct and authentic, related directly to the learning situation. This has the potential for motivating learning, since students can see a direct relevance between what is learnt and what is assessed.

Norm-referenced assessment

'Norm-referenced' assessment makes judgments on how well the student did in relation to others who took the test. It is often used in conjunction with a curve of 'normal distribution', which assumes that a few will do exceptionally well and a few will do badly and the majority will peak in the middle, normally judged as average.

Example of a criterion-referenced test

The driving test is the classic example of a criterion-referenced test. The examiner has a list of criteria, each of which must be satisfactorily demonstrated in order to pass; for example, completing a three-point turn without hitting either kerb. The important thing is that failure in one criterion cannot be compensated for by above-average performance in others; nor can a student fail in spite of meeting every criterion (as they can in norm-referenced assessment) simply because everybody else that day surpassed the criteria and was better than him or her.

Criterion-referenced assessment has the following characteristics:

- a syllabus that describes what students are expected to learn in terms of aims, outcomes and content

- a syllabus that provides a clear sense of the syllabus standards through its aims, outcomes and content
- tasks designed to produce an image of what students have achieved at that point in the learning and teaching process relative to the outcomes
- standards of performance at different levels: the 'performance standards'
- a report that gives marks referenced to predetermined standards
- assessment tasks that refer to syllabus outcomes, content, assessment components and component weightings
- external exams that are based on syllabus outcomes and content. External markers use standards-referenced marking guidelines developed by the Biology examination committee
- assessment that is better integrated with learning and teaching.

See pages 47 and 48 for the learning outcomes performance standards which are criterion referenced and must be used for assessment purposes.

Assessment *for* learning

Assessment *for* learning is often called 'formative assessment'. It is assessment that gathers data and evidence about student learning during the learning process. It enables you to see where students are having problems and to give immediate feedback, which will help your students learn better. It also helps you plan your program to make student learning, and *your* teaching, more effective. Often it is informal—students can mark their own work or their friend's. An example is a quick class quiz to see if students remember the important points of the previous lesson.

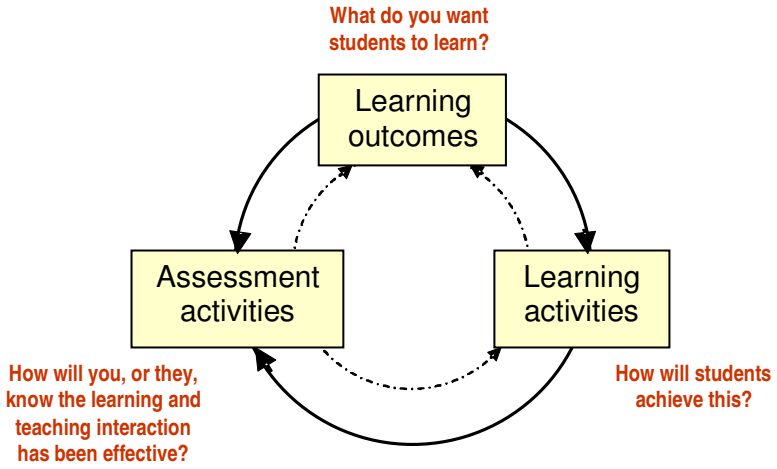
Assessment *of* learning

Assessment of learning is often called 'summative assessment'. It is used to obtain evidence and data that shows how much learning has occurred, usually at the end of the term or unit. End of year examinations are examples of summative assessment. It is usually done for formal recording and reporting purposes.

Assessing Biology units

In Biology the learning outcomes are assessed using the range of assessment methods specified in the syllabus. In deciding what to assess, the first point to start is: 'what do you want to students to do and/or learn?' and, following from this: 'how will the students engage with the material?'. which leads to the design and development of learning tasks and activities. It is crucial that at this point the assessment tasks clearly link back to the learning outcomes and are appropriate for the learning activities. The assessment can be used for formative and summative purposes. Assessment can be represented as follows:

The assessment process



Once it is clear what needs to be assessed and why, then the form the assessment will take needs to be determined. There are many types of assessment tasks that can be implemented; the factors that will determine choices include:

- the number of students - how many are there, what is expected of them, how long will the assessment task take?
- the learning outcomes of the subject and how they might be best achieved

During the year you must set assessment tasks, which ensure that all the learning outcomes of the subject have been assessed internally. Each task you set must include assessment criteria that provide clear guidelines to students as to how, and to what extent, the achievement of the learning outcomes may be demonstrated.

Marking guides and assessment criteria help you with the marking process and ensure that your assessment is consistent across classes. It is important that marking guides and assessment criteria are collectively developed.

Students must complete the assessment tasks set. Each task must provide clear guidelines to students for how the task will be completed and how the criteria will be applied.

When you set a task make sure that:

- the requirements of the task are made as clear as possible to the student
- the assessment criteria and performance standards or marking guides are provided to the student so that they know what it is that they have to do
- any sources or stimulus material used are clear and appropriate to the task
- instructions are clear and concise
- the language level is appropriate for the grade
- it does not contain gender, cultural or any other bias
- materials and equipment needed are available to students
- adequate time is allowed for completion of the task.

Assessment methods

Although assessment methods and weightings are stipulated in the syllabus, you decide which assessment method to use when assessing the learning outcomes. You should use a variety of assessment methods to suit the purpose of the assessment.

Assessment can be classified into four categories:

- tests
- product or project assessments – including group projects
- performance assessments – individual practical skills assessment
- process skills assessments.

Because each has limitations, maintaining a balance of assessment methods is very important.

Tests

A 'test' is a formal and structured assessment of student achievement and progress which the teacher administers to the class.

Tests are an important aspect of the learning and teaching process if they are integrated into the regular class routine and not treated merely as a summative strategy. They allow students to monitor their progress and provide valuable information for you in planning further learning and teaching activities.

Tests will assist student learning if they are clearly linked to the outcomes. Evidence has shown that several short tests are more effective for student progress than one long test. It is extremely important that tests are marked and that students are given feedback on their performance.

There are many different types of tests. Tests should be designed to find out what students know and about the development of thinking processes and skills. Open questions provide more detailed information about achievement than a question to which there is only one answer.

Principles of designing classroom tests

Tests allow a wide variety of ways for students to demonstrate what they know and can do. Therefore:

- students need to understand the purpose and value of the test
- the test must assess intended outcomes
- test must only assess what has been taught
- clear directions must be given for each section of the test
- the questions should vary from simple to complex
- marks should be awarded for each section
- the question types (true or false, fill-in-the-blank, multiple-choice, extended response, short answer, matching) should be varied and supported by reasons.

Tests should:

- be easy to read (and have space between questions to facilitate reading and writing)
- reflect an appropriate reading level

- involve a variety of tasks
- make allowance for students with special needs
- give students some choice in the questions they select
- vary the levels of questions to include gathering, processing and applying information
- provide sufficient time for all students to finish.

Product or project assessments

A 'project' can be an assessment task given to an individual student or a group of students on a topic related to the subject. The project results in a 'product' that is assessed. The project may involve both in-class and out-of-class research and development. The project should be primarily a learning experience, not solely an assessment task.

Because a great deal of time and effort goes into producing a quality product from a project assignment task, you should allow class time to work on the project.

A product or project:

- allows the students to formulate their own questions and then try to find answers to them
- provides students with opportunities to use their multiple intelligences to create a product
- allows teachers to assign projects at different levels of difficulty to account for individual learning styles and ability levels
- can be motivating to students
- provides an opportunity for positive interaction and collaboration among peers
- provides an alternative for students who have problems reading and writing
- increases the self-esteem of students who would not get recognition on tests or traditional writing assignments
- allows for students to share their learning and accomplishments with other students, classes, parents, or community members
- can achieve essential learning outcomes through application and transfer.

Assignments

An 'assignment' is an unsupervised piece of work that often combines formative and summative assessment tasks. Assignments form a major component of continuous assessment in which more than one assessment item is completed within the term. Any of the methods of assessment can be set as assignments, although restrictions in format, such as word limits and due dates, are often put on the assessment task to increase their practicality.

Investigations

An 'investigation' involves students in a study of an issue or a problem. Teachers of Biology may guide students through their study of the issue; or individual students, or groups of students, may choose and develop an issue in negotiation with the teacher. The emphasis in this assessment component

is on the student's investigation of the issue in its context by researching, identifying the issues or problems, collecting, analysing and commenting on secondary data and information. Students should be encouraged to consider and explore a variety of perspectives as they develop and state their position on the issue. Students may present the final investigation for assessment in a variety of forms, including one or a combination of the following: a written scientific report, an oral presentation, a website, linked documents, multimedia, a video or audio recording.

Criteria for judging performance

The student's performance in the investigation will be judged by the extent to which the student:

- identifies and describes the issue or problem
- states a hypothesis
- describes and explains the causes and effects
- records and appropriately processes data
- critically analyses processed information and outlines possible steps leading to a solution or recommendation
- acknowledges errors and suggests alternatives.

Portfolios

A 'portfolio' provides evidence for judgements of student achievement in a range of contexts. A portfolio contains a specific collection of student work or evidence. This collection of work should provide a fair, valid and informative picture of the student's accomplishments.

Computer-based tasks

Using computers to administer student assessment can provide flexibility in the time, location or even the questions being answered of students. The most common type of computer-based assessment is based on multiple-choice questions, which can assist teachers to manage large volumes of marking and feedback.

Process skills assessments

This method of assessment component involves assessing students' understanding of concepts based on the practical skills that can be used, the evaluation of work done, and/or the reporting of information. These skills include, for example:

- interpretation skills
- evaluation skills
- reflection skills
- communication skills (for example, writing, speaking, and listening).

Types of assessment tasks

Using different assessment tasks is the way to make sure that students are able to demonstrate the range of their abilities in different contexts. Each category has advantages in assessing different learning outcomes. For

example, a selected response assessment task, such as a series of multiple-choice questions, is able to assess all areas of mastery of knowledge but only some kinds of reasoning.

Assessment ideas for individual students or groups

Tests	Products or projects	Performances	Process skills
Multiple-choice Matching Short answer Extended answer True or false supported with reasons	Assignments Case studies Displays Diagrams Experiment results Graphs, charts, diagrams Journals of investigations Lab reports Functioning Models Photographs Portfolios Posters Product descriptions Projects Questionnaires Research papers Results of surveys Timelines	Cooperative learning group activities Demonstrations Experiments Field trips Interactive reviews Laboratory experiences Practical activities Presentations Surveys	Interviews Investigations Observations Process folios Responses to reading Safety procedures and processes

Feedback

When you assess the task, remember that feedback will help the student understand why he or she received the result and how to do better next time. Feedback should be:

- *constructive*, so that students feel encouraged and motivated to improve
- *timely*, so that students can use it for subsequent learning
- *prompt*, so that students can remember what they did and thought at the time
- *focused on achievement*, not effort. Assess the work, not the student
- *specific to the unit learning outcomes*, so that assessment is clearly linked to learning.

Types of feedback

Feedback can be:

- *informal or indirect*: such as verbal feedback in the classroom to the whole class, or person to person
- *formal or direct*: in writing, such as checklists or written commentary to individual student either in written or verbal form
- *formative*: given during the topic with the purpose of helping the student know how to improve

- *summative*: given at the end of the topic with the purpose of letting the students know what they have achieved.

Who assesses?

Teacher assessment

Assessment is a continuous process. You should:

- always ask questions that are relevant to the outcomes and content
- use frequent formative tests or quizzes
- check understanding of the previous lesson at the beginning of the next lesson, through questions or a short quiz
- constantly mark or check the students' written exercises, class tests, homework activities and so on
- use appropriate assessment methods to assess the tasks.

Frequency of assessment

You should schedule specific assessment tasks to fit in with teaching of the content of each unit that is being assessed. Some assessment tasks might be programmed to be undertaken early in the unit, others at the end of the unit. You should take care not to overload classes with assessment tasks at the end of the term.

Judging student performance

Student achievement is recorded and reported against standards. You must use performance standards or marking guides—examples of which are provided in this teacher guide—when making a decision about the achievement of your students in relation to the learning outcomes. The performance standards describe the level at which the student has to be working to achieve a particular standard or mark.

Students should always have access to a copy of the assessment criteria and the performance standards so that they know what it is they have to know and be able to do to get a good mark in a particular task. The performance standards will help you in your marking and will help your students improve their performance in the future. They are useful when providing feedback to students as they explain what the student needs to do to improve.

Moderation

To make sure that you are interpreting the performance standards correctly when assessing your students, it is important to undertake Biology moderation of student work within your school and with teachers of nearby schools.

To moderate student work, a common assessment task must be used and a marking scheme developed so that all students complete the same task under the same conditions, and all teachers use the same marking scheme. Teachers can then compare (moderate) the students' work and come to a

common understanding of the performance standards and the requirements for a particular mark or level of achievement.

Moderation enables you to be sure that your understanding of the required standards for levels of achievement is similar to the understanding of other teachers and that you are assessing students at the appropriate level.

Self-assessment and peer assessment

Self-assessment and peer assessment help students to understand more about how to learn. Students should be provided with opportunities to assess their own learning (self-assessment) and the learning of others (peer assessment) according to set criteria.

Self-assessment and peer assessment:

- continue the learning cycle by making assessment part of learning
- show students their strengths and areas where they need to improve
- engage students actively in the assessment process
- enable students to be responsible for the learning
- help to build self-esteem though a realistic view of their abilities
- help students understand the assessment criteria and performance standards.

Managing assessment tasks for Biology

Usually, the marking of assessment tasks is done by the teacher.

To reduce the amount of work it is necessary to develop a strategic approach to assessment and develop efficiencies in marking.

In Biology there are a number of assessment tasks that may be new to teachers and students. Below are suggestions on how to manage some of these tasks to minimise marking or presentation time.

Develop efficiency in marking

Clarify assessment criteria:

Plan the assessment task carefully, and ensure that all students are informed of the criteria before they begin. Discuss the task and its criteria in class, giving examples of what is required. Distribute a written copy of the instructions and the criteria, or put them on the board. Making the assessment criteria explicit speeds marking and simplifies feedback.

Supply guidelines on what is required for the task

This reduces the time wasted evaluating student work that is irrelevant.

Use attachment sheets such as marking guides

An assignment attachment sheet, which is returned with the assessed work, rates aspects of the task with a brief comment. Such a system enables each student's work to be marked systematically and quickly. This strategy can be applied to posters, presentations and performances.

Assess in class

Use class time to carry out and to assess tasks. Presentations or projects, marked by you or the students, enable instant developmental evaluation and feedback. Brief assessments of projects, stages of the design process, or practical work take less time to mark and are useful because they give immediate feedback to students on their progress and allow you to mark the project in stages with minimum effort.

Feedback to the whole class

Feedback to the whole class can cut down on the amount of individual feedback required. On returning assessed work, emphasise the criteria for judging the work, discuss the characteristics of good and bad answers, and highlight common strengths and weaknesses.

Set group-work alternatives

Assess one presentation per group. The student's mark is the group mark, but may include a component based on the individual's contribution. A strategy for allocating an individual mark includes each member of the group using criteria to evaluate the relative contributions of individuals, with the marks averaged for the individual.

Set clear deadlines

Set aside a time for marking. Be careful about extending this period (by allowing students to hand in work late).

Shift the responsibility

Introduce self-assessment and peer assessment

Develop in students the skills to evaluate their own work and that of their peers. With the students, use the assessment criteria against which work is judged, highlighting strengths and weaknesses. Self-assessment increases the amount of feedback students get. It can supplement or replace teacher assessment.

Treat each task differently

Every piece of work need not be evaluated to the same degree; a mark need not be the outcome in every case; and not every piece of student work needs to contribute to the final grade. Assessment is designed to enhance the learning and teaching experience for the teacher and the learner, not just to give marks.

Sample assessment tasks

All assessment tasks must test whether or not the student has achieved the outcome or outcomes. Each task must have clear and detailed instructions. Students must know exactly what they have to do.

You should develop marking guides when you are marking tasks to ensure consistency of your assessment.

The following are examples of assessment tasks and a marking guide.

Grade 11

Sample task: Research report

- Students research a biology topic and present a report.

Learning outcomes

(select appropriate learning outcomes for the specified task)

Students can:

1. demonstrate understanding of fundamental principles and models of biology
2. investigate and explain plant and animal physiology
3. describe and explain interactions between organisms and their environment
4. analyse and interpret data, graphics and other forms of information
5. undertake investigations using scientific methodologies to solve biological problems
6. communicate biological investigations and findings in various ways using biological terms and conventions
7. analyse and evaluate past and present biology-related developments and their impacts on human beings and environment and be able to make informed and ethical decisions
8. evaluate traditional biological knowledge and practices and their relevance today.

Assessment criteria

Students will be assessed on the extent to which they can:

- demonstrate an understanding of the topic being investigated
- research and collate information
- analyse and evaluate information collected
- tabulate, compute and record information using charts, graphs and illustrations
- communicate the findings using appropriate scientific terminology through written and oral presentations.

Grade 12

Sample task: Field trip and report

- Students undertake a field trip and present a scientific report.

Learning outcomes

(select appropriate learning outcomes for the specified field trip)

Students can:

1. demonstrate understanding of fundamental principles and models of biology
2. investigate and explain plant and animal physiology
3. describe and explain interactions between organisms and their environment
4. analyse and interpret data, graphics and other forms of information
5. undertake investigations using scientific methodologies to solve biological problems
6. communicate biological investigations and findings in various ways using biological terms and conventions
7. analyse and evaluate past and present biology-related developments and their impacts on human beings and environment and be able to make informed and ethical decisions
8. evaluate traditional biological knowledge and practices and their relevance today.

Assessment criteria

Students will be assessed on the extent to which they can:

- collect and organise information
- identify and describe biotic and abiotic factors of area visited
- analyse the findings and make presentations
- make inferences on human impact of the site.

Marking guides

Marking guides like the one on page 30 can be used to assess the tasks you set.

Learning activities and assessment tasks

Examples of learning activities and assessment tasks for each of the Biology units are provided in the following sections. Some examples are explained in detail.

Grade 11 units

11.1 Living Things

This is an introductory unit and the maximum time requirement is 4–5 weeks. It is recommended that this unit be taught first.

Suggested activities

A range of activities can be used to support students to learn the content of this unit. Some are identified and elaborated below.

- review characteristics *(feed, grow, excrete, sensitivity, reproduce, respire, move, made of cells)* and survival needs *(food, water, shelter)* of living things
- review parts of compound microscopes and prepare wet mounts
- observe cell structures and identify organelles *(mitochondria, nucleus, endoplasmic reticulum, ribosomes, golgi body, vacuole, cell membrane, nuclear membrane, cell wall, chloroplast, nucleolus)*
- research, identify and state functions of different types of cells such as nerve, muscle, skin, brain, reproductive, blood
- carry out experiments to observe plant and animal cells using microscopes and make comparisons
- research traditional biological classification systems and compare with Linnean classification system
- classify unknown organisms into categories *(kingdom, phylum, class, order, family, genus, species)* using simple dichotomous keys

Elaboration of content

The following table gives elaboration of some activities from the list above.

Activity	Elaboration
Characteristics and survival needs of living things	Questions like these could be asked to help students review characteristics and survival needs of living things: • What is Biology? • How do you differentiate between living and non-living things? • What do living things need in order to survive?
Experiments using microscopes to observe plant and animal cells	• Allocate materials to students in groups • Students prepare wet mounts of onion and cheek cells • Make observations: identify cell membrane, nucleus, cytoplasm, and vacuole. Sketch diagrams and discuss differences

Use dichotomous keys to classify unknown organisms	Divide students into groups. Allocate 3–4 unnamed pictures or specimens of organisms. Use simple dichotomous keys developed by teacher to identify kingdom, phylum and class. Students can also research order, family, genus and species for each organism

Suggested assessment task

An experiment on preparing wet mounts of cheek and onion cells and observe under the microscope.

20 marks

Assessment criteria

Students will be assessed on the extent to which they can:

- prepare wet mounts (cheek and onion cells)
- manipulate the microscope
- calculate magnifications and size of specimens
- observe and present
- produce a written laboratory report (introduction, aim, material, method, result, discussion and conclusion).

Marking guide

11.1: Undertake experiment on wet mounts and present laboratory report				**20 marks**
Performance Criteria	**Very High Achievement (18–20 marks)**	**High Achievement (14–17marks)**	**Satisfactory Achievement (10–13 marks)**	**Low Achievement (0–9 marks)**
Appropriate title (2 marks)	Correctly and clearly state the required title (2)	Clearly state the title (1-2)		Inappropriate title (0-1)
Suitable aim (2 marks)	Aims clearly and correctly written (2)	Aims clearly stated (1-2)		Irrelevant aims (0-1)
Logical procedures (6 marks)	Correct procedures followed and equipment used (6)	Procedures followed and appropriate equipment used (4-6)	Procedures and the use of equipment reasonably followed (1-4)	Inconsistent procedures and use of equipment (0-1)
Detailed analysis and explanation (6 marks)	Scientific analysis with detailed explanation and logical presentation (6)	Good analysis and explanation (5)	Fair analysis and explanation (3-4)	Poor analysis with minimum explanation (0-2)
Appropriate conclusion (4 marks)	Scientific and reliable conclusion (4)	Reliable and well written conclusion (3)	Conclusion appropriate (2)	Inappropriate conclusion Lacks scientific understanding (0-1)

11.2 Nutrition

The maximum time requirement for teaching this unit is 8–10 weeks.

Suggested activities

A range of activities can be used to support students to learn the content of this unit. Some are identified and elaborated below.

- investigate leaf adaptations for photosynthesis
- observe leaf structure under a microscope to identify the epidermis, palisade and spongy mesophyll and describe their functions
- carry out experiments to test for photosynthesis
- carry out experiments on food tests (starch, glucose, protein, fat)
- research chemical compositions of various foods i.e. fats, carbohydrates, proteins
- dissect a small mammal and identify the digestive system
- research functions of liver and kidneys and their related diseases

Elaboration of content

The following table gives elaboration of some activities from the list above.

Activity	Elaboration
Carry out experiments to test for photosynthesis	Identify and isolate leaves from selected plants. Follow instructions to carry out the experiments: • observe and record the results • analyse and discuss results • discuss conclusions and recommendations
Dissect small mammal and identify digestive system	Students can work in groups. Each group bring its own animal • students prepare dissecting board and prepare specimen • Students are guided by teacher to carry out dissection of animal • make observations of digestive system and identify the stomach, oesophagus, small and large intestines (caecum), pancreas, gall bladder, liver, kidney • do sketches and presentations of results

Suggested assessment task

Research on functions of liver and kidneys and their related diseases.

Assessment criteria

Students will be assessed on the extent to which they can:

- research and collect information about the functions and diseases of the liver and kidney from library, internet, journals, hospitals, newspapers and so on
- collate and organise information
- present information on posters or written reports.

Marking guide

11.2: Carry out research on functions of liver and kidneys and their related diseases				20 marks
Performance Criteria	**Very High Achievement (18–20 marks)**	**High Achievement (14–17 marks)**	**Satisfactory Achievement (10–13 marks)**	**Low Achievement (0–9 marks)**
Title (2 marks)	Clearly stated (2)	Title stated (1-2)		Inappropriate title (0-1)
Introduction (3 marks)	Clearly outline reasons for this research (3)	Good reasons for this study outlined (2)		Few reasons stated or none(0-2)
Content (10 marks)	Detailed descriptions and illustrations of functions and diseases of kidney and liver (9-10)	Descriptions and some illustrations of functions and diseases of kidneys and livers (6-8)	Fair descriptions of functions and diseases of kidneys and liver (4-5)	Inadequate descriptions of functions and diseases of kidneys and liver (0-4)
Level of presentation (5 marks)	Neat presentation Content and cover page provided Neat legible writing (5)	Neat and presentable Readable writing Content and cover page provided (3-4)	Neatly presented (2-3)	Presentation lacks neatness (0-3)

11.3 Transport Systems

This unit will take 6–8 weeks. It is recommended that this unit be taught as outlined.

Suggested activities

A range of activities can be used to support students to learn the content of this unit. Some are identified and elaborated below.

- carry out experiments on movement of water through the stem of plants (pak choi, celery or similar plants), using eosin dye
- research and describe structures and functions of the vascular bundle (xylem and phloem vessels)
- carry out simple experiments on osmosis, diffusion and transpiration
- observe and record the effects of osmosis on cells using visking or dialysis tubing
- observe blood circulation in the transparent tail of a tadpole
- measure pulses to compute average heart rate
- dissect an animal heart (such as lamb) and observe different chambers, vessels, valves and so on
- research the structure and function of the lymphatic system
- research the diseases of the heart and problems related to the circulatory system

Elaboration of content

The following table gives elaboration of some activities from the list above.

Activity	Elaboration
Observe blood circulation in the transparent tail of a tadpole	Students collect materials in group and set up experiment • Mount specimen on slide and observe under the microscope • Make careful observations on flow of blood in the tadpole's tail and draw illustrations showing direction of blood flow • Discuss movement of blood in tadpoles and its relationship to other circulatory systems
Measure pulses to compute average heart rate	Explain what pulses are and demonstrate how a pulse is taken Have students grouped in pairs. Students then take turns to measure their pulses at intervals after doing variety of activities. • Record the pulse readings and calculate average heart rate of each student • Discuss the importance of heart rates and the implications of circulatory diseases on these

Suggested assessment task

Design and carry out experiments on movement of water through the stems of plants.

Assessment criteria

Students will be assessed on the extent to which they can:

1. design and set-up experiment
2. carry out experiment and make accurate observations
3. record the results and write up laboratory report (lab report should include title, aim, materials, procedures followed, results, discussion and conclusion).

Marking guide

11.3: Design and carry out experiments on movement of water through the stem of a plant				**20 marks**
Performance Criteria	**Very High Achievement (18–20 marks)**	**High Achievement (14–17 marks)**	**Satisfactory Achievement (10–13 marks)**	**Low Achievement (0–9 marks)**
Correct use of equipment and materials (3 marks)	Equipment and materials correctly used (3)	Appropriate use of equipment and materials (1–2)		Inaccurate use of equipment and materials (0–1)
Correct setting up of experiment (3 marks)	Experiment correctly and accurately set up (3)	Experiment correctly set up (2–3)	Experiment fairly set up (1-2)	Experiments unsatisfactorily set up (0-1)
Appropriate title for write up (3 marks)	Title very clearly stated (3)	Title clearly stated (2–3)	Title stated (1–2)	Title not stated or poor (0–1)
Procedures and materials (4 marks)	Correctly described procedures and materials used (4)	Described procedures and materials used (2–3)	Adequate description of procedures and materials (1–2)	Inadequate description (0–2)
Results and discussions (5 marks)	Excellent interpretation of results and discussion (5)	Good interpretation of results and discussions (3–4)	Adequate interpretation (2–3)	Poor interpretation (0–2)
Conclusion (3 marks)	Accurate conclusions made (3)	Good conclusions made (2–3)	Reasonable conclusions (1–2)	Unsatisfactory conclusions (0–1)

11.4 Respiration and Exchange of Gases

This is an 8-10 weeks unit. It is to be taught as recommended.

Suggested activities

A range of activities can be used to support students to learn the content of this unit. Some are identified and elaborated below.

- demonstrate the processes of diffusion and osmosis through experiments
- use different-sized cubes as models of organisms to demonstrate how the surface area to volume ratio affects the rate of diffusion
- observe organs of gas exchange in amoeba, earthworm, grasshopper, a fish, mammal and a green leaf
- describe characteristics of palisade cells in a green leaf
- observe the surface of a smeared leaf to estimate number of stomata on the upper and lower epidermis
- make a simple computation of the number of stomata for a field of view
- describe overall equation for respiration (word and symbol)
- research the function of mitochondria in respiration
- investigate respiration in green plants by comparing and contrasting respiration with photosynthesis
- summarise gas exchange in a leaf over a 24-hour period and explain energy changes involved in respiration and photosynthesis

Elaboration of content

The following table gives elaboration of some activities from the list above.

Activity	Elaboration
Measure surface area to volume ratio using models	Students are provided with a selected range of different sized cubes (1cm, 2cm, 4cm, 6cm,10cm) • calculate the total surface areas and volumes of each cube • compare and discuss results
Carry out experiments to estimate number of stomata on a leaf of selected pant species	Identify leaf from plant species • state hypothesis and aim • follow procedures and observe stomata using microscope • estimate number of stomata on upper and lower epidermis • presentation of experimental results

Suggested assessment task

- Laboratory activities to demonstrate how the surface area to volume ratio affects the rate of diffusion using cubes as models of organisms.

Assessment criteria

Students will be assessed on the extent to which they can:

- use appropriate materials and equipment
- carry out experiment with confidence
- write up a laboratory report showing
  - title
  - aim or hypothesis
  - procedures
  - results or discussion
  - conclusion
  - presentation.

Marking guide

11.4: Conduct laboratory activities to demonstrate how the surface area to volume ratio affects the rate of diffusion				**20marks**
Performance Criteria	**Very High Achievement (18–20 marks)**	**High Achievement (14–17 marks)**	**Satisfactory Achievement (10–13 marks)**	**Low Achievement (0–9 marks)**
Appropriate title and aims (2 marks)	Correctly and clearly state the required title and aims (2)	Clearly state title and aims (2–3)	Title and aims stated (1–2)	Inappropriate title and aims (0–1)
Logic steps and procedures (5 marks)	In sequence, state and follow the required steps and correct use of equipment (5)	Follow the steps correctly and use appropriate equipment (3–5)	Steps and procedures with use of equipment reasonably followed (2–3)	Steps and procedures with use of equipment inconsistently followed (0–2)
Logic steps and procedures (5 marks)	In sequence, state and follow the required steps and correct use of equipment (5)	Follow the steps correctly and use appropriate equipment (3–5)	Steps and procedures with use of equipment reasonably followed (2–3)	Steps and procedures with use of equipment inconsistently followed (0–2)
Detailed analysis and explanation (5 marks)	Scientific analysis with detailed explanation and logical presentation (5)	Sound analysis and explanation (3–5)	Fair analysis and explanation (1–2)	Poor analysis with minimum explanation (0–2)
Appropriate conclusion (3 marks)	Scientific and reliable conclusion to approve or disprove the hypothesis (5)	Reliable and well-written conclusion (3–5)	Conclusion appropriate (1–2)	Inappropriate conclusion Lacks science understanding (0–1)

11.5 Response to Stimuli

This unit is to be taught for 6–8 weeks.

Suggested activities

A range of activities can be used to support students to learn the content of this unit. Some are identified and elaborated below.

- conduct experiments to investigate responses of plants to light, gravity and water stimuli in the environment
- set up controlled experiments to investigate the effect of:
  - thyroxin on the metamorphosis of tadpoles
  - gibberelic acid on the growth of dwarf plants
- conduct simple experiments to show that stimuli are received by receptors and that responses are made by effectors
- research the composition and function of nervous systems
- demonstrate through simple exercises voluntary and involuntary reflexes
- research the composition and function of the endocrine system
- compare the differences between the nervous and endocrine systems

Elaboration of content

The following table gives elaboration of some activities from the list above.

Activity	Elaboration
Carry out experiments to investigate tropism in plants	Students are provided with various materials and equipment. Carry out experiments to investigate plant responses to light, gravity and water • record and analyse the results • compare and discuss results
Research the composition and function of nervous system	Students use the library, internet, magazines and journals to • research composition and function of the nervous system • collate and compile the findings • write up and present the findings

Suggested assessment task

Research on the composition and function of the endocrine system.

Assessment criteria

Students will be assessed on the extent to which they can:

- research the components of the endocrine system and their functions
- compile and collate the findings
- present the findings:
  - topic, introduction, content or discussions, conclusion

Marking guide

11.5: Research the composition and function of the endocrine system				20 marks
Performance Criteria	**Very High Achievement (18–20 marks)**	**High Achievement (14–17 marks)**	**Satisfactory Achievement (10–13 marks)**	**Low Achievement** (0–9 marks)
Appropriate topic (2 marks)	Topic clearly stated (2)	Topic stated (1–2)		Inappropriate topic (0–1)
Suitable introduction (3 marks)	Very clear introduction (3)	Clear introduction (2–3)	Introduction stated (1–2)	Irrelevant introduction (0–1)
Detailed discussion or illustration of components of the endocrine system (5 marks)	Detailed discussion and illustration of components (5)	Appropriate discussion of components (4–5)	Some discussion of components (2–3)	Very little mention or discussion of components (0–2)
Detailed discussion or illustration of functions of the endocrine system (5 marks)	Detailed discussion and illustration of the functions (5)	Appropriate discussion of the functions (4–5)	Some discussion of the functions (2–3)	Very little mention or discussion of functions (0–2)
Appropriate conclusion and recommendations (3 marks)	Very clear conclusion (3)	Clear conclusion (2–3)	Conclusion made(1–2)	Inappropriate conclusion (0–1)
Presentation neat; clearly written (2 marks)	Very neat and clear presentation (2)	Clear presentaion (1–2)	Fair presentation made (1)	Untidy presentation (0)

11.6 Reproduction

This unit is to be taught between six 6–8 weeks.

Suggested activities

A range of activities can be used to support students to learn the content of this unit. Some are identified and elaborated below. These can be adapted and refined to suit different learning needs.

- review main differences between asexual and sexual reproduction in plants and animals
- investigate reproductive system of a flowering plant through flower dissection
- research and present findings on the reproductive systems of various animals and relate structures with functions of each system
- distinguish between primary and secondary sexual characteristics in humans
- identify and describe the site of production and functions of reproductive hormones—follicle stimulating hormones (FSH), luteinising

hormones(LH), testosterone, oestrogen, progesterone—during the development and functioning of human reproductive system
- research and give a brief account of pregnancy and stages of embryonic development until birth in humans
- interpret diagrams and graphs of hormonal control of human female menstrual cycle and recognise any difference should pregnancy occur
- compare and contrast causes, symptoms, transmission and prevention of sexually transmitted infections (STIs)

Elaboration of content

The following table gives elaboration of some activities from the list above.

Activity	Elaboration
Dissection of flowers to identify male and female reproductive system	Each group selects a flower from selected plant species • students use scalpels to dissect flower and identify stamen, pistil, carpels • draw and illustrate separate parts into notebook • discuss findings through group presentations
Examine root tips for evidence of cell division (mitosis)	Remove root tips and place on watch glass with IM HCl acid • put the content of the watch glass into a water bath at 60°C for 2 minutes • select tips with forceps, trim using scalpels onto a clean slide and stain with aceto-orcein (or any relevant stain) • with a glass rod, tap the root until it breaks into small pieces • apply cover slip • place slide on bench and with gentle, even pressure on cover slip, squash with thumb

Suggested assessment task

Research and present statistical data on STIs and HIV and AIDS and its effect on child maternal health.

Assessment criteria

Students will be assessed on the extent to which they can:

- research by using library, internet and hospital records on STIs and HIV AIDS
- collect, analyse and organise information and data on sexually transmitted infections and its effect on child maternal health
- write up and present research report: including tables, graphical data, charts, illustrations.

Marking guide

11.6: Research and present statistical data on STIs and HIV AIDS and its effect on child maternal health.				20 marks
Performance Criteria	**Very High Achievement (18–20 marks)**	**High Achievement (14–17 marks)**	**Satisfactory Achievement (10–13 marks)**	**Low Achievement (0–9 marks)**
Title (2 marks)	Clearly stated (2)	Title stated (1–2)	Title stated (1–2)	Inappropriate title (0–1)
Introduction (3 marks)	Clear and detail introduction (3)	Clear introduction (2–3)	Adequate introduction (1–2)	Inadequate introduction (0–1)
Content information and documentation (7 marks)	Contains very clear and detailed discussions (6-7)	Contains clear discussions (4–5)	Sound discusssions (2–3)	Inadequate discussions (0–1)
Organisation (5 marks)	Very neatly organised (5)	Neatly organised (3–4)	Neat (1–2)	Unorganised (0–1)
Presentation (3 marks)	Very neat, legible with cover (5)	Neat and legible (3–4)	Neatly presented (1–2)	Presentation lacks neatness (0–1)

Grade 12 topics

12.1 Ecology

This unit is to be taught between six 8–10 weeks.

Suggested activities

A range of activities can be used to ensure students learn the expected content knowledge of this unit, such as:

- explore through research the various types of biomes of the world and the biotic and abiotic factors that influence life: tundra, desert, rainforest, wetlands, grasslands
- investigate soil composition, water retention and drainage, pH and porosity of a range of soil types
- observe and investigate aquatic or terrestrial environments in the school area, such as pond, freshwater or seawater, mangrove, wildlife park, forested area, grassland
- investigate plant and animal adaptations in each of the major biomes
- visit old gardens, forested areas, mangrove or any habitat types to observe feeding relationships
- take an excursion to a logged, mined or destroyed area to identify damage caused and its impacts on the environment
- research a traditional environmental management practice and make comparisons with the current practices
- listen to a guest speaker from the Department of Environment and Conservation on sustainable resource management practices in forestry, fisheries or other resource development activities

Elaboration of content

The following table gives elaboration of some activities from the list above.

Activity	Elaboration
Explore through research various biomes of the world and the biotic and abiotic factors that influence life	Through questioning, have students state the major biomes of the world. Then allocate each group one biome type and have them research the following: • geographical distribution of this biome • biotic factors • abiotic factors • common plants and animals found in this biome • how organisms are adapted to surviving in this biome Students then collate and compile all information collected Each group present their findings in a report format
Visit old gardens, forested areas, mangroves or any habitat types to observe feeding relationships	Divide students into their respective groups. Have students visit an old garden site or any other habitat type common in the area • each group should be instructed to identify different plants and animals found in the area and construct a food web showing the feeding relationships in this site • groups present their food web and discuss in class

Suggested assessment task

Undertake an excursion to a logged, mined or destroyed area to identify damage caused and its impacts on the environment.

Assessment criteria

Students will be assessed on the extent to which they can:

- make observations
- complete questionnaires
- record observations
- write a report that shows: title; introduction; body (description of location, discussion of damage and its impact on plants and animals in the area); conclusion (conclusion of findings, recommendations for improvement).

Marking guide

12.1: Undertake excursion to a logged, mined or destroyed area to identify damage caused and its impacts on the environment				**20 marks**
Performance Criteria	**Very High Achievement (18–20 marks)**	**High Achievement (14–17 marks)**	**Satisfactory Achievement (10–13marks)**	**Low Achievement (0–9 marks)**
Appropriate topic (2 marks)	Topic clearly stated (2)	Topic stated (1–2)		Inappropriate topic (0–1)
Suitable introduction and aim (2 marks)	Appropriate introduction and clear aim (2)	Clear introduction and aim stated (1–2)	Stated (1)	Irrelevant (0)
Description of location and purpose (2 marks)	Very clear descriptions of location and purpose (2)	Clear descriptions and purpose (1–2)	Description and purpose stated (1)	Incorrect description and purpose (0–1)
Detailed discussion on environmental destruction and impact on organisms (5 marks)	Detailed discussions about destruction and its impact (5)	Discussions state type of destruction and its impact (3–5)	Some mention of destruction and its impact (1–3)	Very little mention of destruction and its impact (0–2)
Appropriate conclusion and recommendations (3 marks)	Very clear conclusion and recommendations (3)	Clear conclusion and recommendations (2–3)	Conclusion and recommendations made (1–2)	Inappropriate conclusion and recommendations (0–1)
Presentation (3 marks)	Excellent Very neat Well written (3)	Good Neat Appropriately written (2–3)	Neat and fair (1–2)	Untidy (0–1)

12.2 Population

This is a 4–6 weeks unit. It is to be taught as recommended.

Suggested activities

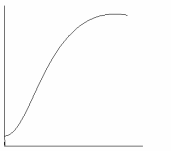
A range of activities can be used to ensure students learn the expected content knowledge of this unit, such as:

- discuss methods of counting organisms using
  - quadrat frame to estimate the percentage cover of plant species
  - capture–recapture technique for sampling animal population
- discuss factors affecting population distribution
  - use transect lines to show population distribution of a particular habitat
- distinguish between the effects of birth, death, immigration and emigration rates on growth rate of a population
- interpret a graph showing exponential growth of population and suggest factors that might limit this growth
- explore predator–prey relationships that show population fluctuations and describe normal regulatory processes
- describe, for a given species, the magnitude of the optimum population that an environment can sustain
- research the relationship between world human population growth rates and Earth's limited resources, with emphasis on Papua New Guinea and the Pacific region

Elaboration of content

The following table gives elaboration of some activities from the list above.

Activity	Elaboration
Do population sampling using capture–recapture method	Select the animal species to be sampled Capture and count animal Mark with paint and release back to the environment Allow 10–20 minutes and then do second sampling by recapturing and counting marked and unmarked animals using the formula below: $\mathbf{N = \frac{n1 \times n2}{n3}}$ where N = total estimated population n1= number in the first sample, n2 = number in the second sample, n3 = number of marked individuals recaptured,

Interpret and analyse exponential graphs	Questions like these could be asked to help students analyse and interpret exponential graphs. • What is population? • What is a population graph?  • How do you read a population graph • Where are the lag, log, and constant phases of the curve? • identify and label these phases

Suggested assessment task

Carry out population sampling using quadrat frame to estimate the percentage cover of plant species.

Assessment criteria

Students will be assessed on the extent to which they can:

1. plan and carry out sampling activity
2. collect data
3. interpret and present findings.

Marking guide

Marking guide for assessment task 12.2: Carry out population sampling using quadrat frame to estimate the percentage cover of plant species				**20 marks**
Criteria	**VHA (18–20)**	**HA (14–17)**	**SA (10–13)**	**LA (0–9)**
Plan and prepare (3 marks)	Excellent planning and preparation (3)	Good planning and preparation (1–2)		Inadequate planning and preparation (0–1)
Conduct experiment (5 marks)	Experiments correctly and confidently carried out (5)	Experiments correctly carried out (3–4)	Experiments carried out (2–3)	Incorrect experiments (0–2)
Interpretation and analysis of data (6 marks)	Accurate interpretation and analysis of data (6)	Good interpretations and analysis (4–5)	Sound interpretations and analysis (3–4)	Unsatisfactory interpretations and analysis (0–2)
Presentation Title Neat (3 marks)	Title stated correctly and very neat and tidy (3)	Fairly neat and title stated (1–2)	Neat (1–2)	Untidy (0–1)
Conclusion (3 marks)	Very clear and concise review of the topic (3)	Concise review of the topic (2)	Fair review of the topic (1–2)	Inadequate review points raised (0–1)

12.3 Genetics

This is an 8–10 week unit.

Suggested activities

A range of activities can be used to ensure students learn the expected content knowledge of this unit, such as:

- describe and explain the terms 'inheritance', 'genotype', 'phenotype', 'gene', 'genome', 'allele'
- carry out research on Mendelian experiments
- construct models of meiosis and mitosis using plasticine
- demonstrate by means of models that DNA is a double helix structure composed of nucleotide units
- investigate structure of chromosomes during DNA replication
- research and interpret processes of protein synthesis
- conduct an experiment to measure continuous variation in a population; draw and interpret graphs of weight or height
- measure and draw graphical representations of discontinuous variation such as blood type, ear lobes, tongue rolling
- carry out research and experiments with simple tissue culture techniques using carrots or other plant tissues

Elaboration of content

The following table gives elaboration of some activities from the list above.

Activity	Elaboration
Construct models of DNA (double helix structure)	Students can do the following: • research and gather information on the structure of a DNA • gather appropriate materials • construct models • do presentation
Research, design and carry out a simple experiment on tissue culture	Students: • gather materials (small discs of carrot or other plant tissue, an appropriate medium in a test tube) • place experiment in safe place and make observations over a period of 21–28 days • analyse and interpret data • present findings

Suggested assessment task

Measure and draw graphical representations of discontinuous variation such as blood type, ear lobes, tongue rolling.

Assessment criteria

Students will be assessed on the extent to which they can:

- identify types of characteristics to investigate
- carry out investigation on selected population
- record, analyse and interpret results collected
- present and discuss results.

Marking guide

12.3: Measure and draw graphical representations of discontinuous variation such as blood type, ear lobes, tongue rolling				**20 marks**
Performance Criteria	**Very High Achievement (18–20 marks)**	**High Achievement (14–17 marks)**	**Satisfactory Achievement (10–13 marks)**	**Low Achievement (0–9 marks)**
Title (2 marks)	Title clearly stated (2)	Title inappropriately written and not clearly stated (1)		Title not appropriate to content (0)
Introduction (3 marks)	Clearly define variation Clearly explain what investigation is about (3)	Clear explanation of the investigation (2–3)	Sound explanation of the investigation (1–2)	No explanations (0–1)
Description of discontinuous variations (4 marks)	Clearly described discontinuous variations (4)	Descriptions are stated (2–3)	Some descriptions are stated (1–2)	Descriptions not stated (0–1)
Analysis of results (5 marks)	Excellent analysis and interpretation of results (4–5)	Very good analysis and interpretation of results (3–4)	Good analysis and interpretation of results (1–2)	Poor analysis and interpretation of results (0–1)
Conclusion (3 marks)	Clear summary of findings of investigation (3)	Summary of findings of investigation stated (2–3)	Some summarised findings stated (1–2)	Unclear summary of findings (0–1
Presentation (3 marks)	Neat cover page Content page Neat and legible writing with glossary and reference (3)	Only have 3 –4 aspects of presentation mentioned (2–3)	Only have 2–3 aspects of presentation mentioned (1–2)	Only have 0–2 aspects of presentation mentioned (0–1)

12.4 Evolution

This is a 6–8 weeks unit.

Suggested activities

A range of activities can be used to ensure students learn the expected content knowledge of this unit, such as:

- observe, analyse and compare structure of vertebrate forelimbs of frogs, birds, bats, and lizards using specimens
- construct a model of two different vertebrate forelimbs (use colours to identify similar bones in each limb) using Styrofoam, cardboard, modelling clay, paints, wire and glue
- perform an investigation to model natural selection
- research and describe Darwin's theory of evolution by natural selection
- collect, observe and analyse samples of fossilised rocks
- construct fossil imprints using plasticine, clay or plaster

Elaboration of content

The following table gives elaboration of some activities from the list above.

Activity	Elaboration
Investigate forelimbs of various vertebrates	Students can do the following: • research and gather information on the different types of forelimbs • construct models • present findings
Collect, observe and analyse samples of fossilised rocks	Take an excursion to a cave, beach, river side or forested area • collect samples of fossilised rocks or imprints • identify the fossils or imprints and sketch them • discuss and present findings

Suggested assessment task

Construct a model of two different vertebrate forelimbs using Styrofoam, cardboard, modelling clay, paints, wire and glue and discuss similarities and differences.

Assessment criteria

Students will be assessed on the extent to which they can:

- select any two vertebrates (such as bird or frog)
- observe and sketch their forelimbs
- design and construct models using appropriate materials
- research limb modifications and discuss similarities and differences

- present findings.

Marking guide

Marking guide for assessment task 12.4: Construct a model of two different vertebrate forelimbs and discuss similarities and differences.				**20 marks**
Performance Criteria	**Very High Achievement (18–20 marks)**	**High Achievement (14–17 marks)**	**Satisfactory Achievement (10–13 marks)**	**Low Achievement (0–9 marks)**
Sample animal (2 marks)	Animal appropriately identified and chosen for use (2)	Appropriate animal used (1-2)	Animal chosen (1)	Inappropriate animal (0)
Observation and illustrations of identified limbs (4 marks)	Accurate observations and illustrations of limbs (4)	Limbs observed and illustrated (3-4)	Limbs illustrated (2–3)	Inaccurate illustrations (0–2)
Construct models of the design (6 marks)	Excellent model construction of selected animal limbs (6)	Very good models constructed (4-5)	Good models constructed (3-4)	Incomplete models (0–2)
Research limb modifications and discuss similarities and differences (5 marks)	Detail discussions of limb modifications and their similarities and differences (5)	Cear discussions on limb modifications (3-4)	Adequate discussions of limb modifications (2-3)	Poor discussions of limb modifications (0-1)
Presentation (3 marks)	Presentation very confident very neat product (3)	Presentation confident neat product (2)	Fair presentation (1)	Unsatisfactory presentation (0)

Recording and reporting

All schools must meet the requirements for maintaining and submitting student records as specified in the *Grade 12 Assessment, Examination and Certification Handbook.*

Recording and reporting student achievement

When recording and reporting student achievement you must record the achievement of the students in each unit and then, at the end of the year make a final judgement about the overall achievement, or progress towards achievement, of the learning outcomes. To help you do this, descriptions of the levels of achievement of the learning outcomes are provided in the 'Learning outcome performance standards' table.

When reporting to parents, the school will determine the method of recording and reporting. In an outcomes-based system, student results should be reported as levels of achievement rather than marks.

Remember that the final school-based mark will be statistically moderated using the external exam results. The students' overall level of achievement may change.

Levels of achievement

The level of achievement of the learning outcomes is determined by the students' performance in the assessment tasks. Marks are given for each assessment task with a total of 100 marks for each 10-week unit, or 50 marks for each five-week unit. The marks show the student's level of achievement in the unit, and therefore progress towards achievement of the learning outcomes.

There are five levels of achievement:

- Very high achievement
- High achievement
- Satisfactory achievement
- Low achievement
- Below minimum standard.

A very high achievement means, overall, that the student has an extensive knowledge and understanding of the content and can readily apply this knowledge. In addition, the student has achieved a very high level of competence in the processes and skills and can apply these skills to new situations.

A high achievement means, overall, that the student has a thorough knowledge and understanding of the content and a high level of competence in the processes and skills. In addition, the student is able to apply this knowledge and these skills to most situations.

A satisfactory achievement means, overall, that the student has a sound knowledge and understanding of the main areas of content and has achieved an adequate level of competence in the processes and skills.

A low achievement means, overall, that the student has a basic knowledge and some understanding of the content and has achieved a limited or very limited level of competence in the processes and skills.

Below the minimum standard means that the student has provided insufficient evidence to demonstrate achievement of the broad learning outcomes.

Achievement level					
Total marks	**Very High Achievement**	**High Achievement**	**Satisfactory Achievement**	**Low Achievement**	**Below minimum standard**
700	630–700	490–629	350–489	200–349	0–199
600	540–600	420–539	300–419	120–299	0–119
500	450–500	350–449	250–349	100–249	0–99
400	360–400	280–359	200–279	80–199	0–79
300	270–300	210–269	150–209	60–149	0–59
200	180–200	140–179	100–139	40–99	0–39
100	90–100	70–89	50–69	20–49	0–19
60	54–60	42–53	30–41	12–29	0–11
50	45–50	35–44	25–34	10–24	0–9
40	36–40	28–35	20–27	8–19	0–7
20	18–20	14–17	10–13	5–9	0–4

Marks are given according to criterion referenced standards below.

Criterion/standards-referenced assessment

Learning Outcomes Performance Standards					
Learning Outcomes	**Very high achievement**	**High achievement**	**Satisfactory achievement**	**Low achievement**	**Below minimum standard**
1. Demonstrate an understanding of fundamental principles and models of Biology	Demonstrates extensive knowledge and understanding of a wide range of complex scientific principles and models of biology	Demonstrates sound knowledge and understanding of a range of scientific principles and models of biology	Demonstrates knowledge and understanding of some scientific principles and models of biology	Demonstrates some knowledge of scientific principles and models of biology	Demonstrates limited knowledge of scientific principles or models of biology
2. Investigate and explain plant and animal physiology	Independently investigates in detail a wide range of plant and animal physiology and clearly and logically explains complex findings using relevant and appropriate examples	Independently investigates a range of plant and animal physiology and clearly explains findings using appropriate examples	Investigates plant and animal physiology and explains findings using examples	Investigates with assistance plant and animal physiology and describes some findings	Investigates with a great deal of assistance plant and animal physiology and describes some findings poorly
3. Describe and explain interactions between organisms and their environment	Identifies and describes in detail and gives comprehensive logical explanations of various interactions between organisms and their environment	Identifies and describes in detail and gives good explanations of interactions between organisms and their environment	Identifies, describes and explains interactions between organisms and their environment	Describes interactions between organisms and their environment	States incorrectly interactions between organisms and their environment
4. Analyse and interpret data, graphics and other forms of information	Independently and proficiently analyses and interprets a wide range of complex data, graphics and other forms of information	Proficiently analyses and interprets a range of data, graphics and other forms of information	Analyses and interprets data, graphics and other forms of information	Interprets some data, graphics and other forms of information with assistance	Interprets some simple data, with assistance

Learning Outcomes	Very high achievement	High achievement	Satisfactory achievement	Low achievement	Below minimum standard
5. Undertake investigations using scientific methodologies to solve biological problems	Independently designs and undertakes investigations by selecting and proficiently applying a wide range of innovative scientific methodologies to solve complex biological problems	Designs and undertakes investigations by selecting and proficiently applying a range of scientific methodologies to solve biological problems	Conducts investigations by applying scientific methodologies to solve biological problems	Conducts investigations with some help and assistance to Solve biological problems	Conducts very simple investigations with assistance
6. Communicate biological investigation and findings in various ways using biological terms and conventions	Communicates complex biological investigations and findings succinctly and logically in a variety of ways using correct and appropriate biological terms and conventions	Communicates biological investigations and findings clearly in a variety of ways using correct biological terms and conventions	Communicates biological investigations and findings in several different ways using biological terms and conventions	Provides limited communication of biological findings and information	Provides very limited and inaccurate communication of biological findings and information
7. Analyse and evaluate past and present biology-related developments and their impacts on human beings and environment and be able to make informed and ethical decisions	Gives logical and detailed explanations and reasons for past and present biology-related developments and their impacts on human beings and environment provides extensive evidence of being able to make informed and ethical decisions	Gives logical explanations and reasons for factors influencing past and present biology-related developments and their impacts on human beings and environment provides evidence of being able to make informed and ethical decisions	Gives explanations for factors influencing past and present biology-related developments and their impacts on human beings and environment provides evidence of being able to make informed and ethical decisions	Gives limited explanations for factors influencing past and present biology-related developments and their impacts on human beings and environment and provides some evidence of being able to make informed and ethical decisions	Gives very limited explanations for factors influencing past and present biology-related developments and their impacts on human beings and environment and provides no evidence of being able to make informed and ethical decisions
8. Evaluate traditional biological knowledge and practices and their relevance today	Provides detailed logical explanations and reasons to give excellent evaluation of a wide range of traditional biological knowledge and practices and their relevance today and to the future	Provides detailed explanations and reasons to give good evaluation of a range of traditional biological knowledge and practices andtheir relevance today	Provides explanations and some reasons to evaluate traditional biological knowledge and practices and their relevance today	Provides limited evaluation of traditional biological knowledge and practices and their relevance today	Requires assistance to evaluate simple traditional biological knowledge and practices

Sample format for recording Biology assessment task results over two years

Student name:

Grade 11			
Unit	**Assessment task**	**Marks**	**Student mark**
11.1	Students: • undertake experiment on preparing wet mounts of cheek and onion cells and observe under the microscope • assignment • do a theory test	 20 20 25	These marks would be the adjustment period
11.2	Students: • carry out experiments to test for photosynthesis • carry out research on functions of liver and kidneys and their related diseases • do a theory test Heterotrophic nutrition tests and assignments will contribute to matriculation marks	 20 10 25 (xx/300)	
11.3	Students can • design and carry out experiments on movement of water through the stem of plants • do theory tests • do a practical test	 20 60 20	
11.4	Students can • conduct laboratory activities to demonstrate how the surface area to volume ratio affects the rate of diffusion using cubes as models of organisms • do a practical test • do a theory test	 20 20 30	
11.5	Students can: • undertake research on the composition and function of the endocrine system • carry out experiments to investigate tropism in plants • do a theory test	 20 15 30	
11.6	Students can • research and present statistical data on STIs and HIV and AIDS • do theory test	 20 30	
	Total marks Grade 11	**300**	

Student name:

Grade 12			
Unit	**Assessment task**	**Marks**	**Student mark**
12.1	Students can • undertake excursion to a logged, mined or destructed area to identify damages caused and its impact on the environment • do unit assignments • do unit tests	 20 10 60	
12.2	Students can • carry out population sampling using quadrat frame to estimate the percentage cover of plant species • do unit assignments • do unit tests	 30 10 30	
12.3	Students can • measure and draw graphical representations of discontinuous variation such as blood type, ear lobes, tongue rolling • do unit assignments • do unit tests	 30 10 30	
12.4	Students can • construct a model of two different vertebrate forelimbs using Styrofoam, cardboard, modelling clay, paints, wire and glue • do unit assignments • do unit tests	 20 20 30	
	Total marks Grade 12	**300**	
	Total marks Grade 11 and 12	**600**	

Learning outcomes and levels of achievement

Levels of achievement in Grade 11 and Grade 12 are recorded and reported against the learning outcomes. The performance standards for the levels of achievement are described in the table on pages 47 and 48.

Steps for awarding final student level of achievement

1. Assess unit tasks using unit performance standards and assessment criteria.
2. Record results for each task in each unit.
3. Add marks to achieve a unit result and term result.
4. Add term marks to get a year result.
5. Determine the overall achievement using the achievement level grid.
6. Report results using the broad learning outcome performance standards.

Using the learning outcomes performance standards descriptors

Name	**Gillian Santo**
Subject	**Biology**
School-based assesment	**High achievement**

This assessment means that Gillian:

Demonstrates sound knowledge and understanding of a range of scientific principles and models of biology

Independently investigates a range of plant and animal physiology and clearly explains findings using appropriate examples

Identifies and describes in detail and gives good explanations of interactions between organisms and their environment

Proficiently analyses and interprets a range of data, graphics and other forms of information

Designs and undertakes investigations by selecting and proficiently applying a range of scientific methodologies to solve biological problems

Communicates biological investigations and findings clearly in a variety of ways using correct biological terms

Gives logical explanations and reasons for factors influencing past and present biology-related developments and their impacts on human beings and environment provides evidence of being able to make informed and ethical decisions

Provides detailed explanations and reasons to give good evaluation of a range of traditional biological knowledge and practices and their relevance today

Resources

Biology becomes more interesting and meaningful when you use a variety of resources and local materials in your teaching.

You should be always trying to adapt, improvise, make, find or write material that will be useful for lessons. Biology can be taught without expensive equipment by making use of what is around you, though there is some equipment and materials that are essential to teach the Biology syllabus.

Materials and equipment for Biology

- variety of scientific equipment such as test tube, beaker, Bunsen burner, test tube rack, microscopes, slides
- strings or ropes
- natural objects such as plants, leaves, flowers, animals

Types of resources for Biology

Materials

- textbooks, reference books including old syllabuses and resource books for Grade 11 and 12
- magazines
- diagrams, charts, posters
- worksheets, information sheets
- pamphlets, brochures
- television and radio broadcasts
- video, film, film strips
- computer software
- pictures, photographs
- models
- newspapers
- made or found objects

Natural and human resources

- natural environment sites: rivers, beaches, rock pools, forests, cliffs, caves
- community elders
- teachers
- parents
- scientists
- health workers

Contacts and list of additional resources/personnel

The following organizations whose addresses appear below could be contacted for assistance to help with posters, brochures or information:

1. Research & Conservation Foundation
   P.O Box 1261, Goroka EHP
   Tel: 732 3211 Fax: 732 1123

2. The Nature Conservancy
   P.O Box 2750
   Boroko, NCD
   Tel: 323 0699 Fax: 323 0397

   P.O Box 217
   Madang, Madang Province
   Tel: 852 2366 Fax: 852 3518

3. World Wide Fund for Nature
   P.O Box 158
   Diwai, Madang Province
   Tel: 852 1763 Fax: 852 2291

4. Conservation International
   P.O Box 106
   Waigani, NCD
   Tel: 323 1532 Fax: 325 4234

   P.O Box 176
   Alotau, Milne Bay Province
   Tel: 641 0349

5. Mahonia Na Dari
   P.O Box 697
   Kimbe, West New Britain Province
   Tel: 983 4783

6. Live and Learn Environmental Education
   P.O Box 844
   Kimbe, West New Britain Province
   Tel/Fax: 983 4237

7. Regional and Provincial Forestry Offices
8. Regional Fisheries Offices
9. Regional and Provincial Department of Primary Industry offices
10. Cocoa and Coconut Institute
11. National Agricultural Research Institute
12. University of Vudal
13. University of Papua New Guinea, Port Moresby
14. University of Technology, Lae
15. Department of Environment and Conservation
16. Department of Health
17. National and Provincial AIDS Council

General guidelines for selecting and using resources

The effectiveness of the resource very much depends on whether it is suitable for the knowledge or skill to be learned and the attitude of the students. Classroom organisation is the key to using resources successfully. You need to:

- Prepare thoroughly. Make sure that you are familiar with the resource so that you use it with confidence and assurance. If equipment is involved, check that it is in working order, make sure that you know how to operate it and that it is available when required.
- Use the resource at the right place and time in the lesson. The resource should fit in with the flow and sequence of the lesson. It should serve a definite teaching purpose.

Should the resource be radio, film, video or television, introduce the program by outlining the content. You might also set some questions to guide listening or viewing. Follow up after using the resource by discussing and drawing appropriate conclusions.

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Glossary for Biology

Abiotic	Non-living
Absorption	Movement of dissolved substances such as digested food and oxygen across a cell membrane to its interior
Active site	Part of an enzyme molecule that binds with a specific substance
Active transport	Movement of dissolved substance across a cell membrane in an energy requiring process that results in a net movement of that substance against a concentration gradient from a region of lower concentration to a region of higher concentration
AIDS	Acquired Immune Deficiency Syndrome: disease caused by the Human Immunodeficiency Virus (HIV) that results in significant damage to the immune system, making the infected person particularly susceptible to infectious diseases
Aerobic	Requiring oxygen
Allele	The different of a particular gene
Amnion	In mammals, fluid-filled sac enclosing the embryo, later a foetus
Anaerobic	Not requiring oxygen; environment where oxygen is not present
Anti-codon	Sequence of three bases in a transfer RNA molecule that can pair with complementary codon of a messenger RNA molecule
ATP	Adenosine triphosphate: compound containing adenosine and three molecules of phosphate, the major supplies of energy which are produced in the mitochondria; common source of chemical energy
Autosome	Refers to any one of a pair of homologous chromosomes that are identical in appearance on males and females of a species
Autotroph	Describes a group of organisms that, given a source of energy, can produce its own food from simple inorganic substances; also known as a producer
Auxins	Group of plant hormones that control cell elongation
Biodegradable	Able to be rotted by living organisms, especially bacteria
Biodiversity	Total variety of living things on Earth and the ecosystems in which they live
Biological control	The use of one kind of organism that is a predator or parasite in the reduction or elimination of the population of a second species
Biomass	Total mass of organic matter present in all living things in a given space within an ecosystem
Biome	A major subdivision of the land surface of Earth, identified in terms of its dominant vegetation, such as tropical rainforest, grasslands
Biotic	Living
Carrying capacity	Stabilised size reached by a given population in a given habitat
Chlorofluorocarbons (CFCs)	Used to make products spray out of aerosol cans, to keep air conditioners and refrigerators cool and in the manufacture of foam plastics
Chromatid	One of the strands in a double-stranded chromosome
Chromosomes	Threadlike structures composed of DNA and proteins that become visible only during cell division (mitosis and meiosis)
Clone	To make an exact copy of another living thing

Codons	Sequence of three bases in messenger RNA molecule that contain information for a particular amino acid in a polypeptide chain
Competition	Interactions between individuals of the same and/or different species that use one or more of the same resources in the same ecosystem
Diffusion	Net movement of a substance from an area of higher concentration to an area of lower concentration; the process does not require energy
DNA	Deoxyribonucleic acid
Dominant	Refers to a trait that is expressed in the heterozygous condition with certain allele masking recessive allele
Ecosystem	Biological unit comprising a community living in a discrete region, the non-living surroundings and the interactions occurring within the community
Emulsification	Breakdown of large fat droplets into smaller fat droplets
Endemic	Describes a species that occurs naturally in and is restricted to one particular geographical region
Estuary	Wide area at the mouth of a river, subject to tidal movements
Eutrophication	Accumulation of dissolved mineral nutrients in a body of water, often a lake
Follicle	Structure in an ovary where an egg develops
FSH	Follicle-stimulating hormones: produced by the pituitary gland, which stimulates the growth of ovarian follicles and ripening of an ovum (egg)
Fossils	Remains of organisms that existed long ago
Genes	Information inside a cell about how a plant or animal looks or behaves
Genetic engineers	Scientists who experiment with decoding and making changes to DNA
Genetic modification	Changing or modifying the genes of plants and animals in the laboratory
Graft	To transplant a piece of skin or other organ
Greenhouse gas	A gas that traps heat in the Earth's atmosphere
Habitat	Part of an ecosystem in which an organism lives, feeds and reproduces
Hibernation	State of reduced metabolic activity seen in some mammals living in cold climates
Hydro chlorofluorocarbons (HCFCs)	Hydrochlorofluorocarbons (hcfcs) can be used for many of the same purposes as cfcs
Hypertonic	Refers to a solution having a higher concentration of dissolved substances than the solution to which it is compared
Inherited	Received genetic characteristics from parents
Immunity	Reaction that occurs in a person in response to an infection
IVF	In-vitro fertilisation: techniques in which eggs collected from an ovary are fertilised outside the body, incubated for a time and later transferred to the uterus for the development
Keratin	A fibrous protein of which hair, horns and feathers are made
Locus	Position of a gene on a chromosome

Luteinising hormone	Pituitary hormone that causes a follicle to rupture and then become the corpus luteum
Meiosis	Process of cell division that results in the production of new gametes containing half the number of chromosomes
Metabolism	Total of all chemical reactions occurring in a living thing
Mitosis	Cell division taking place in all somatic cells that results in growth
Mutation	A spontaneous change in the genetic material (DNA)
Niche	Way of life of organisms in an ecosystem; role of species
Nocturnal	Animals that become active at night, by night
Organelle	Structure present in a cell, which has a specific function; such as mitochondrion, chloroplasts
Organic matter	Matter that has come from living things
Osmosis	Net movement of water across a partially permeable membrane without an input of energy and down a concentration gradient
Ovulation	Release of an egg or ovum from the ovary
Ovum	Female gamete or egg
Ozone-depleting substances	Artificial chemicals that reduce the amount of ozone in the stratosphere
Pituitary gland	Endocrine gland attached to the hypothalamus, sometimes referred to as the 'master gland'
Population	Members of one species living in one region
PLWHIV AIDS	People living with HIV and AIDS
Pesticides	Poisons that kill pests
Recessive	Refers to a trait that is not expressed but remains hidden in a heterozygous organism
Renewable resources	Energy resources that are constantly replenished; for example, wind and sunlight
Ribosomes	Organelle containing RNA that are major sites of protein synthesis
Salinity	Refers to the amount of salt concentration
Somatic cells	Refers to cells of the body other than gametes
Speciation	Process of forming a new species
Sustainable	Using resources such as water and forests carefully so they will continue to be healthy in the future
Sustainable energy	Sustainable energy is the production or use of energy in a manner that meets current energy needs without compromising the ability of future generations to meet their economic, social and environmental needs
Taxon	Any taxonomic group; for example, class, family, genus
Tropism	Directional growth response of a plant to an environmental stimulus
Variation	In a population, a condition in which members of that population differ in one or more traits
Water balance	Balance of water in the body, which must be maintained
Xylem	Vascular tissue that transports water and minerals throughout a plant and which provides a plant with support
Zygote	Fertilised egg that results from the fusion of haploid male and female gametes

Glossary for assessment

Syllabus outcomes, criteria and performance standards, and examination questions have key words that state what students are expected to be able to do. A glossary of key words has been developed to help provide a common language and consistent meaning in the syllabus and teacher guide documents. Using the glossary will help teachers and students understand what is expected in responses to examinations and assessment tasks.

Account	Account for: state reasons for, report on. Give an account of: narrate a series of events or transactions
Analyse	Identify components and the relationship between them; draw out and relate implications
Apply	Use, utilise, employ in a particular situation
Appreciate	Make a judgment about the value of
Assess	Make a judgment of value, quality, outcomes, results or size
Calculate	Ascertain or determine from given facts, figures or information
Clarify	Make clear or plain
Classify	Arrange or include in classes or categories
Compare	Show how things are similar or different
Construct	Make; build; put together items or arguments
Contrast	Show how things are different or opposite
Critically (analyse or evaluate)	Add a degree or level of accuracy, depth, knowledge and understanding, logic, questioning, reflection and quality to (analysis or evaluation)
Deduce	Draw conclusions
Define	State meaning and identify essential qualities
Demonstrate	Show by example
Describe	Provide characteristics and features
Discuss	Identify issues and provide points for and/or against
Distinguish	Recognise or note or indicate as being distinct or different from; to note differences between
Evaluate	Make a judgement based on criteria; determine the value of
Examine	Inquire into
Explain	Relate cause and effect; make the relationships between things evident; provide why and/or how
Extract	Choose relevant and/or appropriate details
Extrapolate	Infer from what is known
Identify	Recognise and name
Interpret	Draw meaning from
Investigate	Plan, inquire into and draw conclusions about

Justify	Support an argument or conclusion
Outline	Sketch in general terms; indicate the main features of
Predict	Suggest what may happen based on available information
Propose	Put forward (for example, a point of view, idea, argument, suggestion) for consideration or action
Recall	Present remembered ideas, facts or experiences
Recommend	Provide reasons in favour
Recount	Retell a series of events
Summarise	Express, concisely, the relevant details
Synthesise	Putting together various elements to make a whole