

SOUTH PACIFIC BOARD FOR EDUCATIONAL ASSESSMENT



Pacific Senior Secondary Certificate

BIOLOGY

Prescription

Form 6

Effective from January 2009

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PACIFIC SENIOR SECONDARY CERTIFICATE

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BIOLOGY PRESCRIPTION

Effective from January 2009

RATIONALE

Biology is the study of science that deals with the diversity of living things and associated biological concepts. It also considers the inter-relationship and inter-dependence between organisms within the biosphere. It explores the processes that occur in organisms at a cellular level, to how these organisms are adapted to survive within their environment.

The study of Biology provides the opportunity for students to appreciate the relationship between structure and function within a variety of living things, and the interactions of organisms with each other and the environment. The impact of human activities requires an increased understanding, care for, and awareness of the biological world to encourage informed discussions and decisions.

Practical work allows for the development of manipulative skills in working with biological equipment. Study in biology also prepares students to be competent in applying the principles and processes of the scientific method to practical investigations, and to apply critical thinking and make informed decisions.

It is hoped that students will develop an appreciation and understanding of the amazing diversity of life in the South Pacific and beyond, and the role they can play as guardians of the environment. Furthermore, students would be motivated to undertake further studies and become successful in their respective fields of interest in science.

GENERAL AIMS

This prescription is designed to promote interest in and appreciation of Biology by encouraging involvement in the scientific process of inquiry into the living world as well as developing an attitude of curiosity and open-mindedness. The skills and knowledge gained can provide a foundation for further study, leading to a career in Biology or related areas.

The aims of studying this subject are to develop:

- understanding of some of the key concepts of Biology;
- appreciation of the role of scientific method in the accumulation of knowledge about Biology;
- an ability to communicate information and ideas using the language of Biology;
- manipulative and observational skills through practical activities;
- the ability to solve problems, using the knowledge and ideas of Biology;
- the ability to obtain information about Biology, using a variety of resources;
- an appreciation of the relevance of Biology for informed decision making, and a concern for the South Pacific environment;
- an awareness of the social implications of biological knowledge and technological advances in Biology.

COURSE OBJECTIVES

Knowledge of Biology is acquired through a variety of activities and experiences.

Students should be able to:

1. undertake biological practical activities;
2. design and undertake investigations;
3. gather and obtain relevant information from a variety of sources.

Biological knowledge is made more meaningful if students can explore and understand its application in different contexts.

Students should be able to:

4. critically analyse and evaluate information and procedures;
5. use and apply knowledge and understanding of biological concepts;

Individuals should use their scientific knowledge and understanding to be more responsible for themselves, society, and the South Pacific environment, becoming active and confident citizens, and be able to plan their future.

Students should be able to:

6. use knowledge of biology to make informed decisions

Communication is an important process in learning and development. It allows people to create, exchange, clarify, modify, and transmit knowledge, ideas, feelings, attitudes, and values.

Students should be able to:

7. communicate biological information, terms, concepts and ideas effectively in a variety of ways.

SKILLS

Practical work is intended to support conceptual development in each section of the prescription. It also emphasises that the concepts of Biology are developed to explain observed experimental results. The concepts of Biology are based on careful observation and measurement, and the analysis and interpretation of results.

The following experimental, information gathering and processing, and communication skills need to be covered as students engage with this prescription.

1. Experimental Skills

Students should be able to

- (a) make a testable hypothesis (based on observations or in response to a specific question,
- (b) identify the variables in an experiment,
- (c) identify any quantities that are deliberately held constant during an experiment,
- (d) design and carry out an investigation to test a hypothesis,
- (e) follow instructions accurately and safely,
- (f) describe and explain the procedure for a given experiment,
- (g) draw or interpret diagrams of the apparatus used in an experiment,
- (h) interpret and describe a pattern or behaviour observed in a practical activity,
- (i) use equipment to make quantitative measurements with an appropriate degree of precision
- (j) identify sources of errors in an experiment,
- (k) record and present data in tabular form with appropriate column headings, including symbols and units,
- (l) plot a graph of a dependent variable versus an independent variable, with appropriate scales and units. (When graphs are plotted, dependent variables are generally plotted vertically and independent variables horizontally.),
- (m) draw a line or curve of best fit through a series of points on the graph,
- (n) replication in an experiment is necessary to reduce the effect of variation,
- (o) interpret data generated from an experiment to draw conclusions relevant to the purpose of the experiment,
- (p) evaluate an experiment for strengths and weaknesses, and suggest improvements.

2. Information Gathering and Processing Skills

A vast amount of information is accessible on any topic in Biology, and a wide variety of means are available for obtaining this information. It is therefore important to learn and practise the techniques for obtaining and evaluating information.

- (a) state the key ideas relevant to the information required when given a topic,
- (b) identify key search words and phrases for a given topic,
- (c) identify and use an information source (library, text, newspaper, CD-ROM, Internet, etc.) to obtain information about a topic,
- (d) evaluate for accuracy and suitability of the information obtained from a source,
- (e) list the sources of the information in a conventional format that enables source documents to be accessed.

3. Communication Skills

It is an important aspect of scientific research that the methods and results are open to scrutiny. This mainly requires the clear and accurate communication of the details of the research to other people.

Students should be able to

- (a) make well-structured, well-organised, and clear oral presentations by talking logically and scientifically,
- (b) write a practical report on an experiment, describing its purpose, procedure, results, discussion and conclusions,
- (c) process information from a variety of sources and write an extended response on a selected topic.

Revised Version

Summary of changes

Based on feedback from the 2008 survey of teachers, and feedback from the country representatives involved in the review process, changes have been made to the PSSC Biology prescription effective in 2009. General feedback indicated a reduction in content and a reduction in assessment.

Topic Changes:

The Topics have been reviewed, resulting in changes to the names of two topics, and changes in the objectives within each topic. The total number of objectives has been reduced, and objectives have been realigned to improve course coherence.

The wording of objectives has been clarified, and the requirements for students more clearly defined. Note that for many objectives students are required to do more than just recall information.

Assessment Changes

There have been changes made to the external examination and the internal assessments.

- External examination: the number of multichoice items has been reduced to 20, and the extended response items have been reduced from 3 to 2 (20 marks).
- Internal assessment: the total number of assessments has been reduced: minimum number of Practical Reports has been reduced to eight and the number of Other Tasks reduced to two.
- The extended investigation is to be assessed as an Environmental Investigation.
- The assessment criteria have been revised, clarifying the requirements of students for each level of performance. The same criteria are also to be used for the Practical Reports and the Extended Investigation.

Advisory Section

This has been expanded to include a list of teacher and student resources.

TOPICS

Students should understand that Biology can be studied at different levels of organisation, and be able to give examples of this organisation at the whole organism, body system, organ, tissue, cell, and cell organelle levels.

Cellular Biology ***4-6 weeks***

This topic explores processes that occur within the cell, and cell structures:

- Enzymes
- Photosynthesis
- Respiration
- Transport processes
- Cell structures

Genetics ***3-5 weeks***

This topic explores the genetic control of variation and inheritance in organisms:

- Molecular genetics
- Cell growth and division
- Mendelian genetics
- Applications of genetics

Organism Level Biology ***8-10 weeks***

This topic explores the structure and functions related to a selection of life processes in plants and animals:

- Plant Transport
- Plant life cycles – alternation of generations
- Human nutrition
- Animal digestion
- Gas exchange (plants)
- Animal circulatory systems
- Excretion in animals
- Reproduction in mammals

Environmental Biology ***4-6 weeks***

This topic explores the diversity of life, the interdependence between members of the same species and between different species, and within an ecosystem:

- Diversity of organisms
- Adaptive features
- Populations
- Communities
- Ecosystems

I. CELLULAR BIOLOGY	
Topic	Outcomes
From the study of cellular biology students should gain an understanding of the processes that occur at the cellular level that sustain life for the organism.	
1. Enzymes	<p>Students should be able to</p> <ol style="list-style-type: none"> describe the purpose and function of enzymes as biological catalysts, explain how enzymes function using the induced-fit model, explain how pH, temperature, surface area, and concentration affect the rates of enzyme-controlled reactions, with reference to optimum conditions, enzyme specificity and denaturing, carry out an experiment to find out how a selected factor affects the rate of an enzyme-controlled reaction.
2. Photosynthesis	<p>Students should be able to</p> <ol style="list-style-type: none"> describe the role of photosynthesis in the conversion of light energy to chemical energy, write a balanced chemical equation for photosynthesis, identify and describe where each of the light and dark reactions occur in the chloroplast, explain why photosynthesis occurs in two phases – the light and dark phases.
3. Respiration	<p>Students should be able to</p> <ol style="list-style-type: none"> describe the role of respiration in the production of ATP in the cell, write a balanced equation for aerobic respiration of glucose, identify and describe where each stage of the reactions of respiration occur (cristae, matrix, cytoplasm), explain why respiration occurs in three phases – glycolysis, Krebs cycle (citric acid cycle), respiratory chain (electron transport chain/electron transport system) [specific details of the processes are not required], explain the importance of oxygen to respiration inside the mitochondrion, compare the products of aerobic and anaerobic respiration in animal cells, explain an application of anaerobic respiration (bread making, beer brewing).

I. CELLULAR BIOLOGY	
Topic	Outcomes
4. Transport Processes	<p>Students should be able to</p> <ul style="list-style-type: none"> a) compare the processes of diffusion, facilitated diffusion, osmosis and active transport, in terms of the molecules transported, concentration gradient and energy requirements, b) relate transport processes to specific situations eg gas exchange, kidney function, guard cells, phagocytosis, c) observe and describe the effect of osmosis on plant and animal cells, and explain this in relation to solute concentration (hypotonic, isotonic, and hypertonic), d) explain how cell size (surface area to volume ratio) affects the rate of diffusion.
5. Cell Structure	<p>Students should be able to</p> <ul style="list-style-type: none"> a) identify and describe the functions of the following cell organelles: nucleus, mitochondrion, chloroplast, ribosome, Golgi apparatus, vacuole, cell membrane, cell wall, lysosome, rough and smooth endoplasmic reticulum, and centrioles, b) observe and distinguish between the structural components of plant and animal cells, c) set up and use a light microscope (low and high power) to observe plant and animal cells, determine size of a specimen using field of view, and be able to prepare a wet mount of a biological specimen.

II. GENETICS	
Topic	Outcomes
<p>From the study of genetics students should gain an understanding of the genetic code and how it is expressed, and how an understanding of genetics can be applied for human need and demand.</p>	
1. Transport Processes	<p>Students should be able to</p> <ul style="list-style-type: none"> a) describe the structure of DNA and RNA in terms of: sugar, phosphate, nucleotide, strands, bases and base pairing, b) explain the relationship between a gene, protein synthesis and polypeptide chain (protein/enzyme), c) describe the processes of transcription and translation, including an overview (details are not required) of the roles of DNA, messenger RNA, transfer RNA, and ribosomes.

II. GENETICS	
Topic	Outcomes
2. Cell Growth and Division	<p>Students should be able to</p> <ul style="list-style-type: none"> a) describe the relationship between chromosomes, DNA, genes and alleles, b) describe the sequence of events in mitosis and meiosis and relate these to the daughter cells produced (chromosome number, number of daughter cells, variation, function) [names of individual stages are not required], c) explain how crossing over, recombination and independent assortment produce variation in daughter cells, d) discuss the role of mitosis and meiosis in the life cycle of an organism.
3. Mendelian Inheritance	<p>Students should be able to</p> <ul style="list-style-type: none"> a) define and use the terms: phenotype, genotype, dominant and recessive alleles, heterozygous, homozygous, co-dominance and incomplete dominance, multiple alleles b) explain the inheritance of blood types in humans as an example of multiple alleles, c) construct Punnet diagrams and apply them to solve examples of dihybrid cross problems, d) explain how the offspring from a test cross can be used to determine the genotype of an individual.
4. Applications of Genetics	<p>Students should be able to</p> <ul style="list-style-type: none"> a) describe how selective plant and animal breeding can be used to produce offspring with specific characteristics, with reference to specific plants or animals, b) discuss the advantages and disadvantages of using genetic modification to produce organisms and/or substances that meet human need or demand (eg disease resistant plant, livestock, vaccine production, insulin production, environmental clean up).

III. ORGANISM LEVEL BIOLOGY	
Topic	Outcomes
From the study of biology at the organism level students should gain an understanding of how plants and animals carry out a range of processes essential to life, and the structure and function of the associated systems.	
1. Plant Transport	<p>Students should be able to</p> <ol style="list-style-type: none"> explain why plants need special structures to transport materials in and out of the plant, and within the plant, describe the structure, function and arrangement of the vascular tissues (phloem, cambium, xylem) in the stems of monocotyledons and dicotyledons, explain how the structure and function of the root hair are related to its role in transport, investigate and explain how the transpiration rate is influenced by one of the following environmental factors; wind, light, temperature and water availability, explain the role of stomata in gas exchange and how the guard cells regulate the movement of gases, investigate and explain how a selected factor such as light intensity, water availability, temperature may affect the rate of photosynthesis.
2. Plant Life Cycles – Alternation of Generations	<p>Students should be able to</p> <ol style="list-style-type: none"> compare the interdependency of the sporophyte and gametophyte generations in ferns and angiosperms with reference to: <ul style="list-style-type: none"> role of mitosis role of meiosis gametes – haploid (n) / diploid (2n) fertilisation – dependency on water dispersal (spores/seeds), distinguish between sexual and asexual reproduction in plants and discuss the biological advantages and disadvantages of each process.
3. Human Nutrition	<p>Students should be able to</p> <ol style="list-style-type: none"> explain the effect of modern diets on the health of Pacific Islanders, with reference to: fat and sugar content of foods, explain the effect on the normal functioning of the digestive system of: <ul style="list-style-type: none"> low fibre diet (constipation, cancer) gastric ulcers (heartburn, bleeding, cancer) gall stones (bile release), explain the function of the liver in maintaining blood sugar levels and relate this to diabetes.

III. ORGANISM LEVEL BIOLOGY	
Topic	Outcomes
4. Animal Digestion	<p>Students should be able to</p> <ul style="list-style-type: none"> a) describe the principles of ingestion, digestion, absorption, egestion, b) compare how the efficiency of the digestive system of the organism relates to its habitat and way of life. <i>digestive systems</i> are limited to: sac gut (eg sea anemone), tube gut (eg earthworm), complex gut (eg human) <i>way of life</i> includes: diet and mobility, c) conduct a practical investigation related to the digestive system of an animal.
5. Gas Exchange (Animals)	<p>Students should be able to</p> <ul style="list-style-type: none"> a) describe the differences between the processes of breathing (ventilation), gas exchange, and cellular respiration, b) compare how the efficiency of the gas exchange system of the organism relates to its habitat and way of life <i>gas exchange</i> systems are: body surface (eg earthworm), gills (eg fish, crab), trachea (eg cockroach), lung (eg human) <i>way of life</i> includes: size and mobility, c) conduct a practical investigation related to the gas exchange system of an animal.
6. Animal Circulatory Systems	<p>Students should be able to</p> <ul style="list-style-type: none"> a) explain why animals above a certain size require an internal transport system, b) compare how the efficiency of the circulatory system of the organism relates to its size and mobility: open (eg insect) closed - single (eg fish), closed - double (eg human), c) explain how smoking, alcohol and obesity can cause coronary heart disease in humans, d) conduct a practical investigation related to the circulatory system of an animal.
7. Excretion in Animals	<p>Students should be able to</p> <ul style="list-style-type: none"> a) state and explain the process involved in the production of carbon dioxide, water and nitrogenous wastes, b) compare how the efficiency of the excretory system of the organism relates to its environment and nitrogenous waste: ammonia (fish), uric acid (insects) or urea (human), c) relate the cause and effect of kidney stones and gout to normal body functioning.

III. ORGANISM LEVEL BIOLOGY	
Topic	Outcomes
8. Reproduction in Mammals	<p>Students should be able to</p> <ul style="list-style-type: none"> a) explain the roles of oestrogen and progesterone in the human menstrual cycle, b) describe the events that lead to successful implantation of the embryo, c) explain the role of the placenta in maintaining foetal development, in relation to: gas exchange, nutrients, excretion, antibodies, drugs.

IV. ENVIRONMENTAL BIOLOGY	
Topic	Outcomes
<p>From the study of environmental biology students should gain an understanding of the diversity of life, how organisms of the same and different species interact for sustainability of life. Students should be familiar with field work techniques and standard biological data presentation.</p>	
1. Diversity of Organisms	<p>Students should be able to</p> <ul style="list-style-type: none"> a) describe how the diversity of life can be classified into groups as listed below (phyla/division or class) based on similarities, and be able to identify typical examples of each of the following: <ul style="list-style-type: none"> Bacteria Unicellular organisms Coelenterates Annelids Molluscs Arthropods Crustaceans Insects Arachnids Myriapods Echinoderms Chordates Fish Amphibians Reptiles Birds Mammals Algae Fungi Lichens Ferns Gymnosperms Angiosperms monocotyledons dicotyledons b) use a dichotomous key to identify unknown organisms.
2. Adaptive Features	<p>Students should be able to</p> <ul style="list-style-type: none"> a) describe an adaptation as a characteristic that enables an organism to survive better in its habitat, b) classify adaptations as structural, physiological, behavioural or life history and give examples of each in a range of organisms, c) explain how adaptations of organisms relate to: tolerance, Gause's Principle, ecological niche and Leibig's Law.

IV. ENVIRONMENTAL BIOLOGY	
Topic	Outcomes
3. Populations	<p>Students should be able to</p> <ol style="list-style-type: none"> describe the characteristics of a population using examples. Characteristics are: <ul style="list-style-type: none"> size: number, natality, mortality space: territory, home range, distribution, density. explain survivorship curves in relation to natality and mortality, explain the advantage genetic variation has for the survival of a population, explain the effect genetic isolation can have on a population, conduct practical activities to estimate population number and distribution using transects and quadrats.
4. Communities	<p>Students should be able to:</p> <ol style="list-style-type: none"> describe the characteristics of a community using examples: <ul style="list-style-type: none"> species composition patterns – zonation and stratification stability – succession and climax. describe the characteristics and the role of a colonising or pioneer species, explain how competition for living space, food and nutrients affect relationships in a community, describe the following relationships and identify an example for each: <ul style="list-style-type: none"> predation parasitism mutualism commensalism. collect and process field data to show the distribution pattern of species in a community.
5. Ecosystems	<p>Students should be able to:</p> <ol style="list-style-type: none"> describe, using examples, the characteristics of an ecosystem. Characteristics are: <ul style="list-style-type: none"> living (biotic) and non-living (abiotic) food chains and food webs energy flows ecological pyramids (biomass, numbers, energy) nutrient cycling (carbon and nitrogen) explain the relationship between biodiversity and ecosystem survival use a local environmental issue to: <ul style="list-style-type: none"> discuss the implications the issue has for the long-term survival of the ecosystem with reference to specific characteristics of the ecosystem design and carry out an investigation to test an hypothesis about the local environmental issue.

ASSESSMENT

The assessment of this prescription is in two parts (internal and external assessment), and is made up of five assessment components, contributing to the overall grade in the following proportions:

External Assessment (60%)

External Examination	60%
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Internal Assessment (40%)

Assessment Component 1: Practical Reports	20%
Assessment Component 2: Investigative Study	10%
Assessment Component 3: Other Tasks	6%
Assessment Component 4: Practical Test	4%

EXTERNAL ASSESSMENT

External Examination

The 3-hour examination assesses the course objectives as specified below.

The examination structure is as follows:

Multiple-choice objective questions.	20%	40 marks
Short-answer questions (restricted response) covering all the topics.	70%	140 marks
Extended-response questions	10%	20 marks

Note: ALL questions are COMPULSORY. TOTAL 200 marks

The four topics and the skills section of the prescription will be examined in approximately the following weightings:

Topic	Weighting	Objectives
Cellular Biology	20%	1(a)-(c) 2(a)-(d) 3(a)-(g) 4(a)-(d) 5(a) (b)
Genetics	15%	1(a)-(c) 2(a)-(d) 3(a)-(d) 4(a)-(b)
Organism Level Biology	35%	1(a)-(f) 2(a)(b) 3(a)-(c) 4(a)(b) 5(a)(b) 6(a)-(c) 7(a)(b) 8(a)-(c)
Environmental Biology	20%	1(b) 2(a)-(c) 3(a)-(d) 4(a)-(d) 5(a)(b)
Skills	10%	

(Assessment of the Skills will be in questions within all four topics in roughly the same proportion. No detailed Chemistry on Photosynthesis and Respiration in the Molecular Biology Section will be examined.)

INTERNAL ASSESSMENT

Tasks for internal assessment should assess skills and understanding that are not easily assessed in an external examination. Good assessment practice will improve student learning.

The 40% internal assessment portion of the final mark is derived from four assessment components:

TASK	WEIGHT (%)	
	Total Assessment	IA Component
1. Practical Reports	20	50
2. Investigative Study	10	25
3. Other Tasks	6	15
4. Practical Test	4	10
TOTAL	40	100

1. The internal assessment is a continuous process, which should include both formative and summative tasks. This will be weighted as 40% of the total assessment.
2. The major purpose of a PSSC internal assessment programme is to measure subject-related skills and abilities that cannot easily be measured by pencil-and-paper tests, i.e. practical skills, long-term research and investigative skills.
3. Although certain student attitudes and behaviours may be desirable (e.g. co-operativeness, perseverance, politeness, etc.) they should not be included as skills to be assessed when recorded through the marking schemes in the PSSC Internal Assessment programme submitted by any school. Attempts to quantify and report such qualities should be done as a separate school activity.
4. Schools that intend to enrol students in PSSC Biology must submit a completed “**PSSC Internal Assessment Summary Form**” by March 1st in the year of enrolment. These forms will be provided by the SPBEA. Several forms may be necessary to document a school’s Internal Assessment programme. Further information must also be attached to these forms. This information should include details of procedures, the marking of separate teacher-designed tasks, and descriptions of intra-school moderation of internal assessments if a school has more than one class taking PSSC Biology.
5. Clear records and documentation regarding the school’s approved PSSC Internal Assessment programme must be kept. Furthermore, all students’ work that has been assessed under this programme (tests, essays, practical reports, projects, etc.) must be available for verification by SPBEA officers during any one school year.
6. Students who will be enrolled in PSSC Biology must be given a copy of the school’s PSSC Internal Assessment programme for the subject. Each student must also be informed of when assessment tasks are to be given, and be notified of his or her assessment result for each task as soon as it is marked.

7. Schools must submit a mark for each of the four assessment components.

Note : the marks for Practical Activities (50) and Investigative Studies (50) are the marks specified in the marking criteria in this prescription. These marks will be reflected in the Mark Capture Sheet provided by SPBEA for these purposes.

Practical Activities	(out of 50)	[see marking criteria]
Investigative Study	(out of 50)	[see marking criteria]
Other Tasks	(out of 15)	
Practical Test	(out of 10)	

Internal Assessment Component 1: Practical Reports

This assessment component is designed to assess Objectives 1, 2, 4 and 7.

About 15 to 20 hours of the 120 hours of programmed school time should be spent on practical work. A suggested list of appropriate practical activities is included in the Advisory Section.

Students should be taught, and have the opportunity to practise, the skills necessary for them to meet the assessment criteria in formative practical activities. The formative practical activities are essential in developing the skills that will enable students to carry out experiments effectively, using the scientific method.

Students are expected to develop manipulative skills in such areas as microscopy, measurement, heating substances, the use of basic apparatus, and conducting chemical tests. Students are also required to develop investigative skills (planning, gathering, processing, interpreting, reporting) that are part of the investigating in Biology. Teachers will choose the skills necessary for the required practical activities.

At least 8 practicals must be completed, with at least two practical activities based on each of the skills of:

- **Focusing and Planning**
- **Data Recording and Processing**
- **Interpreting**
- **Reporting**

For each skill there must be a formative and a summative assessment, giving a minimum of 4 summative and 4 formative assessments in total. Each skill should be assessed in the context of the overall investigation, and not just the skill by itself. For example:

Planning: students plan an investigation for a given topic individually, and submit their plan. The class then comes up with a common plan and carry out the practical.

Processing: the class may carry out a common practical collecting data – this data is then collated and processed independently by each student.

Student performance in the practical activities must be assessed **using the relevant criteria given in the Appendix**. These criteria must be provided to the students in advance of their assessments.

Internal Assessment Component 2: Environmental Investigation

This assessment task is designed to assess the **environmental issue** for Ecosystems: Objective (c), and Course Objectives 1, 2, 3, 4, 5, 6, and 7.

Carrying out an investigation in science involves an interaction of many complex skills. These include focussing, planning, information gathering, processing, interpreting, and reporting.

In this activity students are required to:

- Research information related to a local environmental issue
- Carry out a practical investigation related to this issue
- Present a report integrating ideas from their research and investigation.

Teachers should allow 4-6 weeks for students to complete the overall investigation; students are expected to spend about 10-12 hours on the investigation - some of this will be class time.

The final date for completion is 14 August.

Teachers will provide a list of local environmental issues for the students to select. [Possible topics include, but are not restricted to: use of herbicide, use of pesticides, effluent disposal, fertiliser runoff, recycling, water quality, genetically modified organisms, quarantine, over fishing, marine reserves, introduced species]

Teachers will provide **guidance** to students throughout the study so students are not left on their own. This means providing **milestone** checkpoints to monitor student progress, providing feedback to students that confirms they are on the right track or not, but not giving specific direction. Regular monitoring also helps to ensure authenticity of the final report.

Suggested milestone checkpoints:

- Focussing question – check that students have identified a question that is specific and can be researched, and from which a practical investigation can be developed eg *Does effluent run-off into the mangrove area affect the diversity of organisms?*
- Research sources – check that students have identified reference sources that will enable them to gather relevant information
- Background information gathering – check that students have gathered relevant research information
- Practical investigation hypothesis – check that the hypothesis can be investigated within the time and resources available, and that it is at a suitable level of Biology
- Practical data – check that sufficient data has been gathered to enable a conclusion to be made
- Draft report – check that students are following the required guidelines to meet the assessment requirements.
- Final report.

Teachers are to provide the dates for each milestone in advance for students.

Students are required to maintain a **logbook**. This will contain the summary information from their research, questions and ideas for their practical investigation, draft planning, raw data. The log book is to be submitted with each milestone report and with the final report.

The practical investigation will measure the effect of one factor or variable only, and must generate quantitative data. It could be based on field work or a laboratory experiment, and use skills and equipment that students are familiar with. Students should be able to gather sufficient data in 1-3 hours.

The final report will include the logbook and a written report. The format of the written report will be a scientific report:

- Background information – why the topic is an issue, what makes it an issue and the reason for the investigation (not more than one page)
- Practical investigation – Hypothesis/Aim, Method/Equipment, Processed data (eg average data, graphs), Discussion, Conclusion
- Bibliography/References (and acknowledgements) – in a conventional format (refer to appendix)

The Environmental Investigation study is worth 10% of the overall grade. Marking judgements are to be made using all five criteria given in the Appendix.

Internal Assessment Component 3: Practical Test

This assessment component is designed to assess Objectives 1, 2, 4 and 7.

Teachers are required to design a practical test of at least 1-hour duration which assesses observation, manipulative skills, measurement and following instructions. This may be through a number of stations, short activities or a combination.

The practical test must be **completed by 30 June**.

Practical tests can be used to find out if a student has really mastered particular skills. The student is given one or more specific tasks that involve the use of scientific equipment or the application of certain skills. The teacher then assesses the student's level of skill either by observing the student carrying out the task or by checking the final result.

There are many tasks that students could be given, for example:

- dissecting an insect, a flower
- preparing a microscope slide of some pond slime and setting it up under a microscope
- species identification and use of keys
- sampling exercise

Do not include a task in a practical test unless the student has been taught the general principles related to that task. However, it would be possible to give a student an experiment that had not previously been studied if you were assessing the ability to follow instructions or if the student had completed an earlier experiment that was based on the same principles.

Teachers are to mark the practical test against their own schedule, using clear criteria/judgements that will provide a spread of marks.

Further information on practical tests is given in the Advisory Section.

Internal Assessment Component 4: Other Tasks

This assessment component is designed to assess Objectives 4, 5, 6, and 7.

There are to be **TWO** formal assessments that contribute to the 'Other Task' internal assessment marks. These are to be based on **Topics I, II or III of the prescription** only.

Suitable assessment items include unit tests, essays, assignments, field trips, models, posters, oral presentation, or comprehension and interpretation tasks.

Students must be advised in advance of details of the assessment format and marking criteria (the marking criteria in the Appendix may be used for these activities).

MODERATION

Moderation is a process designed to place different teachers' assessments of their students' performances in the same subject on the same scale so that valid comparisons between performances can be made. The purpose of moderation is to help to ensure fairness to students and to provide the wider community with reliable information about student performance. Moderation is undertaken to ensure that the IA scores given to students taking the subject are comparable from school to school.

Moderation process is subject to the requirements and procedures of the Board.

- a) Internal Assessment component 2 (Environmental Investigation) is to be sample moderated by country followed by an external moderation.
- b) Internal Assessment components 1, 3 & 4 are to be statistically moderated.

APPENDIX

Mark Criteria for the Environmental Investigation and Practical Activities

The full set of the following criteria are to be used to mark the Environmental Investigation.

Each Practical Activity is to be marked using the relevant set of criteria.

Focusing and Planning (10 marks)

<i>Aspect</i>		<i>Marks</i>
<i>Question</i>	Question is relevant to the research/observations	1
	Question is made but is not relevant to the topic	0
<i>Hypothesis</i>	Hypothesis is relevant and makes a prediction related to one variable that can be tested to produce quantitative data	2
	Hypothesis is related to their question and clearly makes a prediction.	1
	Hypothesis has been attempted, but is not clear, or a hypothesis has not been stated.	0
<i>Aim</i>	A clear aim for the study is stated.	1
	An aim is stated, but is not clear, or an aim is not stated	0
<i>Methodology</i>	A clearly expressed method (able to be repeated) is given that will produce valid data to address the hypothesis [Method includes: apparatus, measurement, collection and processing of data, controls, variables, repeats/range for valid results]	6
	A clearly expressed method is given that can be followed that addresses the hypothesis	4
	A method is given that can be followed, but does not address the hypothesis	2
	No statement identifying the methodology has been attempted.	<u>0</u>
	TOTAL	10

Data recording and processing (10 marks)

<i>Aspect</i>		<i>Marks</i>
<i>Recording</i>	Relevant data is recorded in an organized and self-explanatory manner (observations, units, tabulation).	3
	Relevant data is recorded in an organised manner	2
	Relevant data not organised.	1
	No attempt, or irrelevant data.	0
<i>Quality</i>	Complete set of relevant data, within expected values and accuracy of equipment	2
	Incomplete set of relevant data.	1
	No data or irrelevant data	0
<i>Processing</i>	Complete set of data is processed accurately in a manner that validly addresses the hypothesis/purpose (graphing, kite diagrams, averaging)	5
	Data is processed but inaccuracies/omissions prevent valid interpretations to be made	3
	No processing evident or largely inaccurate	<u>0</u>
	TOTAL	10

Interpreting (10 marks)

<i>Aspect</i>		<i>Marks</i>
<i>Discussion</i>	Gives an explanation of the results, relevant to the hypothesis, and supported by background information/experimental data/science ideas	6
	Relates the results to the hypothesis or background information/experimental data/science ideas	4
	Provides a description of the results	2
	No discussion of the results	0
<i>Conclusions</i>	Clear and valid conclusion, based on the data, and relevant to the hypothesis/aim	4
	Conclusion is based on the data and relevant to the hypothesis	2
	An attempt has been made to draw out one or two conclusions from the data	1
	No attempt has been made to identify a conclusion from the data	0
	TOTAL	10

Reporting (10 marks)

<i>Aspect</i>		<i>Marks</i>
<i>Communication</i>	Biological ideas and issues are concisely expressed, using appropriate language and terminology and citing where relevant	6
	Biological ideas and issues are outlined using appropriate language	3
	Ideas are presented but spelling and/or grammatical errors significantly affect understanding	1
	No attempt has been made to identify biological ideas and issues related to the topic	0
<i>Structure</i>	Ideas and issues are coherently organised and clearly structured	4
	Ideas and issues are organised and there is some structure	2
	There is some evidence of organisation and structure	1
	No attempt has been made to organise or structure ideas and issues	0
	TOTAL	10

Research (10 marks)

<i>Aspect</i>		<i>Marks</i>
<i>Log Book</i>	Accurate, complete entries of dates, types of resources identified for the study, episodes of work, planning	4
	Partially accurate and complete entries of dates, types of resources, episodes of work, planning	2
	Largely inaccurate and incomplete	0
<i>Information</i>	Wide range of relevant information sufficient to address the purpose of the research	4
	Information relevant to the topic	2
	No relevant information	0
<i>Bibliography</i>	Sources of information cited are referenced, using accurate, accepted conventions of formatting	2
	Sources of information are included, using accepted conventions for the most part	1
	No real attempt has been made to include an acceptable bibliography	0
	TOTAL	10

ADVISORY SECTION

A PRACTICAL REPORTS

The suggested practical activities listed below could meet the assessment criteria. **They are not prescriptive and students are not expected to complete all the activities listed.**

Cellular Biology

- Enzyme practical activities (e.g. factors that affect the ability of the enzyme catalase to catalyse the breakdown of hydrogen peroxide). Pepsin, amylase, and rennin are also suitable enzymes.
- Extraction and analysis of chlorophyll pigments.
- Microscopic observation of cells. Possibilities include the use of stains to identify organelles or important macromolecules in cells.
- An investigation of the properties of cell membranes. This might include factors that affect the rate of diffusion or osmosis in cells.
- Surface area to volume ratio and effect on rate of diffusion.

Genetics

- Modelling of DNA to show understanding of transcription, translation, and replication
- A study of the process of mitosis, involving the preparation of slides in various stages of the cellular division.
- Observations of chromosomes in meiosis in pollen mother cells.

Organism Level Biology

- Dissection and modelling of the structure and function of organs such as kidney, lung, intestine.
- Microscopic observation of tissue types.
- Investigations of the action of sensory receptors in detecting external stimuli.
- An investigation of factors that affect photosynthesis.
- An investigation of fermentation of yeast.
- An investigation of respiration in germinating seeds.

Environmental Biology

- Competitive exclusion in defined environments.
- Investigation of decomposition rates.
- An investigation of the effect of salinity on germination and/or growth of seeds.
- An investigation of the effects of nutrient levels on the growth rate of seedlings.
- Succession studies using transects.
- Simulation games illustrating the principles of natural selection.
- Simulation games modelling population growth.
- Effects of pollution on the growth of plants or animals.
- Estimate of population numbers (e.g. using capture/recapture).

B PRACTICAL TEST

Practical tests can be used to find out if a student has really mastered particular skills. The student is given one or more specific tasks that involve the use of scientific equipment or the application of certain skills. The teacher then assesses the student's level of skill either by observing the student carrying out the task or by checking the final result.

There are many tasks that students could be given. For example:

- dissecting an insect, a flower
- testing an unknown solution for starch, glucose and protein
- preparing a microscope slide of some pond slime and setting it up under a microscope
- experiment to test a given hypothesis

Do not include a task in a practical test unless the student has been taught the general principles related to that task. However, it would be possible to give a student an experiment that had not previously been studied if you were assessing the ability to follow instructions or if the student had completed an earlier experiment that was based on the same principles.

Practical tests are excellent for assessing practical skills and students usually find them enjoyable and stimulating. Designing and setting up a good practical test will take some time and careful planning. Marking the test, on the other hand, is usually quite simple.

The easiest practical test to design would be one where all students are given the same practical task (e.g., one from the list above) and have a set time to complete it. In reality, such an approach is often not possible as there may not be sufficient equipment for each student or it could be too easy for students to see what others are doing. Such problems can be overcome by having just a few students doing the task while the rest of the class is working unsupervised in another room, or by taking students aside one at a time and having them carry out a particular task while you watch and assess their performance. In this case, the rest of the class would be continuing with set work in the same room.

Another type of practical test that overcomes the problems of limited equipment and collusion between students but can still be sat by a whole class, is the 'station-type' practical test. In this type of test, several 'stations' are set up around the room. At each station there is an instruction card telling the student exactly what to do and all the equipment that will be required. Each station has instructions for a different task. The number of stations will depend on the time each task will take and the total time depends on the time each task will take and the total time available for the test. e.g., If 5 minutes is given for each task then a 10-station test could take 50 minutes to complete. If there were more than 10 students in the class, it would be necessary to either:

- add more stations and make the test longer,
- add more stations but reduce the time spent at each station so that the test will still take the same time,
- set up an identical test in another room

Station-type practical tests take time to set up but are easily controlled by a single teacher. The following steps should be followed:

- students should be given clear instructions about the test before entering the room,
- ideally, each student should be given an answer sheet designed specifically for the questions in the test, (this will help prevent confusion and will also make marking more easier),
- students enter the room and one student occupies each station,
- each student spends the allotted time on the task at his or her station,
- the teacher signals “time up” and all students move to the next station,
- the test ends when all stations have been visited by each student.

C TERMS

Analyse	Interpret information to reach stated conclusions
Apply	Use an idea, principle, theory or law to a given or new situation
Compare	Give an account of similarities and differences between two or more items, with reference to both (or all).
Describe	Recognise, name, state the features, define, draw, give the characteristics (of object or process)
Discuss	Show understanding by linking ideas – may require students to justify, relate, evaluate, compare and contrast, analyse
Explain	Give a reason for how or why
Outline	Give a brief account or summary using essential information only

D RESOURCES

Biology Texts

Bayley, M., 1998 **Patterns of Life** Addison Wesley Longman ISBN: 0-582-87974-4

Bayley, M., 1998 **Investigations of Life** Addison Wesley Longman ISBN: 0-582-86149-7

Bailey, A. and T. Bunn, 2003 **Year 12 Biology Study Guide** ESA Publications (NZ) Ltd ISBN: 1-877291-52-8

Ralph, D., (G Hooke series editor), 1999 **Biology Year 12** (New Zealand Pathfinder Series) New House Publishers Ltd ISBN: 1-86946-726-4

Support Texts

Adds, J., E.Larkcom & R. Miller, 2004 **Exchange and Transport, Energy and Ecosystems** ISBN 0-7487-7487-4

Adds, J., E.Larkcom & R. Miller, 2004 **Genetics, Evolution, and Biodiversity** ISBN 0-7487-7492-0

Clegg, C. J., 1998 **Mammals: Structure & Function** ISBN: 0-7195-7551-6

Clegg, C. J., 1999 **Genetics and Evolution** ISBN: 0-7195-7552-4

Clegg, C. J., 2003 **Green Plants: The Inside Story** ISBN: 0-7195-7553-2

Hale, W.G., J.P.Margham, & V.A. Saunders **Collins: Dictionary of Biology** 3 ed. 2003
HarperCollins ISBN 0-00-714709-0

Hanson, M., 1993 **Units of Life** Longman Paul ISBN 0-582-86017-2

Jones, A., R. Reed, and J. Weyers, 2nd edn, 1998 **Practical Skills in Biology** Longman ISBN 0-582-29885-7

Jones, N., A.Karp., & G. Giddings, 2001 **The Essentials of Genetics** ISBN: 0-7195-8611-9

Web References

www.nzqa.govt.nz	exam papers, mark schedules and reports
www.tki.org.nz	support material for teachers – assessments and subject material
www.biozone.co.nz	support materials for students and teachers, including links to other support websites and resources

Other Resources

Australasian Science (Australia)
New Scientist
Scientific American
Water and Atmosphere (NIWA, NZ)

PSSC Internal Assessment Summary Form

BIOLOGY

Country _____

School _____

Topic	Practical Activities <i>(Indicate with an asterisk (*) the 5 summative practicals and (**) for the design type - 10% each. These 5 practicals should be from all 4 topics.)</i>	Start Date	Completion Date	Task Weight %	
	1.				50%
	2.				
	3.				
	4.				
	5.				
	6.				
	7.				
	8.				
	Investigative Study Report			25%	15%
	Practical Test			10%	
	Other Task 1				
	Other Task 2				
				100%	

- Note:**
- (i) One of the summative practical activities must be a design type.
 - (ii) The practical test must be completed before **30 June**.
 - (iii) At least two practical activities must be based on each prescribed topic.
 - (iv) **Task outlines and detailed marking schemes for the 5 summative practical activities and 'other tasks' must be submitted together with this completed IA Summary Form.**

Teacher

Date:

SAMPLE MARK CAPTURE FORM FOR BIOLOGY INTERNAL ASSESSMENT

No.	Code Number	Name	Practical Report		Practical Test		Other Tasks	
			____ Marks	50%	____ Marks	10%	____ Marks	15%
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
13.								
14.								
15.								
16.								
17.								
18.								
19.								
20.								