Vanuatu National Syllabus

BIOLOGY

Senior Secondary

Years 11 - 12

Ministry of Education and Training
Republic of Vanuatu
2020

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Acknowlegement

These Years 11 to 13 Senior Syllabuses were written, edited, designed and formatted by Ni-Vanuatu officers of the Curriculum Development Unit of the Ministry of Education, the senior secondary school Teachers as writers, individual with the support of technical adviser and people representing the government institutions, semi government Agencies, NGOs and private sectors with the expertise in Biology who a familiar with the Vanuatu context.

Writers of the Biology syllabus consist of the teachers of the senior classes with many years of the teaching experiences and classroom practitioners. The syllabuses were guided by the Vanuatu National Curriculum Statement (2010), which provides the framework for all curriculums developed, published and implemented in Vanuatu Government schools. The following team of curriculum officers and writers contracted with the support of the development partners of Vanuatu Education Road Map (VERM); Department of Foreign Affairs and Trade (DFAT), Ministry of Foreign Affairs and Trade (MFAT) and United Nations Children's Fund (UNICEF) developed these syllabuses at the Vanuatu Curriculum Development Unit (CDU).

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In particular, the Ministry of Education acknowledges the support of the Department of Foreign Affairs and Trade (DFAT), Ministry of Foreign Affairs and Trade (MFAT) and the United Nations Children's Fund (UNICEF).

The syllabus is based on educational materials developed locally as well as regionally approved materials that were reviewed and purchased for schools. This syllabus and materials were reviewed and validated by selected senior Biology teachers representing the country, and by consultations consisting of senior teachers and lectures from the VITE and the regional academic institutions, Vice Rectorat - UNC, USP, FNU, SPBEA, SPC. Feedbacks from these consultations were used to make improvements.

The Ministry of Education acknowledges and express many thanks the main writers and co-writers of the Vanuatu senior Syllabuses for Physics to develop for the senior secondary curriculum.

Mrs Pala Luen, Anglophone Writer

Mrs Felicity Nilwo, Francophone Writer

Forward: Minister of Education and Training

The Government of Vanuatu supports the reform of the curriculum at all levels of schooling. The National Parliament has provided bipartisan support for these historic developments. The Vanuatu National Curriculum Statement provides a national unified approach to education in our country. Our education system will provide the same harmonised curriculum for all students at all levels of schooling. We are one nation, one people striving to achieve better outcomes for all students irrespective of their backgrounds and where they live.

The reformed curriculum begins, in the early years of schooling from Years 1 to 13. This set of syllabus for Years 11 to 13 provides details of what students should learn in Biology. Each year level of the syllabus describes what all students should learn from years11 - 13.

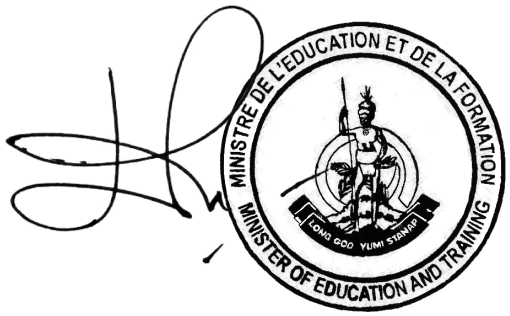
This syllabus connects with the science syllabus developed for students in Years 7-10. First and foremost, the science of biology is mainly studying about life. Second, it provides an in-depth, scientific understanding of how all living and nonliving organisms interact with each other.

Third, it gives insights on how diverse life forms are. Moreover, biology encompasses other fields of research that are related to the sustainability of life, including the environment, ecosystem, food quality, causes of illnesses, the development of medicines, the study of the human body, to name a few.

The importance of Biology as a subject is that it is a branch of life science—which itself is part of the natural science branch—that focuses on the study of life and living organisms of all types. Biology itself branches out into numerous different areas, each affecting the human race to some extent.

Our syllabuses will be reviewed and updated regularly so that they will always reflect the thinking of our national, regional and international educators at this level of schooling.

I extend my best wishes of success for the new Curriculum reform programs at the Senior Secondary level and endeavour for the upliftment of the educational standards of our students around the country.



Honourable Jean Pierre Nirua
Minister of Education and Training

Message from the Director General of Education and Training

This national syllabus for Biology will be used by teachers to teach from Year 11-12-13 throughout Vanuatu. The syllabuses are built upon the concepts, skills and attitudes from the Year 1 to Year 10 National Syllabuses.

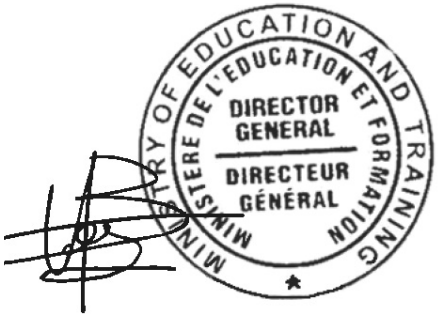
Students taking science streams will be introduced to Biology. It helps in shaping the professional careers of every person. Be it a doctor, chemist, engineer, environmentalist, nurse, scientist, teacher, or other professions that are not inclined to science, studying the scientific concepts of life and other living organisms is going to be a useful tool in achieving success in any chosen field of study.

The syllabus describes what the students need to achieve at the completion of the course. By studying Biology, students will be able to know the reasons behind the sudden changes happening in their respective bodies. In addition, the importance of Biology has produced the scientific branch called Pathology, which studies the different kinds of diseases and how they affect the bodies of both humans and animals. It can also develop or discover new medications that will alleviate some health conditions without medicines yet.

The Biology subject is designed to prepare students to become specialized in the subject and also provide pre requisites to the other courses in upper level after the year 13. Teachers are provided standard scheme of work, time table and course content and weighting with uniform presentations for all subjects in senior level. Students in this year level are expected to enter University for further studies and required to have a common examination between French and English speaking students. This is the beginning of the harmonization of the national curriculum in Vanuatu and it will continue to improve in the coming years.

These syllabuses put into practice the statements made in the Vanuatu Curriculum Statement (VNCS 2010). All schools should be familiar with the VNCS and these syllabuses and follow them carefully.

These syllabuses are approved by the National Curriculum and Assessment Board and by the Minister for Education and are official curriculum documents for all schools to be used with students from Year 11 to Year 13.



Bergmans Iati
Acting Director General of Education and Training

Curriculum Historical Background

The Education sector has made significant efforts since independence, to provide a common primary curriculum up to the Year 10 Leaving Certificate. However, the senior programme still maintained a separate curriculum until 2010, when the Ministry of Education and Training, decided to review the whole curriculum in order to offer common content for Francophone and Anglophone from primary to senior level.

Today, this is happening and the background and concept of the curriculum for the senior cycle is to thoroughly prepare highly qualified members of our community to assist and promote our public and private economic sectors.

The reformed system prepares students to become technicians and engineers, who would be highly qualified in order promote the public and private sector. Furthermore the reform curriculum must prepare qualified bilingual and multilingual who will have the potential to pursue specialised academic or vocational studies.

After 37 years of independence, the senior curriculum perspective considers all subjects to be of equal importance in respect of individual students' needs. In this perspective of subject complementarity, a high level of competency in literacy and numeracy at a senior level is essential and will in the future allow the sudents to support the development of Vanuatu.

The Ministry of Education and Training will need to rearrange school infrastructure in order for each institution to implement this new curriculum in the best possible conditions. The succes of the students will give them better options for university studies or to be self-reliant, able to use properly existing resources, promote our economy to meet the Sustainable Development Goals (SDGs).

The timetabling and subjects choices policy for all senior courses must be respected and the requirements are specified under this policy. These policies will be promulgated to all schools in the country. This is a step towards students having a common examination in Year 12 and at Year 13.

These reforms in Year 11-13 will change the tradition of a dual system of education, by harmonizing the contents and the pedagogical approaches. It will place students at the center of learning, providing them with the knowledge and skills to be innovative, making Vanuatu self-reliant and a developed country; a strong and independent sovereign country in this region and internationally.

Leisel Masingiow
Acting Principal Education Officer
Curriculum Development Unit

Section 1

INTRODUCTION

Biology is a science which is constantly evolving and occupies a significant place in our daily lives. It is important for all citizens to clearly understand questions of biodiversity and biotechnology which require a basic knowledge of biology, particularly bioethics.

Biology occupies an important position in Vanuatu's National curriculum because it has direct applications in professional fields such as the medical, food industry and food nutrition fields. Biology is a discipline that relates to problems in contemporary society as indicated in the various program headings. Its many links with other educational objectives (e.g. heath and environment) will be highlighted as often as possible.

The approach adopted in this program is based on themes that students can identify in their everyday experiences, and phenomena commonly observed in nature. A fundamental objective is to enable students to appreciate the connections between seemingly different scientific topics and therefore help them to be able to integrate ideas from different scientific sources.

The themes include a basic structure of knowledge both in physical and life sciences. This body of concepts was chosen as it offers a broad understanding based on the organism and environment, and helps builds a foundation on which students can use for further studies.

Purpose

Biology is a subject that motivates and prepares a student for higher education as they participate in the different learning areas within the course. It also covers education in health, safety and environment and is suitable for any student who chooses an orientation towards non-scientific sectors.

The purpose of teaching biology is to understand the world around us. This is achieved by undertaking lab experiments, investigations and using scientific explanations. The investigations are based on observations, experiments and models that allow hypothesis testing and the development of critical thinking at different levels.

Knowledge is built on from the known to unknown as students gain more knowledge of the Biology topics.

The program is designed to help the student to:

- Solve basic problems through analysis and experimentation
- Observe, investigate and hypothesize during investigation
- Understand the balance of diversity of living and non-living things and the changes in patterns and interactions

- Adopt sustainable management of the natural environment of humans and society
- Use laboratory equipment effectively with a clear understanding of principles learnt
- Explore, conserve and sustainably use energy realizing that energy is an important resource for the living world
- Discover solutions to problems of life, recognizing the interaction of science, technology and other disciplines.

Rationale

Biology continues to maintain an important place in the Senior Secondary National Curriculum of Vanuatu. The Biology Syllabus builds on the achievements of previous biology classes to establish fundamental knowledge, with an emphasis on scientific reasoning and experimental approaches and techniques, while promoting individual work and the development of the autonomy of each student.

Biology is the study of the diversity of living things and is associated with biological concepts at different levels: the structure and systems of the human body, organs, tissues and cells. It offers students the opportunity to observe, to wonder, to question, to investigate and to explain their surroundings.

The content of the course extends to describe the expectations in terms of the final outcome objectives for the student. The aim is to improve the students understanding, to combine the depth and scope of the specific content and focus more clearly on skills which should be demonstrated by the students of Vanuatu. It is a study into students' perspective on life in relation to their physical, social and biological environment.

Teaching Aims

The content of the syllabus extends to present concepts and skills in terms of final outcomes for students. This improves an understanding of the need to combine the importance and the timeframe of specific content and to focus clearly on outcomes to be demonstrated by students of Vanuatu. Student's perception of life is put into perspective with the physical, social and biological environment.

The aims of studying this subject are to develop skills and knowledge in:

- Understanding the key concepts of biology
- Appreciating the role of the scientific method and accumulating knowledge about biology and the ability to communicate information and ideas using the language of biology
- Manipulating and observing through practical activities
- The ability to solve problems using biological knowledge and ideas
- 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 environment of Vanuatu
- An awareness of the social implications of biological knowledge and technological advances in biology.

Key Learning Outcomes

Biology does more than help students reach a scientific understanding of their world, it provides them with the skills and cognitive abilities to access an ever-expanding body of knowledge. Learners use scientific knowledge, curiosity and intuition to investigate the world and to test and confirm (or challenge) their understandings. They apply their scientific knowledge to make responsible and informed decisions about real world issues.

Biology highlights the need for informed, evidence-based decision-making about current and future applications of science that impact on society and the environment and on other social and ethical issues. The pervasive role of scientific understanding and scientific processes in shaping our society and economy means that the study of Biology can provide access to a wide variety of career opportunities.

Specific Learning Outcomes(SLO)

Using the SOLO (Structure of Observed Learning Outcomes) taxonomy, the specific learning outcomes in this syllabus are provided with skill levels to guide teaching, learning and assessment. The skill levels have discrete scale of either 1, 2, 3, or 4. This scale increases in the complexity and difficulty in the thinking processes from 1 to 4.

Skill level 1 is called the Uni-Structural Level

The student has no understanding of the subject, he just repeats what he has learned by heart. His knowledge has no connection with others, is unorganized and without content. The student does not know how to recognize the context in which it applies.

Skill level 2 is called the Multi-Structural Level

The student deals with only one aspect of knowledge. He can recite, identify, name and follow simple instructions.

Skill level 3 is called the Relational Level

The student can deal with many aspects of a problem, but without making connections between them. He can follow a procedure, describe, classify, etc.

Skill level 4 called is the Extended Abstract Level

At this level, the student connects the knowledge between them, he sees several aspects of a situation and knows how to approach it in several ways. He can explain his understanding and the links between knowledge.

Strands

1. Cellular Biology
2. Genetics
3. Organism Level Biology
4. Environmental Biology
5. Variation and Evolution

Prerequisites

Students who are taking Biology from year 11 to 13 should acquire general knowledge of Biology from year 1 to 10 in the following sub-strands.

Living together

By studying the living world students should be able to identify and record the internal and external physical characteristics of plants and animals and realize that the environment is made up of living and non-living things. Students should discover the characteristics of living organisms and explore food chains and webs and the relationships between plants and animals. Through these enquires students will learn to respect and care for the physical environment and the plants and animals that live there.

Structure and life processes

Students examine, identify and name major internal systems of common plants, animals and humans and their functions. They should distinguish between vertebrates and invertebrates, identify their major organs and life processes and recognize their different purpose. Through this study they will appreciate different unique organisms and how each survives in their environment.

Biodiversity, relationships and sustainability

Through this study students will develop an awareness of the many habitats and the different organisms in those habitats and their way of life. They will appreciate that all living things depend on the environment, and that changes caused by human activities or natural causes affect the environment and their lives. Students will demonstrate a responsibility to care for their physical environment and living things and live in harmony within the environment.

Overview

The table below shows the sequence and the progression of strands and sub-strands that will be taught from year 11–13 at increasing levels of depth and difficulty at each year level. By the end of this course students should have a good foundation in the subject and have achieved the requirements for entrance into the first year of University.

Reference System for Outcomes

In the following tables each sub-strand outcome has letters and numbers which denote the strand name, the sub strand name, the year level, whether it is for Vernacular, French or English and the number indicates how many outcomes with these characteristics. For instance, in the Cellullar Biology table **11BIO1.1** means Year 11 (**11**), Biology (**BIO**), Strand 1 (**1**), Sub-strand 1 (**1**).

Strands	Sub-strands	
	Year 11	**Year 12**
1. Cellular Biology	**11BIO1.1 Cell Structure** *Demonstrate an understanding of plant and animal cell organelles and their structures.* **11BIO1.2 Cell Transport** *Demonstrate an understanding of diffusion, facilitated diffusion and osmosis in terms of energy requirement.* **11BIO1.3 Enzymes** *Demonstrate an understanding of the role and function of enzymes.*	**12BIO1.1 Respiration** *Demonstrate an understanding of the role of respiration in the production of ATP in aerobic and anaerobic respiration.* **12BIO1.2 Photosynthesis** *Demonstrate an understanding of the process in the two phases of photosynthesis.* **12BIO1.3 Cellular immunity** *Demonstrate an understanding of the functions of antibodies.* **12BIO1.4 Practical Skills** *Demonstrate an understanding of practical activities carried out to investigate biological principles*

2. Genetics	**11BIO2.1 Molecular Genetics** *Demonstrate an understanding of the functions of the components of the nucleus and the two process of protein synthesis.* **11BIO2.2 Cell growth and division** *Demonstrate an understanding of the sequence of events in mitosis and meiosis in an organism.*	**12BIO2.1 Mendelian inheritance** *Demonstrate an understanding of Mendel's experiments, results and conclusions and explain Mendel's three principles* **12BIO2.2 Diversity and relatedness of organisms** *Demonstrate an understanding of the anatomical similarities and the genetic control during embryonic development in vertebrates.*
3. Organism Level Biology	**11BIO3.1 Production in Plants** *Demonstrate an understanding of sexual and asexual reproduction in plants and the role of cell division in plant reproduction.* **11BIO3.2 Human Nutrition** *Demonstrate an understanding of modern and traditional diet of Pacific Islanders and the effects of the modern diet on the human body.* **11BIO3.3 Animal Digestion** *Demonstrate an understanding of how food is processed through the digestive tract of animals.* **11BIO3.4 Animal Gas Exchange** *Demonstrate an understanding of the processes of breathing (ventilation), gas exchange, and cellular respiration.*	**12BIO3.1 Plant form and function** *Demonstrate an understanding of diversity in leaf, stem and root structure and function in various plant phyla.* **12BIO3.2 Animal circulatory systems** *Demonstrate an understanding of animals' internal transport system.* **12BIO3.3 Excretion in animals** *Demonstrate an understanding of the process involved in the production of carbon dioxide, water and nitrogenous wastes.* **12BIO3.4 Nervous system** *Demonstrate an understanding of the structure and function of the nervous system.*

4. Environmental Biology	**11BIO4.1 Ecosystems** *Demonstrate an understanding of the characteristics of an ecosystem and the relationship between biodiversity and ecosystem survival.* **11BIO4.2 Diversity of organism** *Demonstrate an understanding of the levels of classification and how the diversity of life can be classified into groups.* **11BIO4.3 Adaptive features** *Demonstrate an understanding of adaptation as a characteristic that enables an organism to survive better in its habitat.*	**12BIO4.1 Communities** *Demonstrate an understanding of the characteristics of a community (patterns and stability) and explain the role of a colonizing or pioneer species.* **12BIO4.2 Population** *Demonstrate an understanding of the characteristics of a population (size and space) and explain the advantage of genetic variation for the survival of a population.*
5. Variation in Species	**1BIO5.1 Variation in species** *Demonstrate an understanding of the events that lead Darwin to the theory of natural selection.*	**12BIO5.1 Patterns of Evolution** *Demonstrate an understanding of the different patterns of evolution such as divergent evolution, adaptive radiation, and convergent and parallel evolution.* **12BIO5.1 Speciation** *Demonstrate an understanding of allopatric and sympatric speciation and describe isolating mechanisms (barriers and isolations).*

Time Allocation

Year 11

There are 36 weeks in the school year. Times allocated are designed to cover a minimum of 33 weeks for teaching concepts and skills and carrying out the continuous assessment; 3 weeks cover semester or term (one week per term) assessment.

- Hours covered per week – 4 hours
- Hours covered per term – 52 hours
- Hours covered per year – 132 hours

Strands	Time allocation	Weighting (%)
1. Cellular Biology	30 hours = 7.5 weeks	23
2. Genetics	24 hours = 6 weeks	18
3. Organism Level Biology	36 hours = 9 weeks	27
4. Environmental Biology	30 hours = 7.5 weeks	23
5. Variation and Evolution	12 hours = 3 weeks	9
Total	**132 hours**	**100%**

Year 12

There are 36 weeks in the school year. Times allocated are designed to cover a minimum of 33 weeks for teaching concepts and skills and carrying out the continuous assessment; 3 weeks cover semester or term (one week per term) assessment.

- Hours covered per week – 4 hours
- Hours covered per term – 52 hours
- Hours covered per year – 132 hours

Strands	Time allocation	Weighting (%)
1. Cellular Biology	30 hours = 7.5 weeks	23
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5. Variation and Evolution	12 hours = 3 weeks	9
Total	**132 hours**	**100%**

Section 2

CONTENT LEARNING OUTCOMES

YEAR 11

STRAND 1: CELLULAR BIOLOGY				
Major Learning Outcome: 11BIO1		Upon the successful completion of this strand students are able to demonstrate understanding of the physiological properties of cell structure, the organelles they contain and the interaction between their life cycle and the environment.		
Sub-strand	**Key Learning Outcome**	**Code**	**Specific Learning Outcome**	**Skill Levels**
Cell Structure	**11BIO1.1** *Upon successful completion of this sub-strand, students are able to demonstrate an understanding of plant and animal cell organelles and their structures.*	11BIO1.1.1.1	**Identify** the specialized cells in animals: nerve cells, muscle cells, red blood cells, sperm cells, and egg cells.	1
		11BIO1.1.1.2	**Identify** the specialized cells in plants: guard cells, phloem cells, and xylem cells.	1
		11BIO1.1.1.3	**Define** cell organelles.	1
		11BIO1.1.1.4	**Label** the specialized cells in animals.	1
		11BIO1.1.1.5	**Draw** cell organelles of a plant: nucleus, mitochondrion, chloroplast, ribosome, Golgi apparatus, vacuole, cell membrane, cell wall, lysosome, and rough and smooth and endoplasmic reticulum. .	1
		11BIO1.1.1.6	**Draw** cell organelles of an animal: nucleus, mitochondrion, ribosome, Golgi apparatus, vacuole, cell membrane, lysosome, rough and smooth endoplasmic reticulum, and centriole.	1
		11BIO1.1.1.7	**Label** the specialized cells in plants.	1

		11BIO1.1.1.8	**Label** the cell organelles that differ in plant and animal cells.	1
		11BIO 1.1.1.9	**Define** wet mount.	1
		11BIO1.1.1.10	**Define** biological organization.	1
		11BIO1.1.2.1	**Describe** the features of cell organelles.	2
		11BIO1.1.2.2	**List** the functions of the cell organelles.	2
		11BIO1.1.2.3	**Describe** the structure of the cell membrane.	2
		11BIO1.1.2.4	**Describe** the function(s) of the cell membrane.	2
		11BIO1.1.2.5	**Calculate** cell size.	2
		11BIO1.1.3.1	**Relate** the structure of the membrane to its functions.	3
		11BIO1.1.3.2	**Explain** the importance of biological organization.	3
		11BIO1.1.3.3	**Explain** the preparation of wet mounts.	3
		11BIO1.1.2.6	**List** the advantages and disadvantages of preparing wet mounts.	2

Cell Transport	**11BIO1.2** *Upon successful completion of this sub-strand, students are able to demonstrate an understanding of diffusion, facilitated diffusion and osmosis in terms of energy requirement.*	11BIO1.2.1.1	**Define** passive transport.	1
		11BIO1.2.1.2	**Define** active transport.	1
		11BIO1.2.1.3	**Define** concentration gradient.	1
		11BIO1.2.1.4	**Define** solute concentrations.	1
		11BIO1.2.1.5	**Define** diffusion.	1
		11BIO1.2.1.6	**Define** facilitated diffusion.	1
		11BIO1.2.1.7	**Define** osmosis.	1
		11BIO1.2.1.8	**Define** cytosis.	1
		11BIO1.2.1.9	**Define** endocytosis.	1
		11BIO1.2.1.10	**Define** pinocytosis.	1
		11BIO1.2.1.11	**Define** phagocytosis.	1
		11BIO1.2.1.12	**Define** exocytosis.	1
		11BIO1.2.3.1	**Differentiate** between passive and active transport in terms of energy requirements	3
		11BIO1.2.3.2	**Relate** passive transport to the concentration gradient.	3
		11BIO1.2.3.3	**Relate** active transport to the concentration gradient.	3
		11BIO1.2.2.1	**Describe** the importance of passive transport in cells.	2
		11BIO1.2.2.2	**Describe** the importance of active transport in cells.	2
		11BIO1.2.2.3	**Demonstrate** how smaller cells are efficient for faster transport.	2
		11BIO1.2.3.4	**Calculate** volume ratio to surface area in cells.	3

		11BIO1.2.3.5	**Explain** the relevance of cell size to transport energy across cell membrane.	3
		11BIO1.2.2.4	**Describe** the effects of osmosis in the cells of animals.	2
		11BIO1.2.2.5	**Describe** the effects of osmosis in the cells of plants.	2
		BIO1.2.2.6	**Describe** the features of passive transport.	2
		BIO1.2.2.7	**Describe** the features of active transport.	2
		11BIO1.2.3.6	**Explain** the relationship between solute concentrations (hypotonic, isotonic, and hypertonic).	3
Enzymes	**11BIO1.3** *Upon successful completion of this sub-strand, students are able to demonstrate an understanding of the role and function of enzymes.*	11BIO1.3.1.1	**Define** biological catalyst.	1
		11BIO1.3.1.2	**Define** enzyme.	1
		11BIO1.3.1.3	**Define** substrate.	1
		11BIO1.3.1.4	**State** where enzymes are found.	1
		11BIO1.3.2.1	**Describe** the biological function of enzymes.	2
		11BIO1.3.2.2	**Describe** the role of enzymes.	2
		11BIO1.3.3.1	**Explain** the induced fit model.	3
		11BIO1.3.2.3	**Describe** the dual specificity of enzymes: substrate specificity and specificity of action using the induced fit model.	2
		11BIO1.3.3.2	**Explain** that enzymes are effective biological catalyst.	3
		11BIO1.3.3.3	**Explain** how a certain environmental factor (temperature, pH, substrate concentration, co-factors, and inhibitors) can affect the functioning of a named enzyme.	3
		11BIO1.3.3.4	**Analyse** the impact of environmental factors (temperature, pH, substrate concentration, co-factors, and inhibitors)on enzyme activity.	3
		11BIO1.3.4.1	**Discuss** the graphs and diagrams of how activity of enzyme is affected by environmental factors.	4

STRAND 2: GENETICS				
Major Learning Outcome: 11BIO2		Upon the successful completion of this strand, students are able to demonstrate understanding of the molecular structure and function of genes and the control of genes, heredity and variation in living organisms and gene behaviour in the context of a cell or organism.		
Sub-strand	**Key Learning Outcome**	**Code**	**Specific Learning Outcome**	**Skill Levels**
Molecular Genetics	**11BIO2.1** *Upon successful completion of this sub-strand, students are able to demonstrate an understanding of the functions of the components of the nucleus and the two process of protein synthesis.*	11BIO2.1.1.1	**Define** molecular genetics.	1
		11BIO2.1.1.2	**Define** nucleus.	1
		11BIO2.1.1.3	**Identify** the main components of the nucleus.	1
		11BIO2.1.1.4	**Define** chromosomes.	1
		11BIO2.1.1.5	**Define** DNA.	1
		11BIO2.1.1.6	**Define** RNA.	1
		11BIO2.1.1.7	**Define** genes.	1
		11BIO2.1.1.8	**Define** alleles.	1
		11BIO2.1.1.9	**Define** proteins.	1
		11BIO2.1.1.10	**Identify** the main components of chromosomes.	1
		11BIO2.1.2.1	**Describe** the structure of a chromosome.	2
		11BIO2.1.3.1	**Explain** the relationship between chromosomes, DNA, RNA, genes, alleles and proteins.	3
		11BIO2.1.2.2	**Describe** the structure of DNA and RNA in terms of: sugar, phosphate, nucleotide strands, bases and base pairing.	2
		11BIO2.1.1.11	**Define** amino acids.	1
		11BIO2.1.2.3	**Describe how** amino acids are determined by a specific DNA base sequence.	2

		11BIO2.1.1.12	**Define** transcription.	1
		11BIO2.1.1.13	**Define** translation.	1
		11BIO2.1.2.4	**Describe** the involvement of DNA, mRNA and tRNA in the production of proteins.	2
		11BIO2.1.3.4	**Explain** the interaction between DNA, mRNA, tRNA in the production of proteins.	3
		11BIO2.1.2.5	**Describe** the sequence of events that involve DNA, mRNA, tRNA in the production of proteins.	2
		11BIO2.1.3.2	**Explain** the relationship between a gene, protein synthesis and polypeptide chain. (protein/enzymes).	3
		11BIO2.1.2.6	**Outline** the processes of transcription and translation.	2
		11BIO2.1.3.3	**Differentiate** between the two processes of protein synthesis.	3
Cell growth and division	**11BIO2.2** *Upon the successful completion of this sub-strand, students are able to demonstrate an understanding of the sequence of events in mitosis and meiosis in an organism.*	11BIO2.2.2.1	**Describe** the process of DNA replication.	2
		11BIO2.2.3.1	**Explain** the importance of the DNA replication.	3
		11BIO2.2.1.1	**Name/Identify** the two types of cell divisions.	1
		11BIO2.2.2.2	**Describe** the different phases of the cell division Meiosis.	2
		11BIO2.2.2.3	**Describe** the different phases of the cell division Mitosis.	2
		11BIO2.2.3.2	**Differentiate** between the two cell divisions: mitosis and meiosis	3
		11BIO2.2.3.3	**Relate** mitosis and meiosis to the daughter cells produced: chromosome number, number of daughter cells, variation and function.	3
		11BIO2.2.3.4	**Explain** how crossing over, recombination and independent assortment produces variation in daughter cells.	3
		11BIO2.2.4.1	**Discuss** the role of mitosis and meiosis in the life cycle of an organism.	4

STRAND 3: ORGANISM LEVEL BIOLOGY				
Major Learning Outcome: 11BIO3		Upon the successful completion of this strand, students are able to demonstrate understanding of the level of organization among plants and animals and their structure and function in relation to a selection of vital processes.		
Sub-strand	**Key Learning Outcome**	**Code**	**Specific Learning Outcome**	**Skill Levels**
Production in Plants	**11BIO3.1** *Upon successful completion of this sub-strand, students are able to demonstrate understanding of sexual and asexual reproduction in plants and the role of cell division in plant reproduction.*	11BIO3.1.1.1	**Define** sexual reproduction in plants.	1
		11BIO3.1.1.2	**Define** asexual reproduction in plants.	1
		11BIO3.1.2.1	**Describe** asexual reproduction in plants.	2
		11BIO3.1.2.2	**Describe** sexual reproduction in plants.	2
		11BIO3.1.4.1	**Discuss** the advantages and disadvantages of sexual reproduction in plants.	4
		11BIO3.1.4.2	**Discuss** the advantages and disadvantages of asexual reproduction in plants.	4
		11BIO3.1.3.1	**Explain** the role of fertilization of seeds, and spore dispersal on the life cycle of mosses.	3
		11BIO3.1.3.2	**Explain** the role of fertilization of seeds, and spore dispersal on the life cycle of ferns.	3
		11BIO3.1.3.3	**Explain** the role of fertilization of seeds, and spore dispersal on the life cycle of gymnosperm.	3
		11BIO3.1.3.4	**Explain** the role of fertilization of seeds, and spore dispersal on the life cycle of angiosperms.	3
		11BIO3.1.2.3	**Describe** the role of mitosis in plant reproduction.	2
		11BIO3.1.2.4	**Describe** the role of meiosis in plant production.	2

		11BIO3.1.4.3	Discuss the roles of meiosis and mitosis in plant reproduction and how these contribute to variations, giving examples.	4
		11BIO3.1.2.5	**Describe** the alternation of generations in the plant life cycle.	2
		11BIO3.1.1.3	**Define** sporophyte.	1
		11BIO3.1.1.4	**Define** gametophyte.	1
		11BIO3.1.1.5	**Define** gymnosperms.	1
		11BIO3.1.1.6	**Define** angiosperm.	1
		11BIO3.1.3.5	**Compare** sporophyte and gametophyte generations in mosses.	3
		11BIO3.1.3.6	**Compare** sporophyte and gametophyte generations in ferns.	3
		11BIO3.1.3.7	**Compare** sporophyte and gametophyte generations in gymnosperms.	3
		11BIO3.1.3.8	**Compare** sporophyte and gametophyte generations in angiosperm.	3

Human Nutrition	**11BIO3.2** *Upon successful completion of this sub-strand, students are able to demonstrate understanding of modern and traditional diet of Pacific Islanders and the effects of the modern diet on the human body.*	11BIO3.2.1.1	**Identify/Name** the types of food in a modern diet.	1
		11BIO3.2.1.2	**Identify/Name** the types of food in a traditional Pacific diet.	1
		11BIO3.2.2.1	**List** the advantages and disadvantages of a traditional Pacific diet.	2
		11BIO3.2.2.2	**List** the disadvantages of a modern diet.	2
		11BIO3.2.3.1	**Compare** the advantages and disadvantages of the traditional Pacific diet and modern diet.	3
		11BIO3.2.2.3	**Descriibe a** diseases caused by the modern diet.	2
		11BIO3.2.1.3	**Identify** the features of a healthy digestive system.	1
		11BIO3.2.2.4	**List** the features of a healthy digestive system.	2
		11BIO3.2.1.4	**Define** gastric ulcers.	1
		11BIO3.2.1.5	**Define** gall stones.	1

		11BIO3.2.3.2	**Compare** a healthy digestive system to one that is affected by a low fibre diet, gastric ulcers and gall stones.	3
		11BIO3.2.3.3	**Explain** the function of the liver.	3
		11BIO3.2.3.4	**Explain** the effects of high blood sugar (diabetes) to the normal functioning of the liver.	3
		11BIO3.2.3.5	**Compare** high blood pressure to normal blood sugar.	3
		11BIO3.2.4.1	**Discuss** the implications of non-communicable diseases to livelihood in the country and recommend ways to minimise the risk of diabetes and other NCDs.	4
		11BIO3.2.2.5	**Describe** the procedure that would be used to investigate the prevalence of an NCD in a community.	2
		11BIO3.2.1.6	**List** the different non communicable diseases that are caused by a change from the traditional Pacific diet to a modern diet.	1
		11BIO3.2.2.6	**Describe** some examples of non-communicable diseases.	2
		11BIO3.2.3.6	**Explain** how non-communicable diseases affect the digestive system	3

Animal Digestion	**11BIO3.3** *Upon the successful completion of this sub-strand, students are able to demonstrate understanding of how food is processed through the digestive tract of animals.*	11BIO3.3.1.1	**Define** ingestion.	1
		11BIO3.3.1.2	**Define** digestion.	1
		11BIO3.3.1.3	**Define** absorption.	1
		11BIO3.3.1.4	**Define** egestion.	1
		11BIO3.3.2.1	**Describe** the processes of ingestion.	2
		11BIO3.3.2.2	**Describe** the processes of digestion.	2
		11BIO3.3.2.3	**Describe** the processes of absorption.	2
		11BIO3.3.2.4	**Describe** the processes of egestion.	2
		11BIO3.3.2.5	**List** the digestive organs in a human being.	2
		11BIO3.3.2.6	**Describe** the functions of each of the digestive organs in humans.	2
		11BIO3.3.3.1	**Explain** the importance of these processes for the survival of animals.	3
		11BIO3.3.2.7	**List** the main digestive enzymes in carnivores.	2
		11BIO3.3.2.8	**List** the main digestive enzymes in herbivores.	2
		11BIO3.3.2.9	**List** the main digestive enzymes in omnivores.	2
		11BIO3.3.3.2	**Distinguish** between the different types of digestive systems of a carnivore, herbivore and omnivore.	3
		11BIO3.3.3.3	**Differentiate** between the digestive systems of the sea anemone, earth worm and humans.	3
		11BIO3.3.4.1	**Discuss** how the digestive systems of the sea anemone, earthworm and humans help each organism to survive, using examples.	4

Animal Gas Exchange	**11BIO3.4** *Upon successful completion of this sub-strand, students are able to demonstrate understanding of the processes of breathing (ventilation), gas exchange, and cellular respiration.*	11BIO3.4.1.1	**Define** ventilation.	1
		11BIO3.4.1.2	**Define** gas exchange.	1
		11BIO3.4.1.3	**Define** cellular respiration.	1
		11BIO3.4.2.1	**List the** gas exchange organs in a human being	2
		11BIO3.4.2.2	**Describe** the functions of each of the digestive organs in humans	2
		11BIO3.4.1.4	**Identify** the body parts of different animals associated with gas exchange.	1
		11BIO3.4.4.1	**Discuss** how the gas exchange systems depend on way of life including size and mobility: body surface (e.g. earthworm), gills (e.g. fish, crab), trachea (e.g. insect), lung (e.g. human).	4
		11BIO3.4.4.2	**Discuss** the importance of the gas exchange process to the life of an organism.	4
		11BIO3.4.3.1	**Compare** the processes of breathing (ventilation), gas exchange and cellular respiration.	3
		11BIO3.4.3.2	**Explain** how gas is exchanged over the surface area.	3
		11BIO3.4.3.3	**Explain** how gas is exchanged over the trachea.	3
		11BIO3.4.3.4	**Explain** how gas is exchanged over the lung.	3
		11BIO3.4.3.5	**Explain** how gas is exchanged over the gills, surface area, trachea and lung.	3

STRAND 4: ENVIRONMENTAL BIOLOGY				
Malor Learning Outcome: 11BIO4		Upon the successful completion of this strand, students are able to demonstrate understanding of how the natural ecosystem is affected by the human activities; the classification of organisms into taxonomies and the different adaptations of most organisms.		
Sub-strand	**Key Learning Outcome**	**Code**	**Specific Learning Outcome**	**Skill Levels**
Ecosystems	**11BIO4.1** *Upon the successful completion of this sub-strand, students are able to demonstrate understanding of the characteristics of an ecosystem and the relationship between biodiversity and ecosystem survival.*	11BIO4.1.1.1	**Define** population.	1
		11BIO4.1.1.2	**Define** community.	1
		11BIO4.1.1.3	**Define** biodiversity.	1
		11BIO4.1.1.4	**Define** ecosystem.	1
		11BIO4.1.3.1	**Distinguish** between population, community and ecosystem.	3
		11BIO4.1.2.1	**Describe** the features of an ecosystem.	2
		11BIO4.1.2.2	**List** some of the factors affecting the ecosystem.	2
		11BIO4.1.1.5	**Define** biotic.	1
		11BIO4.1.1.6	**Define** abiotic.	1
		11BIO4.1.1.7	**Define** food chains.	1
		11BIO4.1.1.8	**Identify** a component of a food chain/web**.**	1
		11BIO4.1.1.9	**Define** food webs.	1
		11BIO4.1.2.3	**Describe** the effects of some of the abiotic factors.	2
		11BIO4.1.2.4	**Describe** the effects of some of the biotic factors.	2

		11BIO4.1.2.5	**Describe** the features of a population that is affected by the issue	2
		11BIO4.1.2.6	**Describe** the environment that is affected by the issue	2
		11BIO4.1.2.7	**Draw** a food chain/web for the community	2
		11BIO4.1.3.2	**Explain** the significance of food chains.	3
		11BIO4.1.3.3	**Explain** the significance of food webs.	3
		11BIO4.1.3.4	**Explain** how energy flows through different trophic levels in a community.	3
		11BIO4.1.4.1	**Discuss** human impacts on specific local ecosystems using specific examples.	4
		11BIO4.1.3.5	**Explain** the relationship between biodiversity and ecosystem survival.	3
		11BIO4.1.4.2	**Evaluate** the loss of biodiversity and its effects on the ecosystem survival.	4
		11BIO4.1.1.10	**Identify** an environmental issue that affects an ecosystem.	1
		11BIO4.1.4.3	**Discuss** the implications of an environmental issue that affects a particular ecosystem.	4
Diversity of organism	**11BIO4.2** *Upon the successful completion of this sub-strand, students are able to demonstrate understanding of the levels of classification and how the diversity of life can be classified into groups.*	11BIO4.2.1.1	**Define** biodiversity.	1
		11BIO4.2.1.2	**Define** classification.	1
		11BIO4.2.3.1	**Distinguish** between a common name and a scientific name .	3
		11BIO4.2.1.3	**Define** any of the level of classification: Kingdom/Phylum/Class/Order/ Genus.	1
		11BIO4.2.1.4	**Define** the level of classification: Species.	1
		11BIO4.2.2.1	**Classify** biodiversity in groups (Phylum/division or class) according to the criteria of similarity using sceintific names.	1

		11BIO4.2.2.2	**Describe** any of the levels of classification: Kingdom/Phylum/Class/ Order/Genus.	2
		11BIO4.2.2.3	**Define** the level of classification: Species.	2
		11BIO4.2.3.2	**Explain** why the classification of life under Kingdom is important.	3
		11BIO4.2.3.3	**Explain** why the classification of life under Phylum is important.	3
		11BIO4.2.3.4	**Explain** why the classification of life under Class is important.	3
		11BIO4.2.3.5	**Explain** why the classification of life under Order is important.	3
		11BIO4.2.3.6	**Explain** why the classification of life under Genus is important.	3
		11BIO4.2.3.7	**Explain** why the classification of life under Species is important.	3
Adaptive features	**11BIO4.3** *Upon the successful completion of this sub-strand, students are able to demonstrate understanding of adaptation as a characteristic that enables an organism to survive better in its habitat.*	11BIO4.3.1.1	**Identify** characteristics that help organisms survive in their habitats.	1
		11BIO4.3.2.2	**List** the characteristics that help organisms survive in their habitats.	2
		11BIO4.3.2.2	**Describe** the structural adaptation.	2
		11BIO4.3.2.3	**Describe** physiological adaptation.	2
		11BIO4.3.2.4	**Describe** behavioural adaptations.	2
		11BIO4.3.2.5	**Describe** life history adaptation.	2
		11BIO4.3.1.2	**Give** examples of each adaptation for a range of organisms.	1
		11BIO4.3.1.3	**Define** tolerance.	1
		11BIO4.3.1.4	**Define** optimum range.	1
		11BIO4.3.1.5	**Define** Gauze's principle.	1

		11BIO4.3.1.6	**Define** ecological niche.	1
		11BIO4.3.1.7	**Define** Liebig's law.	1
		11BIO4.3.4.1	**Discuss** how adaptations of organisms relate to tolerance, optimum range, Gauze's principle, ecological niche and Liebig's law.	4
		11BIO4.3.3.1	**Explain** how adaptations of organisms relate to optimum range.	3
		11BIO4.3.3.2	**Explain** how adaptations of organisms relate to Gauze's principle.	3
		11BIO4.3.3.3	**Explain** how adaptations of organisms relate to ecological niche.	3
		11BIO4.3.3.4	**Explain** how adaptations of organisms relate to Liebig's law.	3

STRAND 5: VARIATION AND EVALUATION				
Major Learning Outcome: 11BIO5		Upon the successful completion of this strand, students are able to demonstrate understanding of the different types of organisms and the hereditary characteristic appearing in successive generations of a population resulting in biological evolution.		
Sub-strand	**Key Learning Outcome**	**Code**	**Specific Learning Outcome**	**Skill Levels**
Variation in species	**11BIO5.1** *Upon the successful completion of this sub-strand, students are able to demonstrate understanding of the events that lead Darwin to the theory of natural selection.*	11BIO5.1.1.1	**Define** natural selection.	1
		11BIO5.1.1.2	**Identify** natural selection.	1
		11BIO5.1.1.3	**Define** artificial selection.	1
		11BIO5.1.1.4	**Identify** artificial selection.	1
		11BIO5.1.2.1	**Describe** Darwin's theory of natural selection.	2
		11BIO5.1.2.2	**List** the evidence to support Darwin's theory of natural selection.	2
		11BIO5.1.2.3	**Describe** the features of natural selections.	2
		11BIO5.1.2.4	**Describe** the features of artificial selections.	2
		11BIO5.1.3.1	**Compare** or contrast the two types of selection.	3
		11BIO5.1.2.5	**List** the advantages and disadvantages of these two types of selection using Darwin's finches.	2
		11BIO5.1.1.5	**Define** adaptive radiation.	1
		11BIO5.1.4.1	**Discuss** the causes of adaptive radiation, using examples.	4
		11BIO5.1.4.2	**Evaluate** the evidence of natural selection given by Darwin to support or negate his theory.	4

YEAR 12

STRAND 1: CELLULAR BIOLOGY				
Major Learning Outcome: 12BIO1		Upon successful completion of this strand, students are able to demonstrate understanding of the processes, mechanisms and significance of respiration, photosynthesis and cellular immunity		
Sub-strand	**Key Learning Outcome**	**Code**	**Specific Learning Outcome**	**Skill Levels**
Respiration	**12BIO1.1** *Upon successful completion of this sub-strand, students are able to describe and explain the role of respiration in the production of ATP in aerobic and anaerobic respiration.*	12BIO1.1.1.1	**Define** respiration.	1
		12BIO1.1.1.2	**Identify** the organelle in plant and animal cells where respiration occurs.	1
		12BIO1.1.2.1	**Describe** the structure of mitochondria.	2
		12BIO1.1.2.2	**List** the raw materials and products of respiration.	2
		12BIO1.1.2.3	**Identify** the three phases of respiration: glycolysis - Krebs cycle (Citric acid cycle), the respiratory chain (the shuttle of electrons), energy transport chain; and where they occur (ridges, matrix, cytoplasm).	2
		12BIO1.1.2.4	**Describe** the main activity or purpose of each phase of respiration: Krebs cycle, the respiratory chain, energy transport chain;	2
		12BIO1.1.4.1	**Discuss** the effect of factors such as substrate and temperature on the rate of reaction.	4
		12BIO1.1.3.1	**Compare** the products of aerobic and anaerobic respiration.	3
		12BIO1.1.2.5	**Describe** the effects of the products of aerobic and anaerobic respiration on plant and animal cells.	2

Photosynthesis	**12BIO1.2** *Upon successful completion of this sub-strand, students are able to explain the process in the two phases of photosynthesis.*	12BIO1.2.1.1	**Define** photosynthesis.	1
		12BIO1.2.1.2	**Define** the concept of a limiting factor.	1
		12BIO1.2.3.1	**Explain** the importance of photosynthesis to life on earth.	3
		12BIO1.2.1.3	**Identify** the organelles in the plant cell where photosynthesis occurs.	1
		12BIO1.2.2.1	**Describe** the structure of chloroplast.	2
		12BIO1.2.2.2	**Describe** the detailed structure of chloroplast and relate features to adaptations for photosynthesis.	2
		12BIO1.2.3.2	**Explain** how light energy is harnessed and converted into chemical energy during the light dependent reaction of photosynthesis.	3
		12BIO1.2.2.3	**Outline** the key stages of photosynthesis.	2
		12BIO1.2.4.1	**Discuss** the effect of limiting factors such as temperature, light intensity and carbondioxide concentration on the rate of reaction.	4
		12BIO1.2.2.4	**Identify** the factors that affect photosynthesis (eg. temperature, light intensity and carbon dioxide concentration).	2
		12BIO1.2.3.3	**Explain** the effect of light intensity, temperature and carbon dioxide concentration on the rate of photosynthesis.	3
		12BIO1.2.3.4	**Explain** the relationship between the light and the dark phases of photosynthesis.	3
		12BIO1.2.4.2	**Discuss** the results of an investigation into the effects of a factor on the rate of photosynthesis.	4

Cellular immunity	**12BIO1.3** *At the completion of this sub-strand, students are able to describe and explain the functions of antibodies*	12BIO1.3.2.1	Describe the properties of antibodies	2
		12BIO1.3.3.1	Explain how the properties of antibodies are used in the protection of the organism	3
		12BIO1.3.3.2	Explain the reason for mass production of a specific type of antibody to an antigen	3
		12BIO1.3.1.1	Define phagocytosis	1
		12BIO1.3.1.2	Define Vaccination	1
		12BIO1.3.2.2	Describe the role of B lymphocytes, T lymphocytes, antigen-presenting cells and memory cells in specific primary and secondary immune response.	2
		12BIO1.3.2.3	Describe the modes of actions of antibiotics such as penicillin on bacteria	2
		12BIO1.3.2.4	Describe the function of LTc: agents for maintaining the integrity of cell populations 1	2
		12BIO1.3.3.3	Explain the mechanism of LT4 in all acquired immune responses triggered by the intrusion of an antigen	3

Practical Skills	**12BIO1.4** *Upon successful completion of this sub-strand, Students are able to report on practical activities carried out to investigate biological principles*	12BIO1.4.1.1	**State** the aim of a practical investigation.	1
		12BIO1.4.1.2	**Identify**/**State** the topic of interest in the practical/laboratory activity.	1
		12BIO1.4.2.1	**Describe** the main idea of the practical activity.	2
		12BIO1.4.1.3	**State** a possible hypothesis for the practical activity.	1
		12BIO1.4.2.2	**Outline** the procedure or methodology of the investigation or practical activity.	2
		12BIO1.4.2.3	**List** the equipment/materials or resources used during activity.	2
		12BIO1.4.2.4	**Draw** a diagram of the experimental set up.	2
		12BIO1.4.2.5	**Present** the results of the practical activity in an acceptable format (table or graph).	2
		12BIO1.4.3.1	**Explain** the results of the practical activity.	3
		12BIO1.4.3.2	**Make** references based on the results.	3
		12BIO1.4.4.1	**Evaluate** the results and make recommendations for change.	4
		12BIO1.4.2.6	**Acknowledge** sources of information referred to for the practical and reporting.	2
		12BIO1.4.4.2	**Discuss** the results and draw conclusions.	4

STRAND 2: GENETICS				
Major Learning Outcome: 12BIO2		Upon successful completion of this strand, students are able to demonstrate understanding of the molecular structure and function of genes, the control of genes, heredity and variation in living organisms and gene behaviour in the context of a cell or organism.		
Sub-strand	**Key Learning Outcome**	**Code**	**Specific Learning Outcome**	**Skill Levels**
Mendelian inheritance	**12BIO2.1** *Upon successful completion of this substrand, students are able to discuss Mendel's experiments, results and conclusions and explain Mendel's three principles.*	12BIO2.1.2.1	**Describe** Mendel's crosses and results.	2
		12BIO2.1.3.1	**Explain** how genotype is linked to phenotype.	3
		12BIO2.1.1.1	**Define** segregation, independent assortment, crossing over, incomplete dominance, codominance, multiple allele,sex-linked genes.	1
		12BIO2.1.2.2	**Determine** which phenotypes are dominant and which are recessive from given genetic cross results.	2
		12BIO2.1.1.2	**Define** the terms: dominant and recessive alleles, heterozygous, homozygous, multiple alleles, genotype, phenotype.	1
		12BIO2.1.2.3	**Describe** Mendelian characteristics using the terms dominant and recessive alleles, heterozygous, homozygous, multiple alleles, genotype and phenotype.	2
		12BIO2.1.2.4	**Describe** the features of the following phenomena: complete dominance, incomplete dominance, and codominance.	2
		12BIO2.1.4.1	**Discuss** examples of complete dominance, incomplete dominance and codominance.	4
		12BIO2.1.3.2	**Distinguish** between monohybrid crosses from dihybrid crosses.	3
		12BIO2.1.4.2	**Evaluate** a punnet square to determine the characteristics of offsprings of a genetic cross.	4

Diversity and relatedness of organisms	**12BIO2.2** *Upon successful completion of this sub-strand, students are able to explain the anatomical similarities and the genetic control during embryonic development in vertebrates.*	12BIO2.2.2.1	**Describe** the anatomical similarities in vertebrates that result in a common plan of organization.	2
		12BIO2.2.3.1	**Compare** the position of the spinal cord in a mouse and a frog.	3
		12BIO2.2.2.2	**Describe** the different stages of the embryonic development in vertebrates.	2
		12BIO2.2.3.2	**Explain** the establishment of the organizational plan following a determined genetic program.	3
		12BIO2.2.1.1	**Define** homeotic genes.	1
		12BIO2.2.3.3	**Explain** the control of homeotic genes on major body plans.	3
		12BIO2.2.3.4	**Explain** the similarities or difference between the different levels of organisation.	3
		12BIO2.2.2.3	**List**/**Describe** the different levels of organization(cells, DNA and organism) leading to common origin of species.	2

STRAND 3: ORGANISM LEVEL BIOLOGY				
Major Learning Outcome: 12BIO3		Upon successful completion of this strand, students are able demonstrate understanding of the level of organization among plants and animals and their structure and function in relation to a selection of vital processes.		
Sub-strand	**Key Learning Outcome**	**Code**	**Specific Learning Outcome**	**Skill Levels**
Plant form and function	**12BIO3.1** *Upon successful completion of this sub-strand, students are able to describe and explain diversity in leaf, stem and root structure and function in various plant phyla.*	12BIO3.1.3.1	**Compare** specific features of leaf structure including the organisation of the vascular tissue (xylem and phloem).	3
		12BIO3.1.2.1	**Describe** a named specific feature of the leaf structure.	2
		12BIO3.1.1.1	**Name** a specific feature in the structure of a leaf.	1
		12BIO3.1.3.2	**Compare** specific stem structure including the organisation of the vascular tissue and pith.	3
		12BIO3.1.2.2	**Describe** a named specific feature of the stem structure.	2
		12BIO3.1.1.2	**Name** a specific feature in the structure of a stem.	1
		12BIO3.1.3.3	**Relate** these features of adaptation to their environment.	3
		12BIO3.1.2.3	**Describe** specific features of root structure including the vascular tissue (stele), pith, cortex and endodermis.	2
		12BIO3.1.1.3	**Name** a specific feature of the root structure.	1
		12BIO3.1.3.4	**Explain** the functions of leaf, steam and root in various plant phyla.	3

Animal circulatory systems	**12BIO3.2** *Upon successful completion of this sub-strand, students are able to explain why animals above a certain size require an internal transport system.*	12BIO3.2.4.1	**Discuss** the difference in efficiency between closed single, closed double and open circulatory systems, using specific examples.	4
		12BIO3.2.2.1	**List** the differences identified in relation to size and mobility of an insect, fish and human.	2
		12BIO3.2.3.1	**Explain** how the efficiency of the circulatory system of an insect relates to its size and mobility.	3
		12BIO3.2.3.2	**Explain** how the efficiency of the circulatory system of a fish relates to its size and mobility.	3
		12BIO3.2.3.3	**Explain** how the efficiency of the circulatory system of a human relates to its size and mobility.	3
		12BIO3.2.2.2	**Tabulate** the differences of the efficiency of the circulatory system in an insect, fish and human.	2
		12BIO3.2.1.1	**Identify** organisms with 2,3 and 4 chambered hearts.	1
		12BIO3.2.1.2	**Define** open/closed circulatory system.	1
		12BIO3.2.3.4	**Differentiate** between a single and a double circulatory system.	3
		12BIO3.2.2.4	**Describe** the features of a single/double circulatory system.	2
		12BIO3.2.4.1	**Discuss** reasons as to why animals above a certain size require an internal transport system using examples.	4

Excretion in animals	**12BIO3.3** *Upon successful completion of this sub-strand, students are able to state and explain the process involved in the production of carbon dioxide, water and nitrogenous wastes.*	12BIO3.3.1.1	**List** the main excretory organs in a fish, insect and human.	1
		12BIO3.3.1.2	**Identify** the excretory product of fish, insects and humans.	1
		12BIO3.3.2.1	**Describe** the structure of the main excretory organs or systems in fish, insects and humans.	2
		12BIO3.3.2.2	**Describe** the function of these specific excretory organs in fish, insects and humans.	2
		12BIO3.3.3.1	**Explain** the process involved in the production of carbon dioxide, water and nitrogenous wastes from fish, insects and humans.	3
		12BIO3.3.4.1	**Discuss** the efficiency of the excretory system of an organism and relate it to its environment in relation to carbon dioxide, water and nitrogenous waste: ammonia (fish), uric acid (insects) or urea (humans).	4
Nervous System	**12BIO3.4** *Upon successful completion of this sub-strand, students are able to describe the structure and function of the nervous system.*	12BIO3.4.2.1	**Describe** the structure of neurons.	2
		12BIO3.4.2.2	**Describe** the characteristics of neurons.	2
		12BIO3.4.3.1	**Explain** the mechanism of nervous signal production and transmission.	3
		12BIO3.4.1.1	**Define** action potential, resting potential.	1
		12BIO3.4.3.2	**Differentiate** between an action potential and a resting potential.	3
		12BIO3.4.3.3	**Differentiate** the actions of neuro transmitters between an action potential and a resting potential.	3
		12BIO3.4.3.4	**Explain** the function of chemical messengers provided by the nervous system.	3
		12BIO3.4.4.1	**Discuss** how the nervous, excretory and circulatory systems in a named animal work together to maintain a constant body evironment.	4

STRAND 4: ENVIRONMENTAL BIOLOGY				
Major Learning Outcome: 12BIO4		Upon successful completion of this strand, students are able to demonstrate understanding of how the natural ecosystem is affected by human activities, the classification of organisms into taxonomies and the different adaptations of most organisms.		
Sub-strand	**Key Learning Outcome**	**Code**	**Specific Learning Outcome**	**Skill Levels**
Communities	**12BIO4.1** *Upon successful completion of this sub-strand, students are able to describe the characteristics of a community (patterns and stability) and explain the role of a colonizing or pioneer species.*	12BIO4.1.1.1	**Define** community.	1
		12BIO4.1.2.1	**Describe** the characteristics of a community.	2
		12BIO4.1.2.2	**List** the features of zonation and stratification.	2
		12BIO4.1.3.1	**Differentiate** the pattern of zonation and stratification in an ecosystem.	3
		12BIO4.1.3.2	**Explain** how community succession and climax impacts the stability of a community.	3
		12BIO4.1.3.3	**Explain** how competition for living space, food and nutrients affects relationships in a community.	3
		12BIO4.1.3.4	**Distinguish** between the following relationships giving specific examples of each: predator - prey relationships, predation, parasitism, mutualism (symbiosis) and commensalism.	3
		12BIO4.1.1.2	**Define** what a pioneer species is.	1
		12BIO4.1.2.3	**Describe** the role of a pioneer species in a community.	2

Population	**12BIO4.2** *Upon successful completion of this sub-strand, students are able to describe the characteristics of a population (size and space) and explain the advantage of genetic variation for the survival of a population.*	12BIO4.2.1.1	**Define** the terms: population, natality, mortality, territory, home range, distribution and density.	1
		12BIO4.2.1.2	**Define** carrying capacity.	1
		12BIO4.2.1.3	**Identify** a survivorship curve from given sketches.	1
		12BIO4.2.2.1	**Sketch** the graph of a survivorship curve.	2
		12BIO4.2.3.1	**Relate** the shape of survivorship curves to natality and mortality.	3
		12BIO4.2.3.2	**Differentiate** between J-shaped and S-shaped growth curves and explain the phases of population growth that they illustrate.	3
		12BIO4.2.3.3	**Distinguish** between density dependent and density independent factors in a population.	3
		12BIO4.2.3.4	**Explain** the advantage of genetic variation to the survival of a population.	3
		12BIO4.2.4.1	**Discuss** the effects of genetic isolation on a population using specific examples.	4

STRAND 5: VARIATION AND EVOLUTION				
Major Learning Outcome: 12BIO5		At the end of this strand, students are able to demonstrate understanding of different types of organisms and the hereditary characteristics appearing in successive generations of a population resulting in biological evolution.		
Sub-strand	**Key Learning Outcome**	**Code**	**Specific Learning Outcome**	**Skill Levels**
Patterns of Evolution	**12BIO5.1** *Upon successful completion of this sub-strand, students are able to evaluate the different patterns of evolution such as divergent evolution, adaptive radiation, and convergent and parallel evolution.*	12BIO5.1.1.1	**Define** divergent evolution, convergent evolution, parallel evolution.	1
		12BIO5.1.2.1	**Describe** the conditions that contributed to divergent, convergent or parallel evolution.	2
		12BIO5.1.2.2	**Describe** the features of adaptive radiation using Darwin's finches.	2
		12BIO5.1.2.3	**Describe** the results of divergent, parallel or convergent evolution using a relevant example.	2
		12BIO5.1.3.1	**Explain** how parallel evolution occurs using wingless birds and insects.	3
Speciation	**12BIO5.2** *Upon successful completion of this sub-strand (topic) students are able to differentiate between allopatric and sympatric speciation and describe isolating mechanisms (barriers and isolations).*	12BIO5.2.1.1	**Define** the two types of speciation: allopatric and sympatric	1
		12BIO5.2.1.2	**Define** pre-zygotic isolation, post-zygotic isolation	1
		12BIO5.2.2.1	**Describe** the process of isolation, whether pre-zygotic or post-zygotic	2
		12BIO5.2.2.2	**Describe** the results of isolation, whether pre-zygotic or post-zygotic	2
		12BIO5.2.3.1	**Differentiate** between the two types of speciation using examples	3
		12BIO5.2.4.1	**Discuss** barriers that may cause speciation such as ecological and reproductive barriers, as well as pre-zygotic and post- zygotic isolations	4
		12BIO5.2.3.2	**Explain** how pre-zygotic and post-zygotic isolation mechanisms differ	3
		12BIO5.2.4.2	**Discuss** the impact of pre-zygotic and post-zygotic isolation mechanisms on populations, using specific examples	4

Section 3

ASSESSMENT AND REPORTING

Assessment

Assessment is a term that describes the processes that are used to identify and gather data about the performance of learners and to analyse and interpret these data to determine progress made towards achieving curriculum standards. (VNCS, p. 24).

The Biology syllabus will be assessed through a variety of assessment techniques to ensure that the learning outcomes are attained.

The internal and continuous assessments will reflect the syllabus content and the learning outcomes specified in each section of the syllabus:

Year 11

Assessment in Biology courses will be in line with that statement and therefore students will be assessed in year 11 using these two modes:

1. Internal Examination (IE) : 60%
2. Continuous Assessment (CA) : 40%

The table below gives the weights and distribution of items based on the two types of assessments that guide the teacher and the examiner in the design of the internal and continuous assessments.

			Skill Levels				Total
			1	**2**	**3**	**4**	
Assessment Type	IE	**Weight**	10	26	12	12	**60**
		Number of items	10	13	4	3	30
	CA	**Weight**	7	16	9	8	**40**
		Number of items	7	8	3	2	20

For Year 11 Biology course, the assessment is in two parts (Internal Examination and Continous Assessment), and is made up of the two assessment components:

1. **Internal Examination (IE) 60%**
2. **Continous Assessment (CA) 40%**

Assessment Blueprint

The assessment blueprint for Biology course is given below. The weighting for each strand and skills level is to be noted as these will be adhered to for assessment.

Strand	Assessment Type	Skill Level/Score				Weight
		1	2	3	4	
1. Cellular Biology	IE					14
	CA					15
2. Genetics	IE					11
	CA					10
3. Organisms Level Biology	IE					15
	CA					15
4. Environmental Biology	IE					14
	CA					
5. Variation and Evolution	IE					6
	CA					
Total number of items		**11**	**16**	**10**	**6**	**40**
Total skill score		**11**	**32**	**33**	**24**	**100**

Internal Examination (EA)

The examination time will be 2 hours long with a total of 60. It will consist of short answer questions, paragraph responses and essay questions. The examination will assess a range of outcomes specified in this prescription. All sections will be represented in the examination.

The weighting attributable to each section will be:

1. Cellular Biology	14%
2. Genetics	11%
3. Organisms Level Biology	15%
4. Environmental Biology	14%
5. Variation and Evolution	6%
Total	**60%**

The examination will assess a range of specific learning outcomes (SLO) in this syllabus. All sections will be represented in the examination.

All questions are COMPULSORY

Continuous assessment

Tasks	Assessment Types	Description	Strands	Weighting (%)
1	Teacher Design Task (TDT)			
2	Teacher Design Task (TDT)			
3	Common Assessment Task (CAT)			
	Total			**40**

Year 12

Assessment in Biology courses will be in line with that statement and therefore students will be assessed in year 11 using these two modes:

1. Internal Examination (IE) : 60%
2. Continuous Assessment (CA) : 40%

The table below gives the weights and distribution of items based on the two types of assessments that guide the teacher and the examiner in the design of the internal and continuous assessments.

			Skill Levels				**Total**
			1	**2**	**3**	**4**	
Assessment Type	IE	**Weight**	10	26	12	12	**60**
		Number of items	10	13	4	3	30
	CA	**Weight**	7	16	9	8	**40**
		Number of items	7	8	3	2	20

For Year 12 Biology course, the assessment is in two parts (Internal Examination and Continous Assessment), and is made up of the two assessment components:

1. **Internal Examination (IE) 60%**
2. **Continous Assessment (CA) 40%**

Assessment Blueprint

The assessment blueprint for Biology course is given below. The weighting for each strand and skills level is to be noted as these will be adhered to for assessment.

Strand	Assessment Type	Skill Level/Score				Weight
		1	2	3	4	
1. Cellular Biology	IE					14
	CA					
2. Genetics	IE					11
	CA					
3. Organisms Level Biology	IE					15
	CA					
4. Environmental Biology	IE					14
	CA					
5. Variation and Evolution	IE					6
	CA					
Total number of items		**11**	**16**	**10**	**6**	**40**
Total skill score		**11**	**32**	**33**	**24**	**100**

Internal Examination (EA)

The examination time will be 3 hours long with a total of 60. It will consist of short answer questions, paragraph responses and essay questions. The examination will assess a range of outcomes specified in this prescription. All sections will be represented in the examination.

The weighting attributable to each section will be:

1. Cellular Biology	14%
2. Genetics	11%
3. Organisms Level Biology	15%
4. Environmental Biology	14%
5. Variation and Evolution	6%
Total	**60%**

The examination will assess a range of specific learning outcomes (SLO) in this syllabus. All sections will be represented in the examination.

All questions are COMPULSORY

Continuous assessment

Tasks	Assessment Types	Description	Strands	Weighting (%)
1	Teacher Design Task (TDT)			
2	Teacher Design Task (TDT)			
3	Common Assessment Task (CAT)			
	Total			**40**

Reporting

Reporting is an essential part of the students learning. Reporting involves feedback on the performances of the student. Reporting helps the students to see the progress in their learning.

Information on reporting involves: the student's marks, grades, and the teacher's comments and appraisals of the students' performance and progress. Information on reports is very important as it is used to compare students with other students, and schools with other schools.

The school must make a written report about the pupil's performance on a regular basis to parents, and to other teachers.

Individual reporting will be done twice a year, after the Midyear and the Final Examinations; and discuss with pupils and their parents.

The Grading system will be standardized or common for all schools. These standards are set by the Evaluation and Assessment Unit.

The Evaluation and Assessment Unit will report final results of individual pupils using official certificates.

Links to other subjects

Biology is not an independent subject; it is linked to other disciplines within the syllabus including:

- Family Life
- Personal Development
- Agriculture
- Chemistry
- Geography
- Earth Science
- Physics

- Mathematics
- Library
- Laboratory & Equipment
- Computer Laboratory

Text Books

Allan, R. (2008). 2010, OCR Biology AS. Student Workbook.. Biozone International Ltd. New Zealand (ISBN 978-1-877462-16-0)

Allan, R. (2009). 2010, OCR Biology A2. Student Workbook. Biozone International Ltd. New Zealand (ISBN 978-1-877462-38-2)

Allan, R. (2010). Level 7 Biology 2011 Student Workbook Model Answers: 2011. Biozone. New Zealand (ISBN 978-1-877462-79-5)

Allan, R. (2010). Level 7 Biology 2011 Student Workbook. Biozone International Ltd. New Zealand (ISBN 978-1-877462-77-1)

Allan, R. (2010). Level 8 Biology 2011 Student Workbook Model Answers: 2011. Biozone. New Zealand (ISBN 978-1-877462-80-1)

Allan, R. (2010). Level 8 Biology 2011 Student Workbook. Biozone International Ltd. New Zealand (ISBN 978-1-877462-78-8)

Allan, R. & Greenwood, T. (1998). Year 11 Biology 1999, Student Resource and Activity Manual. Fifth Ed. BioZone The Biology Learning Media Company. New Zealand

(ISBN 0-909031-30-4)

Allan, R. & Greenwood, T. (2003). Year 12 Biology 2004, Student Resource and Activity Manual. Eleventh Ed. BioZone The Biology Learning Media Company. New Zealand *(ISBN 1-877329-17-7)*

Allan, R., Greenwood, T., and Rendle, J. (2001) Year 13 Biology Student Resource and Activity Manual. Biozone International Ltd, Hamilton.

Anna Roberts. (2011). Level 2 Biology Study Guide. ESA Publications. New Zealand. (ISBN 978-1-927194-11-9)

Bailey, A. & Bunn, T. (2000). NCEA Level 2 BIOLOGY. Year 12 Study Guide. ESA Publication. New Zealand

Bayley, M. (2000) Designs of Life (2nd Edn.): Biology for Year 13 students. Pearson Education New Zealand Limited, Auckland. (ISBN 0 582 54285 5)

Burn, T. (1992). Form 6 Biology Revision. ESA Publication Ltd. Hong Kong. (ISBN 0-908756-47-X)

Campbell, N., Mitchell, L., Reece, J. (1997).Biology Concepts and Connection. 2nd Edition. The Benjamin/Cummings Publishing Company. California. (ISBN: 0-8053-2022-9)

Campbell, N., Mitchell, L., Reece, J. (2000) Biology Concepts and Connection. 3RD Edition. The Benjamin/Cummings Publishing Company. San Francisco. (ISBN 0-8053-6585-0)

Hanson, M. and Sinclair, M. (2006). Year 13 Study Guide: NCEA Level 3 Biology. ESA Publications Ltd, Auckland.

King, R.J. & Sullivan, F.M (1991). Senior Biology. Longman. (Melbourne. ISBN 0 582 86783 5)

Lizeaux, C. and Baude, D. (2008). Niveau TermS, Sciences de la Vie et de la Terre, Edition 2008. Bordas. *(ISBN 978-2-04-732340-3)*

PSSC Science Practical – using a minimum of equipment, Teachers Handbook Biology. (1993). Fiji. South Pacific Board of Education Assessment. *(ISBN 982-299-002-2)*

Relph, D. Pedder, R. & DeLacey, L. (1986). A Textbook for Senior Biology Life Science. Heinemann Education. Hong Kong. *(ISBN 0 86863 115 9)*

Roberts, A. (2011). ESA Study Guide Level 2 Biology. ESA Publications. New Zealand. (ISBN 978-927194-11-9)

Tavernier, R. and Lizeaux, C. (1993). Niveau 2nde, Sciences de la Vie et de la Terre, Programme 1993, Edition. Bordas. *(ISBN 2-04-019729-X)*

Tavernier, R. and Lizeaux, C. (2004). Niveau 2nde, Sciences de la Vie et de la Terre, Edition 2004. Bordas. *(ISBN 978-2-04-729868-8)*

Tavernier, R. and Lizeaux, C. (2001). Niveau 1èreS, Sciences de la Vie et de la Terre, Programme 2001, Edition. Bordas. *(ISBN 2-04729411-8)*

Towle, A. (1993). Modern Biology. Orlando. Holt, Rinehart and Winston, Inc. (ISBN 0-03-074882-8)

Internet Resources

www.teachervision.fen.com/curriculum-planning/printable/52434.html

www.llcc.edu, biology.about.com/, www.biologycorner.com/

highered.mcgrawhill.com/sites/dl/free/0072437316/120060/ravenanimation.html

www.biozone.co.nz/, en.wikipedia.org, www.cnrs.fr/cnrs-images/sciencesdelavieaulycee/

fr.wikipedia.org/wiki/Portail:Biologie

Other Resources

South Pacific Form Seven Certificate, Biology Prescription 2003, SPBEA, Suva Fiji

Pacific Senior Secondary Certificate, Biology Prescription 2009, SPBEA, Suva Fiji

Le programme national des Sciences de la Vie et de la Terre de l'année 11 à 13, Edition 2005 à 2007, Ministère de l'Education, Vanuatu

Le programme des Sciences de la Vie et de la Terre du DAEU

Basic Science for Vanuatu, Syllabus,1997 Ministry Of Education, Vanuatu

Class 1–6 syllabus

Vanuatu National Curriculum Statement. 2010. Ministry of Education, Port Vila: Ministry of Education.