



Government of **Western Australia**
School Curriculum and Standards Authority

BIOLOGY

GENERAL COURSE

Year 11 syllabus

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Important information

This syllabus is effective from 1 January 2024.

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Rationale

Through biology, we investigate and answer questions about the living world. Investigation of biological systems and their interactions, from cellular processes to ecosystem dynamics, has led to biological knowledge and understanding that enable us to explore and explain everyday observations, and find solutions to biological issues. Biological knowledge is continually refined in the light of new evidence.

In the Biology General Year 11 course, students investigate the cell as the basic unit of living systems, and how organisms solve problems to survive.

The Biology General course provides opportunities for students to develop an understanding of important science concepts and processes, the practices used to develop scientific knowledge, of science's contribution to our culture and society, and its applications in our lives. The course supports students to develop the scientific knowledge, understandings and skills to make informed decisions about local, national and global issues.

Through this course, students can become questioning, reflective and critical thinkers about biological issues. Biology highlights the importance of reasoning and respect for evidence. Students consider different perspectives on ethical, environmental and sustainability issues. This process enables students to use evidence to make informed judgements and decisions about controversial biological issues that directly affect their lives and the lives of others.

Biological sciences introduce students to a variety of skills in biological investigations. Students learn to develop and test hypotheses, plan and conduct ethical investigations, and begin to appreciate the critical importance of evidence in forming conclusions. This course enables students to communicate their understandings to different audiences for a range of purposes.

In addition to its practical applications, learning science is a valuable pursuit in its own right. Students can experience the joy of scientific discovery and nurture their natural curiosity about the world around them. In doing this, they develop critical and creative thinking skills, challenge themselves to identify questions, and draw evidence-based conclusions using scientific methods. In order to develop their students' scientific literacy, teachers should use an inquiry-based contextual approach wherever possible.

Aims

The Biology General course aims to develop students’:

- sense of wonder and curiosity about life and respect for all living things and the environment
- understanding of major biological concepts, theories and models related to biological systems
- appreciation of how biological knowledge has developed over time and continues to develop; how scientists use biology in a wide range of applications; and how biological knowledge influences society in local, regional and global contexts
- ability to plan and carry out fieldwork, laboratory and other research investigations, including the collection and analysis of qualitative and quantitative data and the interpretation of evidence
- ability to use sound, evidence-based arguments when evaluating claims and applying biological knowledge
- ability to communicate biological understanding, findings, arguments and conclusions using appropriate representations, modes and genres.

Organisation

This course is organised into a Year 11 syllabus and a Year 12 syllabus. The cognitive complexity of the syllabus content increases from Year 11 to Year 12.

Structure of the syllabus

The Year 11 syllabus is divided into two units, each of one semester duration, which are typically delivered as a pair. The notional time for each unit is 55 class contact hours.

Unit 1 – Classification and cell processes

This unit explores the diversity of organisms and how scientists make sense of the natural world. Microscopic activities of cells provide students with first hand opportunities to explore a world not usually observed. Many everyday applications can be explained and explored through the understanding of cell processes, such as fermentation and plant growth. A deep understanding of a local area is complemented by collection and preservation of specimens and the use of classification keys.

Unit 2 – Solving problems to survive

This unit explores ways in which animals and plants exchange and transport materials between the internal and external environment. Through practical activities, students will study specialised structures and systems used for gas exchange, obtaining nutrients, removal of wastes and transport of materials, in a wide a range of animals and plants. Investigations will be conducted into adaptations in terrestrial and aquatic environments. These will involve visits to local ecosystems, herbariums, museums, parks or zoos.

Each unit includes:

- a unit description – a short description of the focus of the unit
- unit content – the content to be taught and learned.

Organisation of content

Science strand descriptions

The Biology General course has three interrelated strands: Science Inquiry Skills, Science as a Human Endeavour and Science Understanding which build on students' learning in the Year 7–10 Science curriculum. The three strands of the Biology General course should be taught in an integrated way. The content descriptions for Science Inquiry Skills, Science as a Human Endeavour and Science Understanding have been written so that this integration is possible in each unit.

Science Inquiry Skills

Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting data; and communicating findings. This strand is concerned with evaluating claims, investigating ideas, solving problems, reasoning, drawing valid conclusions, and developing evidence-based arguments.

Science investigations are activities in which ideas, predictions or hypotheses are tested, and conclusions are drawn in response to a question or problem. Investigations can involve a range of activities, including experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations. The investigation design will depend on the context and subject of the investigation.

Science as a Human Endeavour

Science concepts, models and theories are reviewed as their predictions and explanations are continually re-assessed through new evidence, often through the application of new technologies. This review process involves a diverse range of scientists working within an increasingly global community of practice.

The application of science may provide great benefits to individuals, the community and the environment, but may also pose risks and have unintended consequences. As an ever-evolving body of knowledge, science frequently informs public debate, but is not always able to provide definitive answers.

Science Understanding

Science understanding is evident when a person selects and integrates appropriate science concepts, models and theories to explain and predict phenomena, and applies those concepts, models and theories to new situations.

The Science Understanding content in each unit develops students' understanding of the key concepts, models and theories that underpin the subject, and of the strengths and limitations of different models and theories for explaining and predicting complex phenomena.

Science Understanding can be developed through the selection of contexts that have relevance to, and are engaging for, students. The science curriculum has been designed to provide jurisdictions, schools and teachers with the flexibility to select contexts that meet the social, geographic and learning needs of their students.

Safety

Science learning experiences may involve the use of potentially hazardous substances and/or hazardous equipment. It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students and that school practices meet the requirements of the *Work Health and Safety Act 2011*, in addition to relevant state or territory health and safety guidelines.

Animal ethics

Through a consideration of research ethics as part of Science Inquiry Skills, students will examine their own ethical position, draw on ethical perspectives when designing investigation methods, and ensure that any activities that impact on living organisms comply with the *Australian code of practice for the care and use of animals for scientific purposes* (www.nhmrc.gov.au).

Any teaching activities that involve the care and use of, or interaction with, animals must comply with the *Australian code of practice for the care and use of animals for scientific purposes*, in addition to relevant State guidelines.

Mathematical skills expected of students studying the Biology General course

The Biology General course requires students to use the mathematical skills they have developed through the Year 7–10 Mathematics curriculum, in addition to the numeracy skills they have developed through the Science Inquiry Skills strand of the Science curriculum.

Within the Science Inquiry Skills strand, students are required to gather, represent and analyse numerical data to identify the evidence that forms the basis of scientific arguments, claims or conclusions. In gathering and recording numerical data, students are required to make measurements using appropriate units to an appropriate degree of accuracy.

It is assumed that students will be able to:

- perform calculations involving addition, subtraction, multiplication and division of quantities
- perform approximate evaluations of numerical expressions
- express fractions as percentages, and percentages as fractions
- calculate percentages
- recognise and use ratios
- translate information between graphical and numerical forms
- distinguish between discrete and continuous data then select appropriate forms, variables and scales for constructing graphs
- construct and interpret frequency tables and diagrams, pie charts and histograms
- describe and compare data sets using mean
- interpret the slope of a linear graph.

Progression from the Year 7–10 curriculum

The Biology General course continues to develop student understanding and skills across the three strands of the Year 7–10 Science curriculum. In the Science Understanding strand, this syllabus draws on knowledge and understanding from across the four sub-strands of Biological, Physical, Chemical, and Earth and Space sciences.

In particular, this syllabus continues to develop the key concepts introduced in the Biological Sciences sub-strand, that is, that a diverse range of living things have evolved on Earth over hundreds of millions of years, that living things are interdependent and interact with each other and their environment, and that the form and features of living things are related to the functions their systems perform.

Representation of the general capabilities

The general capabilities encompass the knowledge, skills, behaviours and dispositions that will assist students to live and work successfully in the twenty-first century. Teachers may find opportunities to incorporate the capabilities into the teaching and learning program for the Biology General course. The general capabilities are not assessed unless they are identified within the specified unit content.

Literacy

Literacy is important in students' development of Science Inquiry Skills and their understanding of content presented through the Science as a Human Endeavour and Science Understanding strands. Students gather, interpret, synthesise and critically analyse information presented in a wide range of genres, modes and representations (including text, flow diagrams, symbols, graphs and tables). They evaluate information sources and compare and contrast ideas, information and opinions presented within and between texts. They communicate processes and ideas logically and fluently and structure evidence-based arguments, selecting genres and employing appropriate structures and features to communicate for specific purposes and audiences.

Numeracy

Numeracy is key to students' ability to apply a wide range of Science Inquiry Skills, including making and recording observations; ordering, representing and analysing data; and interpreting trends and relationships. They employ numeracy skills to interpret complex spatial and graphic representations, and to appreciate the ways in which biological systems are structured, interact and change across spatial and temporal scales. They engage in analysis of data, including issues relating to reliability and probability, and they interpret and manipulate mathematical relationships to calculate and predict values.

Information and communication technology capability

Information and communication technology (ICT) capability is a key part of Science Inquiry Skills. Students use a range of strategies to locate, access and evaluate information from multiple digital sources; to collect, analyse and represent data; to model and interpret concepts and relationships; and to communicate and share science ideas, processes and information. Through exploration of Science as a Human Endeavour concepts, students assess the impact of ICT on the development of science and the application of science in society, particularly with regard to collating, storing, managing and analysing large data sets.

Critical and creative thinking

Critical and creative thinking is particularly important in the science inquiry process. Science inquiry requires the ability to construct, review and revise questions and hypotheses about increasingly complex and abstract scenarios and to design related investigation methods. Students interpret and evaluate data; interrogate, select and cross-reference evidence; and analyse processes, interpretations, conclusions and claims for validity and reliability, including reflecting on their own processes and conclusions. Science is a creative endeavour and students devise innovative solutions to problems, predict possibilities, envisage consequences and speculate on possible outcomes as they develop Science Understanding and Science Inquiry Skills. They also appreciate the role of critical and creative individuals and the central importance of critique and review in the development and innovative application of science.

Personal and social capability

Personal and social capability is integral to a wide range of activities in the Biology General course, as students develop and practise skills of communication, teamwork, decision-making, initiative-taking and self-discipline with increasing confidence and sophistication. In particular, students develop skills in both independent and collaborative investigation; they employ self-management skills to plan effectively, follow procedures efficiently and work safely; and they use collaboration skills to conduct investigations, share research and discuss ideas. In considering aspects of Science as a Human Endeavour, students also recognise the role of their own beliefs and attitudes in their response to science issues and applications, consider the perspectives of others, and gauge how science can affect people's lives.

Ethical understanding

Ethical understanding is a vital part of science inquiry. Students evaluate the ethics of experimental science, codes of practice, and the use of scientific information and science applications. They explore what integrity means in science, and they understand, critically analyse and apply ethical guidelines in their investigations. They consider the implications of their investigations on others, the environment and living organisms. They use scientific information to evaluate the claims and actions of others and to inform ethical decisions about a range of social, environmental and personal issues and applications of science.

Intercultural understanding

Intercultural understanding is fundamental to understanding aspects of Science as a Human Endeavour, as students appreciate the contributions of diverse cultures to developing science understanding and the challenges of working in culturally diverse collaborations. They develop awareness that raising some debates within culturally diverse groups requires cultural sensitivity, and they demonstrate open-mindedness to the positions of others. Students also develop an understanding that cultural factors affect the ways in which science influences and is influenced by society.

Representation of the cross-curriculum priorities

The cross-curriculum priorities address contemporary issues which students face in a globalised world. Teachers may find opportunities to incorporate the priorities into the teaching and learning program for the Biology General course. The cross-curriculum priorities are not assessed unless they are identified within the specified unit content.

Aboriginal and Torres Strait Islander histories and cultures

Contexts that draw on Aboriginal and Torres Strait Islander histories and cultures provide opportunities for students to recognise the importance of Aboriginal and Torres Strait Islander Peoples' knowledge in developing a richer understanding of the Australian environment. Students could develop an appreciation of the unique Australian biota and its interactions, the impacts of Aboriginal and Torres Strait Islander Peoples on their environments and the ways in which the Australian landscape has changed over tens of thousands of years. They could examine the ways in which Aboriginal and Torres Strait Islander knowledge of ecosystems has developed over time and the spiritual significance of Country/Place.

Asia and Australia's engagement with Asia

Contexts that draw on Asian scientific research and development and collaborative endeavours in the Asia Pacific region provide an opportunity for students to investigate Asia and Australia's engagement with Asia. Students could explore the diverse environments of the Asia region and develop an appreciation that interaction between human activity and these environments continues to influence the region, including Australia, and has significance for the rest of the world. By examining developments in biological science, students could appreciate that the Asia region plays an important role in scientific research and development, including through collaboration with Australian scientists, in such areas as medicine, natural resource management, biosecurity and food security.

Sustainability

The Sustainability cross-curriculum priority is explicitly addressed in the Biology curriculum. The Biology General course provides authentic contexts for exploring, investigating and understanding the function and interactions of biotic and abiotic systems across a range of spatial and temporal scales. By investigating the relationships between biological systems and system components, and how systems respond to change, students develop an appreciation for the interconnectedness of the biosphere. Students appreciate that biological science provides the basis for decision making in many areas of society and that these decisions can affect the Earth system. They understand the importance of using science to predict possible effects of human and other activity, and to develop management plans, or alternative technologies, that minimise these effects and provide for a more sustainable future.

Unit 1 – Classification and cell processes

Unit description

In the era of European exploration of the world, many collectors returned from their travels with fantastic specimens of organisms found in distant lands. Some were known, but others, such as the platypus, were particularly hard to believe. Problems arose in identifying and naming specimens. In 1735, Linnaeus developed a hierarchical naming system to bring order to the huge amount of information provided from these collections. Having this system in place helps scientists to understand the common features of groups and the possible evolutionary links between them. With the introduction of the microscope, cells were recognised as the basic unit of life presenting challenges to the classification of some organisms. It is at the microscopic level that the kingdoms of living things can be separated, based on their structures and the processes occurring in cells.

In this unit, students will explore both classification and cell structures, looking for similarities and differences in cells and organisms, using the microscope and field observations. They will develop and use classification keys, using local area specimens to recognise the limitations and processes of classification. Students will also investigate the cellular processes of photosynthesis and respiration.

Unit content

This unit includes the knowledge, understandings and skills described below.

Science Inquiry Skills

- construct questions for investigation; propose hypotheses; and predict possible outcomes
- plan, select and use appropriate investigation methods, including laboratory experimentation and microscopy techniques, to collect reliable data; assess risk and address ethical issues associated with these methods
- represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error; and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate the conclusions by considering the quality of available evidence
- use appropriate representations, including classification keys, diagrams of structures and processes, and images from different imaging techniques, to communicate conceptual understanding, solve problems and make predictions
- communicate scientific ideas and information for a particular purpose, using appropriate scientific language, conventions and representations

Science as a Human Endeavour

- classification is a human construct which allows scientists to easily communicate information regarding organisms, and is constantly under discussion and review based on new information and evidence; for example, eucalypts, *Phytophthora dieback*, human evolutionary groups

- keys are limited in their application due to their range and examples used in their construction; for example, snakes of WA
- use of classification keys is vital to solving life threatening situations, including identification of species for selection of anti-venom, and source of suspected food poisoning
- herbariums, museums and zoos provide reference collections for classification of unknown species
- the cell membrane model has been continually reconceptualised and revised since the mid-nineteenth century, and the currently accepted model, based on the evidence from improved technologies, is the fluid mosaic model
- developments in microscopy and associated preparation techniques have contributed to more sophisticated models of cell structure and function
- fermentation, a type of anaerobic respiration carried out by yeasts and bacteria, is used in the production of food and beverages
- commercial plant growth can be controlled by altering the conditions for photosynthesis

Science Understanding

Classification

- biological classification is hierarchical and based on different levels of similarity of physical features, methods of reproduction and molecular sequences
- binomial nomenclature is used to provide individual species with a unique name based on classification through the hierarchy
- the functional unit of classification is the species, which is a group of morphologically or genetically similar individuals, or a group of organisms, that are able to interbreed to produce fertile offspring in natural conditions – but, in all cases, exceptions are found

Cell processes

- living organisms require inputs and produce outputs that need to be exchanged with the environment. Energy requirements of organisms are reflected in their lifestyle, energy source and cellular contents
- the cell is the smallest unit of all organisms that carries out life processes necessary for survival
- in eukaryotic cells there are many specialised organelles whose functions include control of cell activities, such as photosynthesis, respiration and removal of cell products. These processes are carried out efficiently due to the structure and function of:
 - cytoplasm
 - nucleus
 - mitochondria
 - chloroplasts
 - plasma membrane
 - cell wall
 - vacuoles

- transport of substances across the cell membrane occur through processes of
 - diffusion
 - osmosis
 - active transport
- factors affecting the rate of exchange of materials include:
 - surface area to volume ratio
 - concentration gradient
- prokaryotic cells exhibit less complexity of structure than cells found in eukaryotic organisms and can be identified by:
 - having no clearly defined internal organelles
 - being significantly smaller than eukaryotes
 - having a circular chromosome (plasmid)
 - existing as single cells
- plant and animal cells show differences in structure and function based on their energy source
- photosynthesis and respiration are the two processes that provide the useable energy for living organisms and are affected by environmental and cellular conditions; these processes can be summarised using word equations

Unit 2 – Solving problems to survive

Unit description

All organisms, large and small, need to exchange materials with their environment. Microorganisms have direct contact with their surroundings, but cells within multicellular organisms have to rely on the body systems to exchange materials with the outside. Organisms have a range of specialised structures and systems used in gaseous exchange. Different organisms have solved these problems efficiently in their own environment through their particular adaptations. Adaptations of organisms for the biotic and abiotic factors found in a variety of terrestrial and aquatic habitats enable organisms to survive conditions, such as coping with extremes of temperature, obtaining water or escaping predators.

This unit provides opportunities to engage in practical activities to observe and compare systems and model how these systems work. Students will study adaptations of organisms in terrestrial and aquatic environments. Visits to herbariums, museums, parks and zoos provide the opportunity to observe a variety of organisms, and how adaptations enhance survival in different environments.

Unit content

This unit builds on the content covered in Unit 1.

This unit includes the knowledge, understandings and skills described below.

Science Inquiry Skills

- construct questions for investigation; propose hypotheses; and predict possible outcomes
- plan, select and use appropriate investigation methods, including observation of organisms in their environment, laboratory experimentation, and real or virtual dissections to collect reliable data; assess risk and address ethical issues associated with these methods
- represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error; and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate the conclusions by considering the quality of available evidence
- use appropriate representations, including diagrams of structures and processes to communicate conceptual understanding, solve problems and make predictions
- communicate scientific ideas and information for a particular purpose using appropriate scientific language, conventions and representations

Science as a Human Endeavour

- the use of animals in research has played an important role in furthering scientific understanding of the structure and function of multicellular organisms. Ethical use of animals is regulated by state laws
- human intervention increases the chances of survival in agricultural crops by producing strains of plants to cope with adverse environmental conditions; for example, salt tolerant wheat strains
- many Australian plants and animals have unique features that enable them to survive in the harsh Australian environment
- parks, museums, herbariums and zoos enable the community to appreciate a variety of organisms and their adaptations that enhance survival in different environments.

Science Understanding

Functioning organisms

- the complexity of systems allows for efficient exchange of materials between cells and the environment
- exchange surfaces are thin and moist, have a large surface area and a good blood supply:
 - significance of surface area to volume ratio
 - concentration gradient
- different organisms have a range of specialised structures and surfaces for gas exchange:
 - animals (lungs, gills, spiracles, skin)
 - plants (leaves, stems)
- most animals need to digest food to release useable nutrients and obtain energy
- plants and animals have a range of specialised structures for obtaining nutrients that are dependent upon the mode of nutrition:
 - animals (carnivorous, herbivorous and parasitic)
 - plants, fungi and bacteria (photosynthetic, chemosynthetic, saprophytic, parasitic and insectivorous)
- many animals remove metabolic wastes (nitrogenous, water, salts, gases) through the digestive system, skin, lungs and/or the kidneys before they accumulate to toxic levels
- plants use active methods to remove toxins and salts
- large multicellular organisms have transport systems to allow efficient exchange of substances between the cells and the environment:
 - plants (xylem and phloem)
 - animals (open and closed systems, role of the heart)

Adaptations

- environmental factors that affect an organism's survival include availability of resources (including food, light, water and gases) as well as variations in temperature, salinity, water turbulence, supporting the body against gravity and escaping predators
- organisms have adaptations (structural, physiological and/or behavioural) to meet these challenges in their particular environment

- organisms in terrestrial habitats meet these challenges in different ways
 - animals have adaptations for obtaining food and oxygen, escaping predators, supporting their body against gravity and coping with changes in temperature
 - vascular plants have adaptations for obtaining energy, supporting their body against gravity and coping with variability of water availability and temperature
- organisms in aquatic habitats meet these challenges in different ways
 - animals have adaptations for movement, buoyancy, efficient gas exchange and coping with low or high levels of salinity
 - vascular plants and algae have adaptations for efficient gas exchange, obtaining light, anchorage and support; for example, mangroves, water lilies, kelp

School-based assessment

The *Western Australian Certificate of Education (WACE) Manual* contains essential information on principles, policies and procedures for school-based assessment that needs to be read in conjunction with this syllabus.

Teachers design school-based assessment tasks to meet the needs of students. The table below provides details of the assessment types for the Biology General Year 11 syllabus and the weighting for each assessment type.

Assessment table – Year 11

Type of assessment	Weighting
<p>Science inquiry Science inquiry involves posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting data; and communicating findings. Assessment can take the form of practical work or investigation.</p> <p>Science inquiry: practical Practical work can involve a range of activities, such as practical tests; modelling and simulations; observation checklists; and brief summaries of practical activities.</p> <p>Science inquiry: investigation Investigations are more extensive activities, which can include experimental testing; environmental and field work; conducting surveys; and scientific reports. Field work must be conducted in Year 11.</p>	40%
<p>Extended response Extended response consists of tasks that can involve integrating appropriate science concepts, models and theories to explain and predict phenomena, and applying those concepts, models and theories to new situations; interpreting scientific and media texts and evaluating processes, claims and conclusions by considering the quality of available evidence.</p> <p>Assessment can take the form of answers to specific questions based on individual research; exercises requiring analysis; and interpretation and evaluation of biological information in scientific and media texts. Research completed out of class can be authenticated using an assessment task conducted under supervised conditions.</p>	20%
<p>Test Tests typically consist of multiple choice questions, and questions requiring short and extended answers.</p>	40%

Teachers are required to use the assessment table to develop an assessment outline for the pair of units (or for a single unit where only one is being studied).

The assessment outline must:

- include a set of assessment tasks
- include a general description of each task
- indicate the unit content to be assessed
- indicate a weighting for each task and each assessment type
- include the approximate timing of each task (for example, the week the task is conducted, or the issue and submission dates for an extended task).

In the assessment outline for the pair of units, each assessment type must be included at least once over the year/pair of units. In the assessment outline where a single unit is being studied, each assessment type must be included at least once.

The set of assessment tasks must provide a representative sampling of the content for Unit 1 and Unit 2.

Assessment tasks not administered under test/controlled conditions require appropriate validation/authentication processes.

Grading

Schools report student achievement in terms of the following grades:

Grade	Interpretation
A	Excellent achievement
B	High achievement
C	Satisfactory achievement
D	Limited achievement
E	Very low achievement

The teacher prepares a ranked list and assigns the student a grade for the pair of units (or for a unit where only one unit is being studied). The grade is based on the student's overall performance as judged by reference to a set of pre-determined standards. These standards are defined by grade descriptions and annotated work samples. The grade descriptions for the Biology General Year 11 syllabus are provided in Appendix 1. They can also be accessed, together with annotated work samples, through the Guide to Grades link on the course page of the Authority website at www.scsa.wa.edu.au.

To be assigned a grade, a student must have had the opportunity to complete the education program, including the assessment program (unless the school accepts that there are exceptional and justifiable circumstances).

Refer to the *WACE Manual* for further information about the use of a ranked list in the process of assigning grades.

Appendix 1 – Grade descriptions Year 11

A

Understanding and applying concepts

Applies models and principles to explain biological structures, systems and processes in detail.
Presents clear and logical arguments which are supported by evidence.
Selects scientific information to support a point of view.
Explains biological concepts using appropriate scientific language and representations.

Science inquiry skills

Formulates a testable hypothesis that states the relationship between dependent and independent variables.
Plans an investigation to collect appropriate data. Identifies controlled variables with specific detail.
Organises data logically and presents it in a range of forms, including appropriate graphs and tables to reveal patterns and relationships. Accurately calculates averages.
Analyses experimental data to describe trends and explains these using relevant scientific concepts.
Uses evidence to make and justify conclusions that relate to the hypothesis.
Explains any inconsistencies in data and suggests ways to improve the design of an investigation.
Communicates information and concepts logically, using correct scientific language, conventions and representations.

B

Understanding and applying concepts

Describes and briefly explains biological structures, systems and processes using models.
Presents arguments or statements but these are not well-supported by evidence.
Selects some scientific information to support a point of view.
Explains biological concepts using scientific language and representations.

Science inquiry skills

Formulates a testable hypothesis that states the relationship between dependent and independent variables. Plans an investigation to collect appropriate data.
Identifies some controlled variables without detail.
Presents data in a range of forms, including appropriate graphs, tables and charts to reveal patterns and relationships.
Describes trends and briefly explains these using relevant scientific concepts.
Uses evidence to make conclusions that relate to the hypothesis.
Recognises inconsistencies in data and makes general suggestions to improve the design of an investigation.
Communicates information and concepts logically, generally using scientific language and representations. Makes some errors in the use of conventions.

C	<p>Understanding and applying concepts</p> <p>Describes some biological structures, systems and processes in a general way. Presents statements of ideas, with some development of an argument. Selects some scientific information to support a point of view but includes some irrelevant or incorrect information. Explains biological concepts, without detail, using representations and some scientific language.</p>
	<p>Science inquiry skills</p> <p>With guidance, formulates a hypothesis, that includes dependent and independent variables, within a context that has been provided. Plans an investigation to collect appropriate data. Inconsistently identifies some controlled variables. Presents data using basic tables and graphs. Describes trends in the data and draws simple conclusions that may not be linked back to the hypothesis. Describes difficulties experienced in conducting the investigation and suggests general improvements. Communicates information and concepts, without detail, using some scientific language and conventions. Representations lack detail.</p>
D	<p>Understanding and applying concepts</p> <p>Identifies biological structures, systems and processes. Explanations are incomplete or contain errors. Presents statements of ideas, but with limited development of an argument. Selects inappropriate scientific information to support a point of view. Explains biological concepts using simple representations and everyday language but including some irrelevant or incorrect information. Responses are often incomplete.</p>
	<p>Science inquiry skills</p> <p>Predicts a general outcome for an investigation. Follows a provided experimental procedure to collect data. Confuses variables. Presents data that is unclear, insufficient and lacks appropriate processing. Identifies trends in the data incorrectly or overlooks trends. Offers simple conclusions that are not supported by the data or are not related to the hypothesis. Identifies difficulties experienced in conducting the investigation. Communicates information using everyday language with frequent errors in the use of conventions. Responses are often incomplete.</p>
E	<p>Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.</p>

Appendix 2 – Glossary

This glossary is provided to enable a common understanding of the key terms in this syllabus.

Accuracy

The extent to which a measurement result represents the quantity it purports to measure; an accurate measurement result includes an estimate of the true value and an estimate of the uncertainty.

Animal ethics

Consideration of respectful, fair and just treatment of animals. The use of animals in science involves consideration of replacement (substitution of insentient materials for conscious living animals), reduction (using only the minimum number of animals to satisfy research statistical requirements) and refinement (decrease in the incidence or severity of 'inhumane' procedures applied to those animals that still have to be used).

Biosecurity

Policy and regulatory frameworks designed to safeguard against biological threats to environments, organisms and human health; biosecurity measures aim to restrict entry of disease causing agents, genetically modified species, or invasive alien species or genotypes.

Biotechnology

The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for human purposes.

Comparative genomics

The study and comparison of the genome sequences of different species; comparative genomics enables identification of genes that are conserved or common among species, as well as genes that give each organism its unique characteristics.

Data

The plural of datum; the measurement of an attribute, for example, the volume of gas or the type of rubber. This does not necessarily mean a single measurement: it may be the result of averaging several repeated measurements. Data may be quantitative or qualitative and be from primary or secondary sources.

Ecological survey techniques

Techniques used to survey, measure, quantify, assess and monitor biodiversity and ecosystems in the field; techniques used depend on the subject and purpose of the study. Techniques may include random quadrats, transects, capture - recapture, nest survey, netting, trapping, flight interception, beating trays, dry extraction from leaf litter samples, 3-minute habitat-proportional sampling of aquatic habitats, aerial surveys and soil, air and water sampling.

Evidence

In science, evidence is data that is considered reliable and valid and which can be used to support a particular idea, conclusion or decision. Evidence gives weight or value to data by considering its credibility, acceptance, bias, status, appropriateness and reasonableness.

Field work

Observational research undertaken in the normal environment of the subject of the study.

Genre

The categories into which texts are grouped; genre distinguishes texts on the basis of their subject matter, form and structure (for example, scientific reports, field guides, explanations, procedures, biographies, media articles, persuasive texts, narratives).

Hypothesis

A scientific statement based on the available information that can be tested by experimentation. When appropriate, the statement expresses an expected relationship between the independent and dependent variables for observed phenomena.

Investigation

A scientific process of answering a question, exploring an idea or solving a problem that requires activities, such as planning a course of action, collecting data, interpreting data, reaching a conclusion and communicating these activities. Investigations can include observation, research, field work, laboratory experimentation and manipulation of simulations.

Law

A statement describing invariable relationships between phenomena in specified conditions, frequently expressed mathematically.

Measurement error

The difference between the measurement result and a currently accepted or standard value of a quantity.

Media texts

Spoken, print, graphic or electronic communications with a public audience. Media texts can be found in newspapers, magazines and on television, film, radio, computer software and the internet.

Mode

The various processes of communication – listening, speaking, reading/viewing and writing/creating.

Model

A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.

Primary data

Data collected directly by a person or group.

Primary source

Report of data created by the person or persons directly involved in observations of one or more events, experiments, investigations or projects.

Reliable data

Data that has been judged to have a high level of reliability; reliability is the degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute, achieving similar results for the same population.

Reliability

The degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute, achieving similar results for the same population.

Representation

A verbal, visual, physical or mathematical demonstration of understanding of a science concept or concepts. A concept can be represented in a range of ways and using multiple modes.

Research

To locate, gather, record, attribute and analyse information in order to develop understanding.

Research ethics

Norms of conduct that determine ethical research behaviour; research ethics are governed by principles, such as honesty, objectivity, integrity, openness and respect for intellectual property and include consideration of animal ethics.

Risk assessment

Evaluations performed to identify, assess and control hazards in a systematic way that is consistent, relevant and applicable to all school activities. Requirements for risk assessments related to particular activities will be determined by jurisdictions, schools or teachers as appropriate.

Secondary data

Data collected by a person or group other than the person or group using the data.

Secondary source

Information that has been compiled from records of primary sources by a person or persons not directly involved in the primary event.

Simulation

A representation of a process, event or system which imitates a real or idealised situation.

System

A group of interacting objects, materials or processes that form an integrated whole. Systems can be open or closed.

Theory

A set of concepts, claims and/or laws that can be used to explain and predict a wide range of related observed or observable phenomena. Theories are typically founded on clearly identified assumptions, are testable, produce reproducible results and have explanatory power.

Uncertainty

Range of values for a measurement result, taking account of the likely values that could be attributed to the measurement result given the measurement equipment, procedure and environment.

Validity

The extent to which tests measure what was intended; the extent to which data, inferences and actions produced from tests and other processes are accurate.