NSW Education Standards Authority

Biology 11–12 (2025)

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Table of contents

Table of contents 4
Biology 11–12 (2025) 5
Implementation from 2027 5
Overview 5
Syllabus overview 5
Course description 6
Rationale 11
Aim 12
Table of outcomes 13
Outcomes and content for Year 11 15
Working scientifically 15
Cells as the basis of life 17
Cells to systems 19
Evolution and ecosystems 21
Outcomes and content for Year 12 23
Working scientifically 23
Heredity 25
Diseases 27
Biodiversity 29
Biotechnology 31
Assessment 33
Course standards 33
School-based assessment 34
HSC examinations 36

Biology 11–12 (2025)

Implementation from 2027

The new Biology 11–12 Syllabus (2025) is to be implemented from 2027 and will replace the **Biology Stage 6 Syllabus (2017)**.

2026

- Plan and prepare to teach the new syllabus

2027, Term 1

- Start teaching the new syllabus for Year 11
- Start implementing new Year 11 school-based assessment requirements
- Continue to teach the **Biology Stage 6 Syllabus (2017)** for Year 12

2027, Term 4

- Start teaching the new syllabus for Year 12
- Start implementing new Year 12 school-based assessment requirements

2028

- First HSC examination for the new syllabus

Overview

Syllabus overview

The *Biology 11–12 Syllabus* aligns with the *Biology Life Skills 11–12 Syllabus* to provide opportunities for integrated delivery.

Through collaborative curriculum planning, it may be decided that Life Skills outcomes and content are the most appropriate option for some students with intellectual disability.

Organisation of Biology 11–12

The organisation of the syllabus illustrates the important role of Working scientifically across all areas of Biology 11–12 and its connection to scientific knowledge and concepts. Depth studies provide students with opportunities to apply their knowledge through scientific investigations

Figure 1 shows the organisation of Biology 11–12.

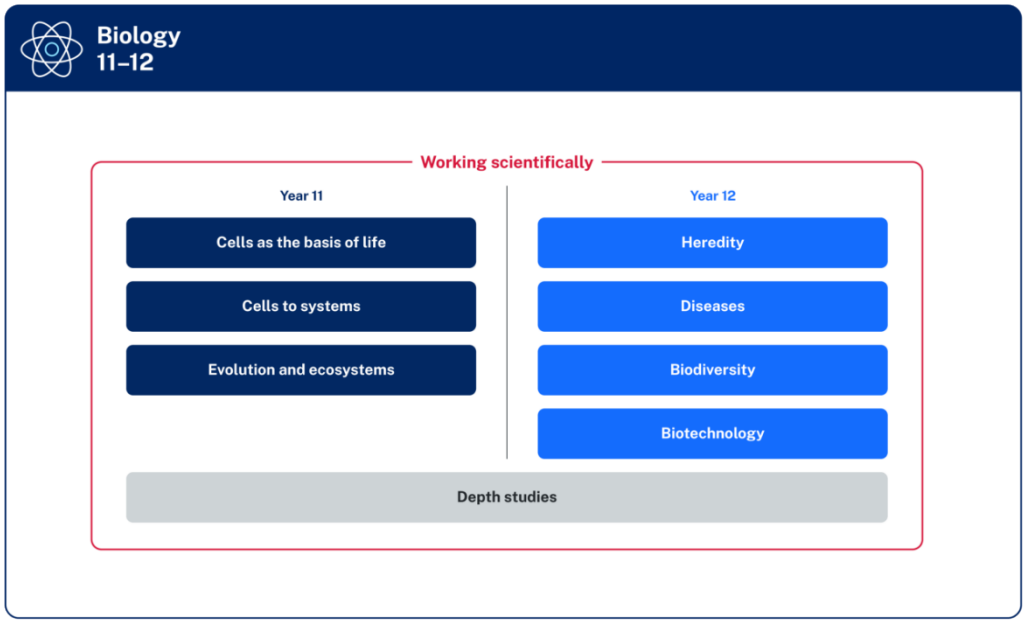

Figure 1: The organisation of Biology 11–12

Image long description: The focus areas are listed in 2 columns under the headings Year 11 and Year 12. The 3 focus areas for Year 11 are Cells as the basis of life; Cells to systems; and Evolution and ecosystems. The 4 focus areas for Year 12 are Heredity; Diseases; Biodiversity; and Biotechnology. Extending across the bottom of both columns is a rectangular box labelled 'Depth studies'. A line labelled 'Working scientifically' encircles all elements listed.

Protocols for collaborating with Aboriginal and Torres Strait Islander Communities

NESA is committed to working in partnership with Aboriginal Communities and supporting teachers, schools and schooling sectors to improve educational outcomes for young people.

It is important to respect appropriate ways of interacting with Aboriginal Communities and Cultural material when teachers plan, program and implement learning experiences that focus on Aboriginal and Torres Strait Islander Priorities.

Indigenous Cultural and Intellectual Property (ICIP) protocols need to be followed. Aboriginal and Torres Strait Islander Peoples' ICIP protocols include Cultural Knowledges, Cultural Expression and Cultural Property and documentation of Aboriginal and Torres Strait Islander Peoples' identities and lived experiences. It is important to recognise the diversity and complexity of different Cultural groups in NSW, as protocols may differ between local Aboriginal Communities.

Teachers should work in partnership with Elders, parents, Community members, Cultural Knowledge Holders, or a local, regional or state Aboriginal Education Consultative Group. It is important to respect Elders and the roles of men and women. Local Aboriginal Peoples should be invited to share their Cultural Knowledges with students and staff when engaging with Aboriginal histories and Cultural Practices.

Course description

The *Biology 11–12 Syllabus* provides students with the opportunity to analyse, study and enjoy an understanding of the biological world around us. Students build on their learning from the *Science*

7–10 Syllabus (2023) as they investigate phenomena, make predictions and solve problems related to health, sustainability and biotechnology. Students generate and analyse data and evaluate results to make ethical, evidence-based decisions as informed, reflective and scientifically literate citizens.

What students learn

Through the study of Biology 11–12, students:

- develop knowledge and understanding of the complex interactions between living things and how human actions can affect the environment
- apply their knowledge of biology to investigate phenomena, make predictions, address real-world problems and explore the impact of science on society
- explore how Aboriginal and Torres Strait Islander Peoples' ways of Knowing, Being and Doing enhance and provide social and Cultural context to the study of biology
- develop critical thinking, ethical decision-making and problem-solving skills.

Course structure and requirements

Year 11 course structure and requirements

The Year 11 Biology course comprises a study of:

- 120 indicative hours across 3 focus areas, including 10 hours of depth studies
- integrated Working scientifically outcomes and content
- one fieldwork exercise.

Students are required to study all components of the course.

Year 11 focus areas	Indicative hours
Cells as the basis of life	40
Cells to systems	40
Evolution and ecosystems	40

Year 12 course structure and requirements

The Year 12 Biology course comprises a study of:

- 120 indicative hours across 4 focus areas, including 10 hours of depth studies
- integrated Working scientifically outcomes and content.

Students are required to study all components of the course.

Year 12 focus areas	Indicative hours
Heredity	30
Diseases	30
Biodiversity	30
Biotechnology	30

Working scientifically

The Working scientifically outcomes and content are integral to the study of Biology 11–12. The Working scientifically outcomes address:

- questioning and predicting
- planning scientific investigations
- conducting scientific investigations
- processing data and information
- analysing data and information
- problem-solving
- communicating.

Teachers must integrate relevant Working scientifically outcomes and content with each focus area. All the Working scientifically outcomes and content must be addressed by the end of Year 12.

Scientific investigations

Each focus area in the *Biology 11–12 Syllabus* includes content points that contain scientific investigations. These content points include practical investigations and secondary-source investigations and are conducted individually and collaboratively.

Practical investigations include:

- laboratory experiments
- computer simulations, modelling, processing and analysing primary data, and using appropriate digital technologies
- fieldwork.

Secondary-source investigations include:

- extracting, analysing and using data and information from secondary sources
- reorganising and communicating secondary-source data and information in the form of flow charts, tables, graphs, diagrams, written documents, keys, spreadsheets or databases
- using existing models to inform understanding.

Some students with disability may require adjustments to conduct scientific investigations.

Depth studies

Depth studies are targeted scientific investigations in which students deepen their understanding of course content through the application of Working scientifically knowledge. They provide opportunities for students to pursue their interests and deepen their scientific understanding of one or more focus areas.

- 10 hours of depth studies are undertaken as part of course requirements.
- At least ONE depth study must be completed in both Year 11 and Year 12.
- The depth study must include Working scientifically content from Questioning and predicting in addition to content from at least ONE other focus area.
- Depth studies may be completed individually or collaboratively.

Some students with disability may require adjustments in order to engage with the depth studies.

Fieldwork

Fieldwork provides students with the opportunity to develop and apply the Working scientifically outcomes and content outside the classroom. Fieldwork can be undertaken within the school grounds, around local neighbouring areas or at more distant locations.

- The completion of a minimum of one fieldwork exercise in Year 11 forms part of the indicative hours of the course.
- Fieldwork must be integrated with one or more of the following focus areas: Cells as the basis of life, Cells to systems and Evolution and ecosystems.
- Fieldwork may be integrated with the Year 11 depth study.

It is important that fieldwork is accessible to all students. Some students with disability may require adjustments in order to engage with fieldwork.

When conducting fieldwork, there are ethical issues to consider such as the effect on environments, implications for plants and animals, or intellectual property where fieldwork involves Aboriginal and/or Torres Strait Islander Peoples.

Teachers and students should follow the NESA Aboriginal and Torres Strait Islander principles and protocols. Teachers should consult their local Aboriginal Community for direction and guidance.

If fieldwork is proposed for Aboriginal sites or Aboriginal and/or Torres Strait Islander Peoples, the protocols of Indigenous Cultural and Intellectual Property (ICIP) must be followed.

Students should be familiar with a range of Cultural protocols for working with Aboriginal Communities and ensure appropriate consultation with local Communities. For more information, refer to the NESA Working with Aboriginal Communities document.

It is the responsibility of the school to perform appropriate risk assessments and ensure duty of care is maintained for the health and safety of students undertaking off-site fieldwork activities.

Safety and risk management

Schools are required to ensure they follow safety and risk management in delivering the *Biology 11–12 Syllabus*.

Course enrolment details

Biology Year 11

- Course number: 11030
- Course hours: 120
- Course units: 2
- Enrolment type: Elective
- Endorsement type: Board developed

Exclusions

- Biology Life Skills (Year 11, 2 units): 16666

Prerequisites

- Nil

Corequisites

- Nil

Biology Year 12

- Course number: 15030
- Course hours: 120
- Course units: 2
- Enrolment type: Elective
- Endorsement type: Board developed

Exclusions

- Biology Life Skills (Year 12, 2 units): 16666

Prerequisites

- Biology (Year 11, 2 units): 11030

Corequisites

- Nil

HSC information

Information about curriculum requirements for the HSC are available on Assessment Certification Examination (ACE).

Rationale

Biology is the study of life. The study of evolution, the structure and function of organisms, the Earth's biodiversity, heredity, biotechnologies and the effects of disease make up fundamental knowledge of existence, with applications including health and sustainability in a rapidly changing world.

Studying Biology develops a deep knowledge of living things, from the molecular level to macroscopic systems, and their interactions with the environment. Students enhance their learning of a changing world through an awareness of Aboriginal and Torres Strait Islander Peoples' Cultures, Knowledges and Practices relating to the environment, health, biotechnology and sustainability issues.

Biology equips students with the tools to understand the complexity of life and the interconnectedness of ecosystems. Understanding biological systems allows students to engage with issues such as genetic engineering, conservation, disease prevention and environmental sustainability. Through this understanding, they engage with ethical considerations about the relationships between living things and systems.

In Biology, the application of scientific models to predict future environmental changes and their possible effects on society enables students to apply Working scientifically knowledge through data analysis, problem-solving, scientific reasoning and communication. Fieldwork and scientific investigations help students to acquire practical skills, while communication skills enable them to present findings and conclusions effectively. This knowledge is critical for students becoming informed, scientifically literate citizens capable of addressing local and global challenges.

Biology provides opportunities for students to develop critical and creative thinking skills for a range of post-school contexts. The study of Biology develops students' knowledge and understanding of personal and public health, sustainability, and their relationship with the world. It provides a foundation for careers in health care, environmental science, biotechnology and research, and for the development of informed citizenship in an increasingly scientific and technological world.

Aim

Biology 11–12 aims to develop students' understanding and appreciation of the diversity of living things, from the molecular level to macroscopic systems, and the interactions, interrelations and changes that occur in biological systems. It enables students to apply Working scientifically to examine the development of scientific knowledge through the scientific method, and explore the application of biological technologies in society.

Table of outcomes

Year 11	Year 12
BI-11WS-01 Working Scientifically Questioning and predicting develops and evaluates questions and hypotheses for scientific investigations	**BI-12WS-01 Working Scientifically Questioning and predicting** develops and evaluates questions and hypotheses for scientific investigations
BI-11WS-02 Working Scientifically Planning scientific investigations designs and evaluates scientific investigations	**BI-12WS-02 Working Scientifically Planning scientific investigations** designs and evaluates scientific investigations
BI-11WS-03 Working Scientifically Conducting scientific investigations conducts scientific investigations to collect data and information	**BI-12WS-03 Working Scientifically Conducting scientific investigations** conducts scientific investigations to collect data and information
BI-11WS-04 Working Scientifically Processing data and information selects and processes qualitative and quantitative data and information	**BI-12WS-04 Working Scientifically Processing data and information** selects and processes qualitative and quantitative data and information
BI-11WS-05 Working Scientifically Analysing data and information analyses and evaluates primary and secondary data and information	**BI-12WS-05 Working Scientifically Analysing data and information** analyses and evaluates primary and secondary data and information
BI-11WS-06 Working Scientifically Problem-solving uses scientific processes to solve scientific problems	**BI-12WS-06 Working Scientifically Problem-solving** uses scientific processes to solve scientific problems
BI-11WS-07 Working Scientifically Communicating communicates scientific arguments using evidence, scientific language and terminology for a specific audience	**BI-12WS-07 Working Scientifically Communicating** communicates scientific arguments using evidence, scientific language and terminology for a specific audience
BI-11-01 explains how cell structures enable biological processes needed for life	**N/A**
BI-11-02 explains how cells, tissues and systems contribute to complex multicellular organisms	**NA**
BI-11-03 analyses the relationships between organisms	**NA**

Year 11	Year 12
and their environment using the theory of evolution by natural selection	
NA	**BI-12-01** analyses the role of DNA in the transmission of heritable characteristics
NA	**BI-12-02** analyses causes and effects of diseases and strategies for disease prevention and management
NA	**BI-12-03** analyses changes in ecosystems and strategies for biodiversity conservation
NA	**BI-12-04** evaluates the use of biotechnologies in medicine, agriculture and biodiversity conservation

Outcomes and content for Year 11

Working scientifically

Outcomes

A student:

- develops and evaluates questions and hypotheses for scientific investigations **BI-11WS-01**
- designs and evaluates scientific investigations **BI-11WS-02**
- conducts scientific investigations to collect data and information **BI-11WS-03**
- selects and processes qualitative and quantitative data and information **BI-11WS-04**
- analyses and evaluates primary and secondary data and information **BI-11WS-05**
- uses scientific processes to solve scientific problems **BI-11WS-06**
- communicates scientific arguments using evidence, scientific language and terminology for a specific audience **BI-11WS-07**

Related Life Skills outcomes: BI-LSWS-01, BI-LSWS-02, BI-LSWS-03, BI-LSWS-04, BI-LSWS-05, BI-LSWS-06, BI-LSWS-07

Content

Relevant Working scientifically outcomes and content must be integrated with each focus area. All the Working scientifically outcomes and content must be addressed by the end of Year 12.

Questioning and predicting

- Use observations and scientific knowledge and understanding to propose questions and hypotheses for scientific investigations involving primary and secondary data
- Evaluate questions and hypotheses based on scientific knowledge
- Modify questions and hypotheses to reflect new evidence

Planning scientific investigations

- Justify the use of independent, dependent and controlled variables, and experimental controls in a valid scientific investigation
- Explain how reliable primary data is obtained
- Assess the reliability of secondary data and information when planning
- Assess potential hazards and their associated risks to develop a risk assessment
- Select appropriate materials and technologies to design a scientific investigation
- Discuss ethical issues in the development and use of scientific knowledge

Conducting scientific investigations

- Apply safe work practices and manage risks while conducting a scientific investigation
- Construct and manipulate identified materials and technologies to perform scientific investigations
- Use equipment appropriately and systematically to collect and record data, information, evidence and findings
- Gather data and information from a range of secondary sources

Processing data and information

- Select qualitative and quantitative information from texts, diagrams, flow charts, tables, databases, graphs and multimedia resources
- Apply quantitative processes to data, including unit conversions

- Select and use a range of representations to organise data and information, including graphs, keys, models, diagrams, tables and spreadsheets
- Extract data and information from a wide range of sources and acknowledge these sources using an accepted referencing style
- Describe the Cultural Knowledges and observations of Aboriginal and Torres Strait Islander Peoples and examine how these contribute to the development of scientific knowledge

Analysing data and information

- Describe qualitative and quantitative relationships between variables
- Explain patterns and trends, including inconsistencies in data and information
- Assess error, uncertainty and limitations in data and include calculations of percentage error, range, mean and standard deviation
- Assess the validity, reliability, accuracy and precision of data and information
- Interpret data and information to identify outliers, make predictions, explain results and draw conclusions
- Evaluate data and information to suggest improvements or further investigations

Problem-solving

- Apply scientific principles to address real-world applications and problems
- Use modelling and cause-and-effect relationships, including mathematical examples, to make predictions, explain phenomena and solve problems
- Evaluate and modify a scientific investigation in response to new evidence
- Explain why current scientific knowledge is both contestable and testable by further inquiry

Communicating

- Construct evidence-based arguments and recognise the role of peer review in the evaluation of scientific practices, solutions or conclusions
- Select and use appropriate digital, visual, written and oral media to convey scientific arguments
- Apply appropriate scientific notations, language and nomenclature
- Use evidence and correct scientific language and terminology to address a specific audience and purpose in a variety of contexts

Cells as the basis of life

Outcomes

A student:

- explains how cell structures enable biological processes needed for life **BI-11-01**

Related Life Skills outcomes: BI-LS-01, BI-LS-02

Content

Relevant Working scientifically outcomes and content must be integrated with each focus area. All the Working scientifically outcomes and content must be addressed by the end of Year 12.

Related: Working scientifically

Cell structures and functions

- Use a variety of sources to compare the cellular structures of eukaryotic and prokaryotic cells
- Conduct a practical investigation to prepare a wet mount slide and identify the cytoplasm, cell wall and nucleus under a light microscope
- Describe the structure and function of the capsule, cell wall, cell membrane, cytoplasm, nucleoid, plasmid, ribosomes, flagella and pili in prokaryotic cells
- Contrast the cell structure and organelles of plant and animal cells based on the function of the cell
- Describe the structure and function of the cell wall, cell membrane, cytoplasm, nucleus, mitochondria, chloroplast, endoplasmic reticulum, Golgi body, ribosomes, lysosomes and vacuoles in eukaryotic cells
- Conduct a practical investigation to calculate the size of a variety of specialised cells under the microscope using a mini-grid and the equation $\textit{Cell size} = \frac{\textit{diameter of field of view}}{\textit{number of cells across the field of view}}$
- Assess the impact of technological developments in microscopy on scientific understanding of cell structure and function

Cells and their environments

- Use the fluid mosaic model of the cell membrane to explain the structure and function of protein channels, phospholipids, peripheral proteins, integral proteins, cholesterol and glycoproteins
- Explain the processes of simple diffusion, osmosis and facilitated diffusion
- Conduct practical investigations to demonstrate the processes of diffusion and osmosis
- Predict the effects of hypertonic, hypotonic and isotonic solutions on animal and plant cells
- Explain the processes of active transport, exocytosis and endocytosis
- Relate the movement of glucose, oxygen, carbon dioxide, salts and wastes across membranes to concentration gradients and the characteristics of the materials being exchanged

Biochemical processes

- Relate carbon dioxide, oxygen, water, ions, amino acids and glucose to cell requirements
- Use the summary equation $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \textit{energy}$ to describe the process of cellular respiration
- Use the summary equation $6CO_2 + 6H_2O \xrightarrow[\textit{chlorophyll}]{\textit{light}} C_6H_{12}O_6 + 6O_2$ to describe the process of photosynthesis
- Explain the role of enzymes in cells

- Use diagrams of the induced fit model and the lock and key model to explain the interaction between enzymes and specific substrates
- Plan and conduct laboratory experiments to demonstrate the effect of temperature, pH and substrate concentration on the efficiency of a selected enzyme
- Analyse graphs to explain the effect of temperature, pH and substrate concentration on enzyme activity

Cell division

- Use the deoxyribonucleic acid (DNA) double helix model to demonstrate the structure of DNA, including nucleotide composition, complementary base pairing and hydrogen bonding
- Conduct a practical investigation to model the process of DNA replication, demonstrating the role of complementary bases, the replication fork with leading and lagging strands, and the enzymes of helicase, primase, DNA polymerases and ligase
- Assess the use of models to demonstrate DNA replication
- Construct diagrams to compare the forms in which DNA exists in prokaryotic and eukaryotic cells
- Compare the structures and roles of somatic and gametic cells
- Account for the phases of gap 1 (G1), synthesis, gap 2 (G2) and mitosis in the cell cycle
- Conduct a practical investigation to model the named phases of mitosis and cytokinesis
- Describe the processes of crossing over, independent assortment and random segregation during meiosis
- Conduct a practical investigation to model the named phases of meiosis and cytokinesis
- Evaluate the importance of DNA replication, mitosis, meiosis and cytokinesis in cell division

Cells to systems

Outcomes

A student:

- explains how cells, tissues and systems contribute to complex multicellular organisms **BI-11-02**

Related Life Skills outcomes: BI-LS-02, BI-LS-03

Content

Relevant Working scientifically outcomes and content must be integrated with each focus area. All the Working scientifically outcomes and content must be addressed by the end of Year 12.

Related: Working scientifically

Cell organisation

- Compare the characteristics and structures of cells in unicellular, colonial and multicellular organisms
- Explain the effect of the surface-area-to-volume ratio on the rate of movement of materials into and out of a cell
- Conduct a laboratory experiment to predict the effect of the surface-area-to-volume ratio on the rate of movement of materials into and out of a cell
- Explain the hierarchical organisation of organelles, cells, tissues, organs and systems in organisms

Plants as autotrophic organisms

- Describe the nutrient, water and gas requirements of plants for photosynthesis and respiration
- Discuss the conditions required for photosynthesis
- Conduct a practical investigation to predict how changes in conditions affect photosynthesis
- Use a variety of sources to compare the structures and functions of xylem and phloem in the plant transport system
- Use the translocation theory to explain the movement of nutrients through phloem tissue
- Use the cohesion-tension theory to explain how osmotic pressure, transpiration stream and the cohesion of water molecules control the movement of water and dissolved minerals through the xylem
- Explain how light, temperature, wind and humidity affect the rate of transpiration in plants
- Conduct a practical investigation to demonstrate the effect of an environmental factor on the rate of transpiration
- Conduct a practical investigation to explain the functions of gas exchange, water and nutrient transport in microscopic leaf, stem and root structures

Animals as heterotrophic organisms

- Describe the organ systems required for nutrient, water, gas and waste management in animals
- Use a variety of sources to describe how the processes of mechanical, physical and chemical digestion, absorption and elimination in the human digestive system enable cellular functions
- Account for changes in the concentration of gases, nutrients and wastes in blood as it travels through the lungs, liver, small intestine, large intestine, kidneys and muscles organs in mammals

- Use models to demonstrate the relationship between the structure and function of arteries, capillaries and veins
- Explain the relationship between the structure of plasma, red blood cells, white blood cells and platelets and their function within blood
- Use models to demonstrate how the organisation of alveoli and capillaries in the lungs allows for efficient gas exchange
- Explain how glomerular filtration, selective reabsorption and secretion contribute to the removal of waste in nephrons
- Use models to explain how the glomerulus, Bowman's capsule and nephron tubules contribute to filtration and reabsorption for waste removal in the kidney
- Conduct a secondary-source investigation to compare the process of renal dialysis to the function of the kidney

Homeostasis in humans

- Describe the key components of a typical feedback system, including stimulus, receptor, control centre, effector and response
- Construct and interpret diagrams of negative feedback loops to demonstrate maintenance of homeostasis

  Example(s):

  Glucose, blood pH, blood oxygen levels, erythropoietin (EPO) hormone in kidney, thermoregulation.

- Discuss the role of the hypothalamus and pituitary gland in regulating the secretion of hormones
- Describe the function of the primary hormones that regulate blood sugar levels and the stress response
- Conduct a secondary-source investigation to analyse the impact of diabetes on the body's ability to maintain homeostasis
- Analyse data on hormone levels and physiological processes to illustrate the role of an endocrine hormone in regulating a specific function
- Using a physiological condition discuss the optimal range for functioning and critical tolerance limit

Evolution and ecosystems

Outcomes

A student:

- analyses the relationships between organisms and their environment using the theory of evolution by natural selection **BI-11-03**

Related Life Skills outcomes: BI-LS-04, BI-LS-05

Content

Relevant Working scientifically outcomes and content must be integrated with each focus area. All the Working scientifically outcomes and content must be addressed by the end of Year 12.

Related: Working scientifically

Natural selection

- Discuss the role of genetic variation, inheritance and selective pressures in contributing to the process of evolution by natural selection
- Use examples to demonstrate how abiotic and biotic factors exert selective pressures on populations
- Explain how human-induced changes may function as selective pressures
- Analyse how evolution causes species diversity
- Describe examples from Aboriginal palaeontological evidence that demonstrate the existence of Australian megafauna
- Evaluate the role of isolation and adaptation in the evolution of Australian monotremes and marsupials
- Conduct a practical investigation to model the processes involved in natural selection
- Discuss the validity of various models that demonstrate natural selection
- Use examples to explain convergent and divergent evolution

Evolution and adaptations

- Use plant and animal examples to explain how structural, physiological and behavioural adaptations shaped by evolution enable survival in their environment
- Conduct a practical investigation to examine structural adaptations for water balance in Australian plants
- Use examples to explain behavioural adaptations used by ectotherms and endotherms to survive in the Australian environment
- Analyse data to compare how the external environment and body temperature are related in endotherms and ectotherms
- Explain physiological adaptations of aquatic animals to regulate water and salt balance
- Explain how Aboriginal and Torres Strait Islander Peoples use the adaptations of local plants and animals for specific purposes

  Example(s):

  Pandanus for flotation, plant barbs as hooks, shark teeth for knives.

- Use phylogenetic trees to compare the gradualism model with the punctuated equilibrium model of evolution

- Conduct a secondary-source investigation to analyse how human-induced pressures can drive the emergence of antibiotic-resistant strains of bacteria and Dichloro-Diphenyl-Trichloroethane (DDT)-resistant mosquitoes
- Analyse information on how transitional fossils, fossil assemblages and relative dating have provided palaeontological and geological evidence for past changes in life forms
- Conduct a scientific investigation to infer evolutionary relationships between species using DNA and amino acid sequences
- Evaluate comparative anatomy, genetic phylogeny, biogeography and biochemistry as evidence for the theory of evolution by natural selection

Ecosystem dynamics

- Conduct a practical investigation to collect and analyse abiotic and biotic data, to discuss the features of an ecosystem
- Compare abiotic data from a variety of aquatic and terrestrial ecosystems
- Explain how abiotic and biotic factors influence the abundance, distribution and diversity of species in an ecosystem
- Compare sampling techniques to estimate distribution and abundance of organisms
- Conduct a practical investigation to examine the distribution and abundance of a plant or animal using belt transect, line transect or quadrat sampling techniques
- Conduct a practical investigation to model the mark-release-recapture method and estimate abundance of mobile organisms
- Use examples to determine relationships between organisms, including predation, competition, mutualism, commensalism, allelopathy and parasitism
- Analyse data on the impact of predator–prey relationships and competition on populations
- Explain how the carrying capacity of a selected ecosystem is affected by biotic and abiotic factors
- Evaluate the validity, reliability and accuracy of ecological sampling data when drawing conclusions about ecosystem dynamics

Outcomes and content for Year 12

Working scientifically

Outcomes

A student:

- develops and evaluates questions and hypotheses for scientific investigations **BI-12WS-01**
- designs and evaluates scientific investigations **BI-12WS-02**
- conducts scientific investigations to collect data and information **BI-12WS-03**
- selects and processes qualitative and quantitative data and information **BI-12WS-04**
- analyses and evaluates primary and secondary data and information **BI-12WS-05**
- uses scientific processes to solve scientific problems **BI-12WS-06**
- communicates scientific arguments using evidence, scientific language and terminology for a specific audience **BI-12WS-07**

Related Life Skills outcomes: BI-LSWS-01, BI-LSWS-02, BI-LSWS-03, BI-LSWS-04, BI-LSWS-05, BI-LSWS-06, BI-LSWS-07

Content

Relevant Working scientifically outcomes and content must be integrated with each focus area. All the Working scientifically outcomes and content must be addressed by the end of Year 12.

Questioning and predicting

- Use observations and scientific knowledge and understanding to propose questions and hypotheses for scientific investigations involving primary and secondary data
- Evaluate questions and hypotheses based on scientific knowledge
- Modify questions and hypotheses to reflect new evidence

Planning scientific investigations

- Justify the use of independent, dependent and controlled variables, and experimental controls in a valid scientific investigation
- Explain how reliable primary data is obtained
- Assess the reliability of secondary data and information when planning
- Assess potential hazards and their associated risks to develop a risk assessment
- Select appropriate materials and technologies to design a scientific investigation
- Discuss ethical issues in the development and use of scientific knowledge

Conducting scientific investigations

- Apply safe work practices and manage risks while conducting a scientific investigation
- Construct and manipulate identified materials and technologies to perform scientific investigations
- Use equipment appropriately and systematically to collect and record data, information, evidence and findings
- Gather data and information from a range of secondary sources

Processing data and information

- Select qualitative and quantitative information from texts, diagrams, flow charts, tables, databases, graphs and multimedia resources
- Apply quantitative processes to data, including unit conversions

- Select and use a range of representations to organise data and information, including graphs, keys, models, diagrams, tables and spreadsheets
- Extract data and information from a wide range of sources and acknowledge these sources using an accepted referencing style
- Describe the Cultural Knowledges and observations of Aboriginal and Torres Strait Islander Peoples and examine how these contribute to the development of scientific knowledge

Analysing data and information

- Describe qualitative and quantitative relationships between variables
- Explain patterns and trends, including inconsistencies in data and information
- Assess error, uncertainty and limitations in data and include calculations of percentage error, range, mean and standard deviation
- Assess the validity, reliability, accuracy and precision of data and information
- Interpret data and information to identify outliers, make predictions, explain results and draw conclusions
- Evaluate data and information to suggest improvements or further investigations

Problem-solving

- Apply scientific principles to address real-world applications and problems
- Use modelling and cause-and-effect relationships, including mathematical examples, to make predictions, explain phenomena, and solve problems
- Evaluate and modify a scientific investigation in response to new evidence
- Explain why current scientific knowledge is both contestable and testable by further inquiry

Communicating

- Construct evidence-based arguments and recognise the role of peer review in the evaluation of scientific practices, solutions or conclusions
- Select and use appropriate digital, visual, written and oral media to convey scientific arguments
- Apply appropriate scientific notations, language and nomenclature
- Use evidence and correct scientific language and terminology to address a specific audience and purpose in a variety of contexts

Heredity

Outcomes

A student:

- analyses the role of DNA in the transmission of heritable characteristics **BI-12-01**

Related Life Skills outcomes: BI-LS-06

Content

Relevant Working scientifically outcomes and content must be integrated with each focus area. All the Working scientifically outcomes and content must be addressed by the end of Year 12.

Related: Working scientifically

Polypeptide synthesis

- Interpret models of the structure and composition of eukaryotic DNA, messenger ribonucleic acid (mRNA) and transfer ribonucleic acid (tRNA)
- Conduct a practical investigation to model the process of polypeptide synthesis, demonstrating the role of the template strand, coding strand, uracil, ribonucleic acid (RNA) polymerase, free-floating RNA nucleotides, mRNA, ribosomal ribonucleic acid (rRNA), start codon, stop codon, tRNA, peptide bonds and amino acids
- Explain the roles of mRNA and tRNA in transcription and translation
- Explain the role of introns and exons in alternative splicing of mRNA sequences
- Solve problems using nitrogenous base pairing rules and codon tables to model the expression of a given exonic DNA coding strand, determining the sequence of the template strand, the mRNA and the amino acid sequence
- Use an example to explain the relationship between a protein's primary, secondary, tertiary and quaternary structure and function
- Explain the function of proteins in living things
- Explain the role of protein synthesis in the relationship between DNA sequence and phenotype
- Assess how environmental factors influence phenotype

  Example(s):

  Soil pH and hydrangea flower colour, melanin production in response to UV light, temperature-dependent sex determination in reptiles.

- Conduct a scientific investigation to demonstrate the effect of environment on gene expression
- Discuss the role of regulatory RNA in gene expression and its potential biotechnological application
- Assess how epigenetic changes influence phenotype

  Example(s):

  Glucocorticoid receptor (GR) gene, agouti gene.

- Evaluate the importance of polypeptide synthesis in living things

Inheritance patterns

- Distinguish between alleles, genes and genotypes

- Analyse the processes and the implications of meiosis, crossing over, independent assortment, random segregation and fertilisation in creating genetic variation in offspring
- Use examples to distinguish between autosomal dominant/recessive, codominant and incomplete dominant inheritance
- Compare autosomal, sex-linked and multiple allele inheritance
- Use Punnett squares to solve inheritance problems, including autosomal dominant/recessive, codominance, incomplete dominance, multiple alleles and sex-linked
- Explain the difference in genotype and phenotype ratios observed in Punnett squares for sex-linked and autosomal inheritance
- Construct and interpret pedigree charts involving autosomal and sex-linked inheritance

Genetic variants

- Explain how electromagnetic radiation, chemicals and naturally occurring mutagens may result in mutations
- Explain how mutations in coding DNA affects the function of a protein
- Use diagrams to distinguish between base substitutions, insertions and deletions as point mutations
- Compare silent, missense, nonsense and frameshift mutations
- Use diagrams to distinguish between duplications, deletions, inversions and translocations as chromosomal mutations
- Compare point mutations and chromosomal mutations
- Interpret images of karyotypes, showing how chromosomes arranged as homologous pairs explain non-disjunction
- Analyse the implications of somatic and germline variants in the context of tumour formation, genetic disease and genetic diversity
- Conduct a secondary-source investigation on single nucleotide polymorphisms (SNPs) in populations and their association with a genetic disease
- Assess potential limitations and constraints of SNP testing and databases in diagnostic medicine

Diseases

Outcomes

A student:

- analyses causes and effects of diseases and strategies for disease prevention and management **BI-12-02**

Related Life Skills outcomes: BI-LS-07, BI-LS-08, BI-LS-09

Content

Relevant Working scientifically outcomes and content must be integrated with each focus area. All the Working scientifically outcomes and content must be addressed by the end of Year 12.

Related: Working scientifically

Non-infectious diseases

- Use examples to explain the impact of genetics, environment and nutrition on the development of non-infectious diseases in humans
- Compare the causes and effects of a range of non-infectious diseases in humans
- Explain the Aboriginal Cultural Practices of using native grasses to prevent nutritional disease
- Conduct a secondary-source investigation to evaluate the effectiveness of a campaign to prevent a non-infectious disease

Infectious diseases

- Use examples of infectious diseases to classify infectious agents as macroorganisms, microorganisms or non-cellular pathogens
- Describe the adaptive features of prions, viruses, bacteria, protozoans, fungi and macroparasites
- Compare direct contact, indirect contact and vector transmission of pathogens that facilitate entry into and transmission between hosts
- Conduct a laboratory experiment to assess the effect of antimicrobial treatment on the growth of microorganisms found in food or water
- Distinguish between innate and adaptive immune response
- Interpret and construct diagrams of the innate immune system including barriers, secretions, phagocytic leukocytes, antimicrobial proteins, inflammatory response and fever
- Conduct a scientific investigation to determine the effect of temperature on the viability of a non pathogenic *E. coli*
- Discuss the role of interleukin communication between innate and adaptive cells
- Describe the roles of helper T cells, cytotoxic T cells, memory T cells and suppressor T cells of the cell-mediated immune response within the adaptive immune system
- Describe the roles of plasma cells, memory B cells and antibodies of the humoral immune response within the adaptive immune system
- Interpret and construct diagrams of the adaptive immune system to demonstrate how the cell-mediated and humoral components of the immune system respond after primary and secondary exposure to a pathogen
- Distinguish between passive and active immunity
- Use data to demonstrate how vaccinations support adaptive immunity
- Compare pharmaceutical treatments for viral and bacterial diseases

- Describe the use of an Aboriginal bush medicine in treating disease

  Example(s):

  Tea tree oil, Kakadu plum or emu bush.

- Explain procedures that can be employed to limit transmission of infectious diseases in humans

Epidemiological studies

- Explain the role of epidemiology in public health and disease control
- Compare the features of observational, analytical and experimental epidemiological studies
- Discuss the features of randomised clinical trials, cross-sectional studies, case studies and cohort studies
- Assess surveillance methods used in the management of disease
- Distinguish between incidence, prevalence, morbidity and mortality as used in epidemiological studies
- Analyse data of the incidence, prevalence, morbidity and mortality rates for a non-infectious and an infectious disease in humans
- Explain how epidemiological information is used to create strategies that prevent and treat a selected disease in humans
- Outline the impact of the work of selected scientists on current disease management

  Example(s):

  Sussman Yalow, Franklin, McClintock, Levi-Montalcini.

- Distinguish between causal and correlational relationships
- Interpret evidence from secondary sources about herpes, human papillomavirus (HPV) and cervical cancer to discuss scientific causation and correlation
- Analyse data that demonstrates a causal relationship for a selected environmental disease
- Assess approaches taken to reduce selection error and confounding factors in an epidemiological study
- Interpret data and information to outline causes of error, information bias, measurement bias and limitations in data relating to a disease during an epidemic or pandemic
- Evaluate, using examples, the benefits of engaging in an epidemiological study on preventing and managing disease

Biodiversity

Outcomes

A student:

- analyses changes in ecosystems and strategies for biodiversity conservation **BI-12-03**

Related Life Skills outcomes: BI-LS-10, BI-LS-11, BI-LS-12, BI-LS-13

Content

Relevant Working scientifically outcomes and content must be integrated with each focus area. All the Working scientifically outcomes and content must be addressed by the end of Year 12.

Related: Working scientifically

Changing ecosystems

- Explain ecosystem changes that have occurred as a result of the introduction of invasive species
- Explain impacts of monoculture, pesticide use, land clearing and habitat loss on the health of ecosystems
- Interpret data to demonstrate the effects of invasive species on the local environment
- Conduct a secondary-source investigation to analyse the natural and human-induced causes for a selected Australian species becoming threatened, endangered or extinct
- Describe the role of a keystone species in the health of an ecosystem
- Analyse data on a keystone species and predict the outcomes of removing the species from an Australian ecosystem

Genetic diversity

- Discuss biodiversity in relation to the diversity of genes and species in ecosystems
- Assess the importance of gene pool size for the ongoing survival of a population
- Use examples to compare asexual and sexual reproduction methods of plants for creating variation in a species
- Use examples to compare external and internal fertilisation methods for creating variation in a species
- Explain how asexual reproductive methods of budding, spore formation, parthenogenesis and binary fission impact on the continuity of species in changing environments
- Explain how the founder effect and bottlenecks result in genetic drift
- Discuss genetic drift, gene flow and selection pressures in relation to allele frequency in a population
- Conduct a practical investigation to model how allele frequencies can be affected by different factors over successive generations
- Analyse data on the effect of reduced genetic diversity on the survival of Tasmanian devil populations
- Evaluate the effect of mutation, natural selection, non-random mating, gene flow and genetic drift on allele frequencies in populations
- Relate changes in the frequency of genetic variants to the genetic diversity, stability and evolution of a population
- Explain the physical and chemical changes of a plant in response to the presence of pathogens
- Conduct a scientific investigation to evaluate the effect of Panama disease on bananas
- Use examples to assess the effects of infectious diseases on plants

- Analyse data to justify the choice of an indicator species to determine a change in an Australian ecosystem
- Explain the importance of genetic diversity in a species, species diversity and ecosystem diversity for ecosystem health, and the continuity of life in a changing environment

Sustainable ecosystems

- Discuss the concept of ecological sustainability
- Describe how Aboriginal and Torres Strait Islander Peoples' Practices focus on sustainability and maintaining the health of Country/Place
- Explain procedures employed in Australia to limit transmission of infectious diseases in animals and plants
- Use examples to evaluate environmental management and quarantine methods used to control and prevent an epidemic in plants or animals in Australian ecosystems
- Evaluate the success of physical, chemical and biological strategies used to control an invasive species in Australia
- Assess the role of national parks and marine reserves in maintaining biodiversity in Australia
- Analyse the benefits, limitations and ethical issues associated with the reintroduction of an extinct Australian species
- Conduct a scientific investigation to evaluate an Australian conservation program that aims to improve genetic diversity of a threatened population
- Predict future impacts of human-induced and natural selection pressures on the biodiversity of an ecosystem

Biotechnology

Outcomes

A student:

- evaluates the use of biotechnologies in medicine, agriculture and biodiversity conservation **BI-12-04**

Related Life Skills outcomes: BI-LS-14

Content

Relevant Working scientifically outcomes and content must be integrated with each focus area. All the Working scientifically outcomes and content must be addressed by the end of Year 12.

Related: Working scientifically

Modern biotechnologies

- Discuss the roles of biological knowledge, genetic engineering and bioinformatics techniques used in biotechnology
- Use examples to explain how biotechnology is currently used in Australian research, agriculture, biodiversity conservation and health
- Use examples to compare transgenic organisms and genetically modified organisms
- Compare germline genetic changes in reproductive and genetic engineering biotechnologies
- Assess the role of data and modelling in developing and using biotechnology

Biotechnology in human diseases

- Use examples to explain how biotechnologies diagnose genetic diseases

  Example(s):

  Cystic fibrosis, alpha-1 antitrypsin deficiency, inherited retinal dystrophy, Leber congenital amaurosis (LCA).

- Assess the use of genetic databases for the analysis of the prevalence of a genetic disease

  Example(s):

  National Center for Biotechnology Information (NCBI) GenBank database, EMBL Nucleotide Sequence Database for cystic fibrosis.

- Discuss the risks and benefits of using biotechnologies to provide personalised information about the risk of developing, and management of, a non-infectious disease
- Outline the method and outcome of 2 selected gene therapies used to reduce the impact of genetic conditions
- Conduct a scientific investigation to model the process of using recombinant DNA technology to produce human insulin
- Analyse data to evaluate a biotechnology used for a selected non-infectious disease
- Discuss current and future applications of biotechnology to improve outcomes of a selected non-infectious disease
- Assess the ethical and legal implications of using gene therapies in health care
- Compare the processes of 2 current biotechnologies used in diagnosing infectious diseases

- Conduct a secondary-source investigation to evaluate the use of biotechnologies on the prevalence of mosquito-borne diseases
- Evaluate the potential societal benefits of using genetic technologies to manage infectious diseases

Biotechnology in agriculture and biodiversity

- Discuss Aboriginal and Torres Strait Islander Peoples' uses and applications of biotechnologies
- Account for the use of artificial pollination in Australian agriculture, including its methods and outcomes
- Conduct a secondary-source investigation on a current plant reproductive technology used to support biodiversity in Australia
- Discuss how bioinformatics is used to determine the health of an ecosystem
- Use an example to account for the use of bioinformatics to inform decisions about the conservation of an Australian species
- Discuss the benefits and ethical implications of using a genetically modified plant to address a nutritional deficiency
- Evaluate the release of a genetically modified organism into the wild and predict the impacts on natural populations
- Assess the influence of social, economic and cultural contexts on the use of a biotechnology in agriculture

Assessment

Course standards

Course standards are comprised of syllabus standards and performance standards. Syllabus outcomes and content form the syllabus standards that describe what students are expected to know, understand and do. Performance standards, including the Common Grade Scale for Preliminary courses, HSC Performance Band Descriptions and Achievement Level Descriptions (for HSC courses with grades only) describe how well students have achieved in relation to syllabus standards. Performance standards are used to report student achievement on NESA credentials.

Common Grade Scale for Preliminary courses

Stage 6 – Year 11

The Common Grade Scale for Preliminary courses provides generic, holistic descriptions for performance at each of the 5 grade levels. It is used to report student achievement in Year 11 courses in all NSW schools.

Performance band descriptions for Biology

Stage 6 – Year 12

HSC performance band descriptions summarise the knowledge, understanding and skills typically demonstrated by students at each band level in a particular course. NESA uses these holistic descriptions to report a student's overall level of achievement in an HSC course.

Band 6

A student who performs at this level typically:

- demonstrate extensive knowledge and understanding of scientific concepts in Biology
- applies knowledge and understanding to unfamiliar situations to explain and propose solutions to complex scientific scenarios
- designs and plans investigations to obtain accurate, reliable, valid and relevant primary and secondary data and information, evaluates and mitigates risks, and makes effective modifications in response to new evidence
- selects, processes, interprets and represents data using a range of scientific formats to show patterns and relationships, derive trends, explain phenomena and make predictions
- designs solutions to complex problems, questions or hypotheses using data and by applying scientific processes, modelling and formats
- communicates scientific understanding succinctly, logically and consistently using accurate scientific terms in a variety of formats and contexts.

Band 5

A student who performs at this level typically:

- demonstrates thorough knowledge and understanding of scientific concepts in Biology
- applies knowledge and understanding to unfamiliar situations to explain scientific scenarios
- designs and plans investigations to obtain accurate, reliable, valid and relevant primary and secondary data and information, evaluates and mitigates risks, and makes some modifications in response to new evidence
- selects, processes, interprets and represents data using a range of scientific formats to show patterns and relationships, derive trends, describe phenomena and make predictions

- designs solutions to problems, questions or hypotheses using data and by applying scientific processes, modelling and formats
- communicates scientific understanding succinctly and logically using accurate scientific terms in a variety of formats and contexts.

Band 4

A student who performs at this level typically:

- demonstrates sound knowledge and understanding of scientific concepts in Biology
- applies knowledge and information relevant to scientific issues and scenarios
- designs and plans investigations to obtain primary and secondary data and evaluates risks
- processes, interprets and represents data using a range of scientific formats
- uses scientific processes to address problems, questions or hypotheses
- communicates scientific understanding effectively using scientific terms.

Band 3

A student who performs at this level typically:

- demonstrates basic knowledge and understanding of scientific concepts in Biology
- recalls scientific knowledge and information
- implements scientific processes to obtain primary and secondary data and identifies risks
- processes and represents data using scientific formats
- responds to scientific problems, questions or hypotheses
- communicates basic scientific understanding.

Band 2

A student who performs at this level typically:

- demonstrates limited knowledge and understanding of scientific concepts in Biology
- recalls limited scientific knowledge and information in Biology
- outlines investigations to obtain data and information
- provides simple descriptions of scientific problems
- communicates limited scientific understanding.

Band 1

Performance reported as Band 1 indicates that the minimum standard expected was not demonstrated.

School-based assessment

Schools are required to develop an assessment program for each Year 11 and Year 12 course. NESA provides information about the responsibilities of schools in developing assessment programs in course-specific assessment requirements and in the Assessment Certification Examination (ACE) rules and requirements.

Year 11 Biology school-based assessment

Stage 6 – Year 11

Schools are required to submit to NESA a grade for each student based on their achievement at the end of the course.

Teachers use professional, on-balance judgement to allocate grades based on the Common Grade Scale for Preliminary courses.

Teachers consider all available assessment information, including formal and informal assessment, to determine the grade that best matches each student's achievement at the end of the course.

See Assessment Certification Examination (ACE) rules and requirements for further information.

Assessment programs must reflect course components and weightings

The course components and component weightings for Year 11 are mandatory.

Course component	Weighting %
Skills in Working scientifically	60
Knowledge and understanding of course content	40

Schools may determine specific elements of their assessment program

Schools have authority to determine the number, type of task and the weighting allocated to an assessment task. Schools may also follow the sample assessment programs provided by NESA.

Sample assessment program

NESA's sample Year 11 formal school-based assessment program for Biology is:

- 3 assessment tasks, including:
  - one depth study or aspect of a depth study
  - a formal written examination
  - a weighting for any individual task of 20% to 40%.

Some students with disability may require adjustments in order to access assessment opportunities and demonstrate achievement of outcomes.

Year 12 Biology school-based assessment

Stage 6 – Year 12

NESA requires schools to submit a school-based assessment mark for each Year 12 student who completes this course. Formal school-based assessment tasks should reflect the syllabus outcomes and content. The mark submitted by the school provides a summation of each student's achievement measured at several points throughout the course.

A school's program of school-based assessment includes both mandatory and non-mandatory elements.

See Assessment Certification Examination (ACE) rules and requirements for further information.

Assessment programs must reflect course components and weightings

The course components and component weightings for Year 12 are mandatory.

Course component	Weighting %
Skills in Working scientifically	60
Knowledge and understanding of course content	40

Schools may determine specific elements of their assessment program

Schools have authority to determine the number, type of task and the weighting allocated to an assessment task. Schools may also follow the sample assessment programs provided by NESA.

Sample assessment program

NESA's sample Year 12 formal school-based assessment program for Biology is:

- 4 assessment tasks, including:
  - one depth study or aspect of a depth study
  - a formal written examination
  - a weighting for any individual task of 10% to 40%.

Some students with disability may require adjustments in order to access assessment opportunities and demonstrate achievement of outcomes.

Sample assessment schedules

Stage 6

Sample assessment schedules and tasks are being updated to align with new ACE Rules. More information: New limit on take-home assessment tasks from Term 4 2026.

Further information

Stage 6 – Year 12

- Assessment in Stage 6
- Principles of effective assessment
- Assessment in practice
- School-based assessment requirements
- Adjustments to assessment for students with disability
- Life Skills
- Assessment Certification Examination (ACE)

HSC examinations

The external HSC examination measures student achievement in a range of syllabus outcomes.

The external examination and its marking relate to the syllabus by:

- providing clear links to syllabus outcomes
- enabling students to demonstrate the levels of achievement outlined in the Performance Band Descriptions
- applying marking guidelines based on criteria that relate to the quality of the response
- aligning performance in the examination each year to the standards established for the course.

Examination questions may require students to integrate knowledge, understanding and skills developed through studying the course.

The Year 11 course is assumed knowledge for the Year 12 course.

Some students with disability may be eligible for HSC exam provisions when completing the HSC examination.

Biology HSC examination specifications

Stage 6 – Year 12

The examination will consist of a written paper worth 100 marks.

Time allowed: 3 hours plus 10 minutes reading time.

NESA-approved calculators may be used.

The paper will consist of two sections.

Questions assessing Working scientifically outcomes will be integrated throughout the examination.

Questions may refer to stimulus material.

Section I (20 marks)

- There will be objective-response questions to the value of 20 marks.

Section II (80 marks)

- Questions may contain parts.
- There will be 20 to 25 items.
- At least two items will be worth 7 to 9 marks.

HSC Biology – Sample examination materials

Stage 6 – Year 12

- HSC Biology – annotated sample examination materials
- Sample HSC examinations: A4 guide for teachers

Further information

Stage 6 – Year 12

- Assessment in Stage 6
- Principles of effective assessment
- Assessment in practice
- School-based assessment requirements
- Adjustments to assessment for students with disability
- Life Skills
- Assessment Certification Examination (ACE)