DEPARTMENT OF EDUCATION
learners first

Discipline-based study

Science

Biology 2

Course document

independent schools tasmania

Catholic Education Tasmania

Years 9-12 Learning

Tasmanian Government

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Focus area – Discipline-based study

Courses aligned to the Years 9 to 12 Curriculum Framework belong to one of the five focus areas of Discipline-based study, Transdisciplinary projects, Professional studies, Work-based learning and Personal futures.

Biology Level 2 is a Discipline-based study course.

Discipline-based study includes content, core concepts and big ideas enabling deep knowledge and understanding of the content and the application of what is learned. Learners consider accepted key disciplinary knowledge, apply distinctive ways of thinking and become increasingly independent learners. They use methodologies specific to the discipline to explore and strengthen their understanding of key concepts and develop deep knowledge, skills and understanding.

Discipline-based study courses have three key features that guide teaching and learning:

- specialist knowledge
- theories and concepts and
- methodology and terminology.

In this course learners will do this by engaging with:

- how biological systems interact and are interrelated
- major biological concepts, theories and models related to biological systems at all scales
- biological knowledge development, how scientists use biology and how biological knowledge influences society
- fieldwork, laboratory and other research investigations; collecting and analysing qualitative and quantitative data and interpreting evidence
- evidence-based arguments creatively and analytically when evaluating claims and applying biological knowledge
- communication of biological understanding, findings, arguments and conclusions.

Rationale

The *Biology* suite of courses explores ways in which scientists work collaboratively and individually in a range of integrated fields to increase understanding of an ever-expanding body of biological knowledge. Australian, regional and global communities rely on the biological sciences to understand, address and successfully manage environmental, health and sustainability challenges facing society in the twenty-first century. These include the biosecurity and resilience of ecosystems, the health and wellbeing of humans and other organisms and their populations and the sustainability of biological resources. This course focusses on the structure and function of cells, multicellular organisms, biodiversity and ecosystems.

Learners use their understanding of the interconnectedness of biological systems when evaluating both the impact of human activity and the strategies proposed to address major biological challenges now and in the future in local, national and global contexts. An understanding of biological concepts, as well as general science knowledge and skills, are relevant to a range of careers, including those in medical, veterinary, food and marine sciences, agriculture, biotechnology, environmental rehabilitation, biosecurity, quarantine, conservation and eco-tourism. This course will also provide a foundation for learners to critically consider and make informed decisions about contemporary biological issues in their everyday lives.

Learners will develop their investigative, analytical and communication skills through field, laboratory and research investigations of living systems. They will develop skills through critical evaluation of the development, ethics, applications and influences of contemporary biological knowledge in a range of contexts.

The purpose of Years 9 to 12 Education is to enable all students to achieve their potential through Years 9 to 12 and beyond in further study, training or employment.

Years 9 to 12 Education enables personal empowerment, cultural transmission, preparation for citizenship and preparation for work.

This course is built on the principles of access, agency, excellence, balance, support and achievement as part of a range of programs that enables learners to access a diverse and flexible range of learning opportunities suited to their level of readiness, interests and aspirations.

Learning outcomes

On successful completion of this course learners will be able to:

1. set and meet individual and collaborative goals within timeframes
2. access and communicate biological understanding using qualitative and quantitative representations
3. use science inquiry skills to design, conduct, analyse and communicate investigations into biological systems
4. identify how theories and models have developed based on evidence from multiple disciplines and identify the uses and limitations of biological knowledge in a range of contexts
5. identify the structure, components and function of cells
6. identify how cellular processes and biochemistry are related to the need to exchange matter and energy with a cell's immediate environment
7. identify how multicellular organisms reproduce and consist of multiple interdependent, hierarchically organised systems, that enable the exchange of matter and energy with their immediate environment

8. identify ecosystem diversity and dynamics with reference to biotic and abiotic interactions and use classification to organise and communicate in relation to biodiversity.

Integration of general capabilities and cross-curriculum priorities

The general capabilities addressed specifically in this course are:

- critical and creative thinking
- ethical understanding
- literacy
- numeracy
- personal and social capability.

The cross-curriculum priorities enabled through this course are:

- Aboriginal and Torres Strait Islander histories and cultures
- sustainability.

Course description

In *Biology* Level 2 learners will understand the basic building blocks of biology. Learners will explore cell structure, processes and function. They will investigate organ systems and their place within multicellular organisms. They will apply this knowledge when inquiring into ecosystems and biodiversity.

Learners will use these concepts to explore one or more contexts or themes; for example, human biology, agriculture, environmental biology, biochemistry or marine studies.

Learners will come to understand how applying biological knowledge is central to society. They will explore relationships between biology and society and investigate the processes of biological discovery. They will use practical inquiry to engage with and understand the natural world.

Pathways

Biology Level 2 has a clear pathway from Australian curriculum: Science F–10 and other TASC accredited science courses as well as being a pathway from some TASC-accredited HASS, HPE, Technologies and Mathematics courses.

As the study of all life, *Biology* Level 2 has a clear pathway to a range of TASC-accredited courses, such as *Biology* Level 3, *Environmental Science* Level 3, *Foods and Nutrition* Level 3, *Sport Science* Level 3, *Health* Level 3 and *Geography* Level 3. It also provides a pathway to vocational opportunities including agriculture, food and natural resources and health and community services.

Course requirements

Access

Learners are required to work as directed in practical situations as potentially dangerous materials and equipment may be used in this course.

Learners are required to apply some mathematical skills from Australian curriculum F–10. See Appendix 2 for full details.

This course requires learners to collaborate with others.

Resource requirements

Providers offering this course will need equipment, materials and a suitable space to carry out the practical component of the course effectively and safely.

Course size and complexity

This course has a complexity level of 2.

For a full description of courses at a complexity level of 2, please refer to the Levels of complexity – Tasmanian senior secondary education: https://www.tasc.tas.gov.au/wp-content/uploads/2021/07/Levels-of-Complexity-Tasmanian-Senior-Secondary-Education.pdf)

Level 2 courses enable contextual opportunities for learners to:

- apply required knowledge and skills to demonstrate personal responsibility and accountability for the quality of defined outcomes, as individuals and team members
- demonstrate skills to access, develop, summarise, analyse and communicate knowledge and ideas; develop and access expertise when solving problems, think creatively and flexibly and work with others.

This course has a size value of 15. Upon successful completion, this course will contribute 15 points towards the achievement of the Tasmanian Certificate of Education (TCE).

Course structure and delivery

Structure

This course consists of three 50-hour modules.

Module 1: Science as a human endeavour and science inquiry

Module 2: Cell biology

Module 3: Multicellular organisms and environmental interactions

Delivery

Module 1 must be delivered concurrently with modules 2 and 3. There is no further order of delivery required.

Course content

Module 1: Science as a human endeavour and science inquiry

Module 1 defines the inquiry skills and contexts that are intertwined with science understanding that learners will use and refer to throughout this course. Through the investigation of appropriate contexts, learners explore how international collaboration, evidence from multiple disciplines and the use of ICT and other technologies have contributed to developing an understanding of biology. They investigate how scientific knowledge is used to offer valid explanations and reliable predictions and investigate the ways in which scientific knowledge interacts with social, economic, cultural and ethical factors.

Learners will use science inquiry skills to explore the relationship between structure and function, by conducting real or virtual dissections and carrying out microscopic examination of cells. Learners consider the ethical considerations that apply to the use of living organisms in research. They develop skills in constructing and using models to describe and interpret data about the functions of cells and organisms.

Module 1 learning outcomes

The following learning outcomes are a focus for this module:

1. set and meet individual and collaborative goals within timeframes
2. access and communicate biological understanding using qualitative and quantitative representations
3. use science inquiry skills to design, conduct, analyse and communicate investigations into biological systems
4. identify how theories and models have developed based on evidence from multiple disciplines and identify the uses and limitations of biological knowledge in a range of contexts.

Module 1 content

Key knowledge – science as a human endeavour

Development and collaboration within biology

- science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility (ACSBL008)
- development of complex models and theories often requires a wide range of evidence from multiple individuals and across disciplines (ACSBL009)
- scientific knowledge can enable scientists to offer valid explanations and make reliable predictions (ACSBL013).

Science and technology

- advances in science understanding in one field can influence other areas of science, technology and engineering (ACSBL010)
- the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations (ACSBL011).

Science and the broader community

- the use of scientific knowledge may have beneficial or harmful or unintended consequences (ACSBL012)
- scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability (ACSBL014)
- First Nations Australians' knowledge may be valuable when investigating biological science.

Key skills – science inquiry

Design of inquiry

- identify, research and construct questions for investigation, propose hypotheses and predict possible outcomes (ACSBL001)
- design investigations, including the procedure or procedures to be followed, the materials required and the type and amount of primary and secondary data to be collected; conduct risk assessments and consider research ethics, including animal ethics (ACSBL002).

Implementation of inquiry

- conduct investigations, including microscopy techniques, real or virtual dissections and chemical analysis, safely, competently and methodically for the collection of valid and reliable data (ACSBL032)
- represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error and uncertainty

and limitations in data. Select, synthesise and use evidence to make and justify conclusions (ACSBL033).

Evaluation of inquiry

- interpret a range of scientific and media texts and evaluate processes, claims and conclusions by considering the quality of available evidence. Use reasoning to construct scientific arguments (ACSBL034)
- select, construct and use appropriate representations, including diagrams of structures and processes and images from different imaging techniques to communicate conceptual understanding, solve problems and make predictions (ACSBL035)
- communicate to specific audiences and for specific purposes using appropriate language, nomenclature, modes, formats, conventions and structures (ACSBL036).

Module 1 work requirements summary

This module includes the following work requirements:

- one folio using science inquiry skills
- one extended inquiry: investigating a question or hypothesis through collection, analysis and synthesis of primary data
- one investigation: applying science as a human endeavour.

See Appendix 3 for the full specifications of the work requirements of this course.

Module 1 assessment

This module has a focus on criteria 1, 2, 3 and 4.

Module 2: Cell biology

The cell is the basic unit of life. Although cell structure and function is diverse, all cells possess some common features. All prokaryotic and eukaryotic cells need to exchange materials with their immediate external environment in order to maintain the chemical processes vital for cell functioning. In this module, learners will examine inputs and outputs of cells to develop an understanding of the chemical nature of cellular systems, both structurally and functionally, and the processes required for cell survival. Learners will investigate the ways in which matter moves and energy is transformed and transferred in the biochemical processes of photosynthesis and respiration and some roles of enzymes in controlling biochemical systems.

Where possible, learners will use scientific inquiry skills from module 1 as the process of learning and use science as a human endeavour as the context.

Module 2 learning outcomes

The following learning outcomes are a focus for this module:

1. set and meet individual and collaborative goals within timeframes
2. access and communicate biological understanding using qualitative and quantitative representations
5. identify the structure, components and function of cells
6. identify how cellular processes and biochemistry are related to the need to exchange matter and energy with a cell's immediate environment.

Module 2 content

Key knowledge – science understanding

Cell structure

- biological molecules – cell requirements – inputs and outputs – carbohydrates, lipids, proteins, ions, minerals, vitamins, water (ACSBL049)
- the distinction between prokaryotic and eukaryotic cells (ACSBL048)
- internal compartments, including organelles, with specific cellular functions (ACSBL048)
- the characteristics of the plasma membrane as a semi-permeable boundary between the internal and external environments of a cell (ACSBL045).

Cell function

- modes of passive transport of soluble substances across the plasma membrane including simple diffusion and osmosis (ACSBL046)
- enzymes are specific to their substrate (ACSBL051)
- enzymes break down biological compounds (ACSBL051)
- photosynthesis – summary of the inputs and outputs – worded equation only carbon dioxide + water glucose → oxygen + water (ACSBL052)
- cellular respiration occurs in the mitochondria and is necessary to release usable energy in the form of ATP, only aerobic respiration required (ACSBL053)
- summarise the reactions of aerobic respiration inputs and outputs - worded equation only glucose + oxygen → carbon dioxide + water + energy. (ACSBL053).

Key skills – application of science understanding

Cell structure

- cell theory – demonstrate and apply the concept that cells are the basic structural feature of life on Earth (ACSBL048)
- investigate observations that demonstrate that the cell membrane separates the cell from its surroundings and controls the exchange of materials, including gases, nutrients and wastes, between the cell and its environment (ACSBL045)
- construct models to investigate the impact of surface area to volume ratio and apply understanding as an important factor in explaining the limitations of cell size and exchange of materials (ACSBL047).

Cell function

- explore enzymes as biological catalysts in biochemical reactions compared to the same environment without enzymes
- investigate the factors affecting enzyme action including temperature, pH, enzyme and substrate concentration, competitive and non-competitive inhibitors (ACSBL051)
- design investigations to understand photosynthesis as a process that in plant cells occurs on the chloroplast and uses light energy to synthesise organic compounds
- apply the concept that aerobic cellular respiration, which occurs in the mitochondria, releases usable energy in the form of ATP.

Module 2 work requirements summary

This module includes the following work requirements:

- one extended response: applying cell biology theories and models
- one short response: applying cell biology ideas and problem solving.

See Appendix 3 for the full specifications of the work requirements of this course.

Module 2 assessment

This module has a focus on criteria 1, 2, 5 and 6.

Module 3: Multicellular organisms and environmental interactions

Multicellular organisms typically consist of a number of interdependent systems of cells organised into tissues, organs and organ systems. Learners examine the structure and function of plant and animal systems at cell and tissue levels in order to describe how they facilitate the efficient provision or removal of materials to and from all cells of the organism.

Learners will develop an understanding of the processes involved in the movement of energy and matter in ecosystems. They investigate ecosystem dynamics, including interactions within and between species, and interactions between abiotic and biotic components of ecosystems. They also investigate how measurements of abiotic factors, population numbers and species diversity, and descriptions of species interactions, can form the basis for spatial and temporal comparisons between ecosystems. Learners will use classification keys to identify organisms, describe the biodiversity in ecosystems, investigate patterns in relationships between organisms and aid scientific communication.

Where possible, learners will use scientific inquiry skills from module 1 as the process of learning and use science as a human endeavour as the context.

Module 3 learning outcomes

The following learning outcomes are a focus for this module:

1. set and meet individual and collaborative goals within timeframes
2. access and communicate biological understanding using qualitative and quantitative representations
7. identify how multicellular organisms reproduce and consist of multiple interdependent, hierarchically organised systems, that enable the exchange of matter and energy with their immediate environment
8. identify ecosystem diversity and dynamics with reference to biotic and abiotic interactions and use classification to organise and communicate in relation to biodiversity.

Module 3 content

Key knowledge – science understanding

Multicellular organisms

- multicellular organisms have a hierarchical structural organisation of cells, tissues, organs and systems (ACSBL054).

Digestive system

- the structure of the digestive system facilitates the breakdown of food to compounds that can be readily absorbed into the blood for use in the cells (ACSBL055)
- mechanical digestion, including the teeth and peristalsis, is required to reduce the size of food pieces and to increase the surface area on which chemical digestion can act. (ACSBL055).

Gas exchange in animals and plants

- to be efficient, gas exchange surfaces must have the following characteristics: have large surface area, be thin, moist and vascular (ACSBL059)
- the mechanics of breathing help to maintain the efficient exchange of gases in the lungs.

Transport in animals and plants

- the circulatory system is structured to facilitate the transport of materials to and from exchange surfaces, including the lungs, digestive system and kidneys and the cells of the body (ACSBL057)
- the structure of the heart facilitates the efficient flow of blood around the body and the blood vessels of the circulatory system have specialised structures that provide for efficient distribution and collection of blood around the body (ACSBL058)
- the blood is made up of plasma and several types of blood cells, each with particular functions that aid in the transport of materials, including oxygen, nutrients and waste. (ACSBL055)
- gases are exchanged via stomata and the plant surface; their movement within the plant by diffusion does not involve the plant transport system (ACSBL059).

Reproductive system

- the types of asexual reproduction including fission, budding, vegetative propagation and spore formation and the biological advantages and disadvantages of asexual reproduction (ACSBL075)
- human reproductive system.

Classification and biodiversity

- biological classification is hierarchical and based on different levels of similarity of physical features, methods of reproduction and molecular sequences (ACSBL016)

- evidences for the theory of evolution (ACSBL089).

Ecosystem dynamics

- habitats, biotic and abiotic factors (ACSBL021) (ACSBL019)
- interactions of organisms with their environment (ACSBL022)
- relationships between organisms which include predation, competition, symbiosis and disease (ACSBL020)
- keystone species (ACSBL024) (ACSBL012).

Biogeochemical cycling

- matter cycles through and between the lithosphere, biosphere, atmosphere and hydrosphere with specific focus on the carbon cycle and the water cycle (ACSBL022).

Key skills – application of science understanding

Digestive system

- observe the structures in animals where the exchange of nutrients and wastes between the internal and external environments of the organism are facilitated by the structure and function of the cells and tissues of the digestive system, for example, villi structure and function (ACSBL057)
- investigate how chemical digestion involves the use of enzymes; for example, amylase, protease and lipase to chemically break down food for absorption (ACSBL051)
- apply the concept that materials eliminated from the digestive system include indigestible contents, excess materials and some metabolic wastes. (ACSBL057).

Gas exchange in animals and plants

- observe in animals where the exchange of gases between the internal and external environments of the organism is facilitated by the structure and function of the respiratory system at cell and tissue levels (ACSBL056)
- investigate structures in plants where gases are exchanged via stomata and the plant surface; gas movement within the plant by diffusion does not involve the plant transport system (ACSBL059).

Transport in animals and plants

- investigate how, in animals, the transport of materials within the internal environment for exchange with cells is facilitated by the structure and function of the circulatory system at cell and tissue levels; for example, the structure and function of capillaries (ACSBL058)
- design investigations in plants to explain how the transport of water and mineral nutrients from the roots occurs via xylem involving root pressure. Examples include transpiration, cohesion of water molecules and the transport of the products of photosynthesis and some mineral nutrients by translocation in the phloem (ACSBL060).

Reproductive system

- gather evidence and represent how the continuity of life requires the replication of genetic material and its transfer to the next generation through processes including binary fission, mitosis, meiosis and fertilisation (ACSBL075)
- research and represent how an offspring from two parents has a unique genetic identity (ACSBL085)
- investigate the biological advantage of sexual reproduction, specifically the genetic diversity in offspring. (ACSBL084).

Classification and biodiversity

- investigate some significant changes in life forms in Earth's geological history; for example, the rise of multicellular organisms, animals on land, mammals and the first flowering plants (ACSBL027)
- investigate examples where biological classification systems reflect evolutionary relatedness between groups of organisms (ACSBL017)
- identify some patterns of biological change over geological time; for example, within divergent evolution, convergent evolution and mass extinctions (ACSBL015).

Ecosystem dynamics

- represent ecosystems using energy flows, food chains, food webs and pyramids; for example, biomass, energy and number (ACSBL029)
- explore and apply the roles of autotrophs, heterotrophs and decomposers (ACSBL029)
- research examples where ecosystems have changed over time, identifying patterns and relationships (ACSBL027).

Module 3 work requirements summary

This module includes the following work requirements:

- one extended response: applying multicellular organisms and environmental interactions, theories and models
- one short response: applying multicellular organisms and environmental interactions, ideas and problem solving.

See Appendix 3 for the full specifications of the work requirements of this course.

Module 3 assessment

This module has a focus on criteria 1, 2, 7 and 8.

Assessment

Criterion-based assessment is a form of outcomes assessment that identifies the extent of learner achievement at an appropriate endpoint of study. Although assessment as part of the learning program is continuous, much of it is formative and is done to help learners identify what they need to do to attain the maximum benefit from their study of the course. Therefore, assessment for summative reporting to TASC will focus on what both teacher and learner understand to reflect endpoint achievement.

The standard of achievement each learner attains on each criterion is recorded as a rating 'A', 'B', or 'C', according to the outcomes specified in the standards section of the course.

A 't' notation must be used where a learner demonstrates any achievement against a criterion less than the standard specified for the 'C' rating.

A 'z' notation is to be used where a learner provides no evidence of achievement at all.

Internal assessment of all criteria will be made by the provider. Providers will report the learner's rating for each criterion to TASC.

Criteria

The assessment for *Biology* Level 2 will be based on the degree to which the learner can:

1. work independently and collaboratively towards goals
2. access, interpret and communicate biological data and information
3. undertake biological inquiry to generate and analyse data
4. describe the local, national and global context for biological science
5. describe and use concepts of cell structure
6. describe and use concepts of cell processes
7. describe and use concepts of multicellular organisms
8. describe and use biodiversity and ecosystem concepts.

	Module 1	Module 2	Module 3
Criteria focus	1, 2, 3, 4	1, 2, 5, 6	1, 2, 7, 8

Standards

Criterion 1: work independently and collaboratively towards goals

Criterion elements	Rating A	Rating B	Rating C
E1 - Uses strategies to complete work within timeframes	uses planning and self-management strategies to enable the successful completion of tasks within agreed time frames	uses planning strategies to enable the successful completion of tasks within agreed time frames	uses planning strategies to enable the completion of key elements of tasks within agreed time frames
E2 - Modifies tasks to improve and complete activities	explains how modifications were made to improve outcomes and complete tasks	describes how modifications were made to improve outcomes and complete tasks	identifies how modifications were made to improve outcomes and complete tasks
E3 - Describes contributions to complete collaborative activities	explains own and others' contributions to the completion of a product in collaborative activities.	describes own contribution to the completion of a product in collaborative activities.	identifies own contribution to the completion of a product in collaborative activities.

Criterion 2: access, interpret and communicate biological data and information

Criterion elements	Rating A	Rating B	Rating C
E1 - Interprets problems and makes predictions	interprets problems and makes valid predictions in familiar contexts	interprets problems and makes simple valid predictions in familiar contexts	interprets simple problems and makes simple predictions in familiar contexts
E2 - Represents and records sources of information	represents and accurately records sources of information using a variety of relevant sources	represents and records sources of information using a variety of relevant sources	represents and records sources of information as directed from a limited range of relevant sources
E3 - Describes the reliability of data and sources of information	explains how a range of factors influence the reliability of primary and secondary data and sources of information	describes a range of factors that influence the reliability of primary and secondary data and sources of information	identifies factors from a given range that influence the reliability of primary and secondary data and sources of information
E4 - Uses appropriate formats and units	selects and uses appropriate scientific structures, conventions, formats and units for communication of data and information	selects and uses appropriate scientific structures, conventions, formats and units from a range for communication of data and information	uses appropriate scientific structures, conventions, formats and units for communication of data and information, as directed
E5 - Uses biological terminology	selects and uses scientific terminology accurately and correctly to clearly communicate concepts and ideas.	uses a range of scientific terminology to clearly communicate concepts and ideas.	uses given scientific terminology to clearly communicate concepts and ideas.

Criterion 3: undertake biological inquiry to generate and analyse data

Criterion elements	Rating A	Rating B	Rating C
E1 - Describes risk	explains how they have considered safety and ethics when designing and conducting investigations	describes where they have considered safety and ethics when planning and conducting investigations	identifies where they have considered safety and ethics when planning and conducting investigations
E2 - Develops hypotheses	expresses a hypothesis to explain observations as a precise and testable statement	expresses a statement to explain observations meeting most of the criteria of a testable hypothesis	identifies and constructs evidence-based questions and problems that can be tested scientifically
E3 - Designs and conducts investigations	designs and conducts investigations to generate valid data to answer a question or problem	plans and conducts investigations to generate valid data in response to a question or problem	plans and conducts investigations to generate valid simple data in response to a question or problem
E4 - Selects and represents data to draw conclusions	selects and represents data to demonstrate relationships, anomalies and sources of error and presents evidence-based conclusions	selects and represents data to demonstrate relationships and anomalies and presents evidence-based conclusions	selects and represents data to demonstrate trends and presents simple, evidence-based conclusions
E5 - Analyses conclusions and processes.	evaluates processes and conclusions and suggests improvements or alternatives.	analyses processes and conclusions and suggests improvements or alternatives.	discusses processes and conclusions and suggests improvements.

Criterion 4: describe the local, national, and global context for biological science

Criterion elements	Rating A	Rating B	Rating C
E1 - Explains broader context of biology	analyses the local, national or global context and some social, economic or ethical implications of biological knowledge	explains the local, national or global context and some social, economic or ethical implication of biological knowledge	describes the local, national or global context and some social, economic or ethical implications of biological knowledge
E2 - Explains collaboration and use of evidence in the development of biology	explains the roles of collaboration and new evidence in the development of biological knowledge	describes the roles of collaboration and new evidence in the development of biological knowledge	identifies the roles of collaboration and new evidence in the development of biological knowledge
E3 - Explains the role of technologies in biology	compares and explains relationships between the development of technologies and biological knowledge	compares and describes relationships between the development of technologies and biological knowledge	identifies and compares relationships between the development of technologies and biological knowledge
E4 - Explains ways biology meets needs in society	explains ways in which biology has been used to meet needs in society.	describes ways in which biology has been used to meet needs in society.	identifies ways in which biology has been used to meet needs in society.

Criterion 5: describe and use concepts of cell structure

Criterion elements	Rating A	Rating B	Rating C
E1 - Describes types of cells	explains functions and structures of plant and animal cells	describes functions and structures of plant and animal cells	identifies functions and structures of plant and animal cells
E2 - Describes organelles and their functions	explains cell organelle processes and their function	describes cell organelles and their function	identifies cell organelles and their function
E3 - Describes the structure and function of the cell membrane	explains how the structure of the cell membrane relates to its function	describes the structure and functions of the cell membrane	identifies structural components and functions of the cell membrane
E4 - Describes the effect of surface area to volume ratio	explains the effect of surface to volume ratio on cell function and processes	describes the effect of surface to volume ratio on cell function and processes	identifies the effect of surface to volume ratio on cell function and processes

Criterion elements	Rating A	Rating B	Rating C
E5 - Describes cell differentiation and specialisation	explains how the structure of a range of specialised cells is related to their function within multicellular organisms.	describes a range of specialised cells and their function within multicellular organisms.	identifies given specialised cells and their function within multicellular organisms.

Criterion 6: describe and use concepts of cell processes

Criterion elements	Rating A	Rating B	Rating C
E1 - Describes properties of biological molecules	explains properties of biological molecules and the cellular processes in which they are involved	describes properties of biological molecules and the cellular processes in which they are involved	identifies properties of biological molecules and the cellular processes in which they are involved
E2 - Describes passive transport of materials across cell membranes	explains factors that affect movement of materials across cell membranes	describes factors that affect movement of materials across cell membranes	identifies factors that affect movement of materials across cell membranes
E3 - Describes enzyme function	explains the functions of enzymes and the factors that affect them	describes the functions of enzymes and the factors that affect them	identifies the functions of enzymes and the factors that affect them
E4 - Describes processes of photosynthesis	explains the molecules synthesised and wastes produced within the biochemical process of photosynthesis	describes the molecules synthesised and wastes produced within the biochemical process of photosynthesis	identifies the molecules synthesised and wastes produced within the biochemical process of photosynthesis
E5 - Describes processes of cellular respiration	explains the molecules synthesised and wastes produced within the biochemical process of cellular respiration.	describes the molecules synthesised and wastes produced within the biochemical process of cellular respiration.	identifies the molecules synthesised and wastes produced within the biochemical process of cellular respiration.

Criterion 7: describe and use concepts of multicellular organisms

Criterion elements	Rating A	Rating B	Rating C
E1 - Describes digestion in animals	explains structures and processes required for digestion in animals	describes structures and processes required for digestion in animals	identifies structures and processes required for digestion in animals
E2 - Describes gas exchange in plants and animals	explains structures and processes required for gas exchange in plants and animals	describes structures and processes required for gas exchange in plants and animals	identifies structures and processes required for gas exchange in plants and animals
E3 - Describes transport in plants and animals	explains structures and processes required for transport in plants and animals	describes structures and processes required for transport in plants and animals	identifies structures and processes required for transport in plants and animals
E4 - Describes the functions and processes of cell division	explains the functions and processes of cell division	describes the functions and processes of cell division	identifies the functions and processes of cell division
E5 - Describes the functions and processes of sexual and asexual reproduction	explains the functions and processes of sexual and asexual reproduction.	describes the functions and processes of sexual and asexual reproduction.	identifies the functions and processes of sexual and asexual reproduction.

Criterion 8: describe and use biodiversity and ecosystem concepts

Criterion elements	Rating A	Rating B	Rating C
E1 - Describes and applies classification techniques	explains and applies biological classification techniques	describes and applies biological classification techniques	identifies and applies biological classification techniques
E2 - Describes and applies concepts of biodiversity	explains and applies concepts of biodiversity	describes and applies concepts of biodiversity	identifies and applies concepts of biodiversity
E3 - Describes and uses evidence of evolution	explains and uses evidence in support of evolution	describes and uses evidence in support of evolution	identifies and uses evidence in support of evolution
E4 - Describes energy flow and matter cycling through ecosystems	explains energy flow and matter cycling through ecosystems	describes energy flow and matter cycling through ecosystems	identifies energy flow and matter cycling through ecosystems

Criterion elements	Rating A	Rating B	Rating C
E5 - Describes ecosystem change over time	explains ecosystem change over time.	describes ecosystem change over time.	identifies ecosystem change over time.

Quality assurance

The following processes will be facilitated by TASC to ensure there is:

- a match between the standards of achievement specified in the course and the skills and knowledge demonstrated by individual learners
- community confidence in the integrity and meaning of the qualification.

Process

TASC will verify that the provider's course delivery and assessment meet the course requirements and community expectations for fairness, integrity and validity of qualifications TASC issues. This will involve checking:

- Provider standard 1: scope and sequence documentation:
  - course delivery plan
  - course assessment plan, assessment matrix
- Provider standard 2: student attendance records
- Provider standard 3 examples of assessments tools and instruments and associated rubrics and marking guides
- Provider standard 1 and 3: examples of student work including that related to any work requirements articulated in the course document
- Provider standard 4: class records of assessment

This process will be scheduled by TASC using a risk-based approach.

Qualifications and award requirements

The final award will be determined by the Office of Tasmanian Assessment, Standards and Certification from 8 ratings.

The minimum requirements for an award are as follows:

EXCEPTIONAL ACHIEVEMENT (EA)
6 'A' ratings, 2 'B' ratings

HIGH ACHIEVEMENT (HA)
3 'A' ratings, 4 'B' ratings, 1 'C' rating

COMMENDABLE ACHIEVEMENT (CA)
4 'B' ratings, 3 'C' ratings

SATISFACTORY ACHIEVEMENT (SA)
6 'C' ratings

PRELIMINARY ACHIEVEMENT (PA)
4 'C' ratings

A learner who otherwise achieves the rating for a CA (Commendable Achievement) or SA (Satisfactory Achievement) award but who fails to show any evidence of achievement in one or more criteria ('z' notation) will be issued with a PA (Preliminary Achievement) award.

Course evaluation

Years 9-12 Learning will develop and regularly review and revise the curriculum. Course evaluation is informed by the experience of the course's implementation, delivery and assessment. More information about course evaluation can be found on the Years 11 and 12 website.

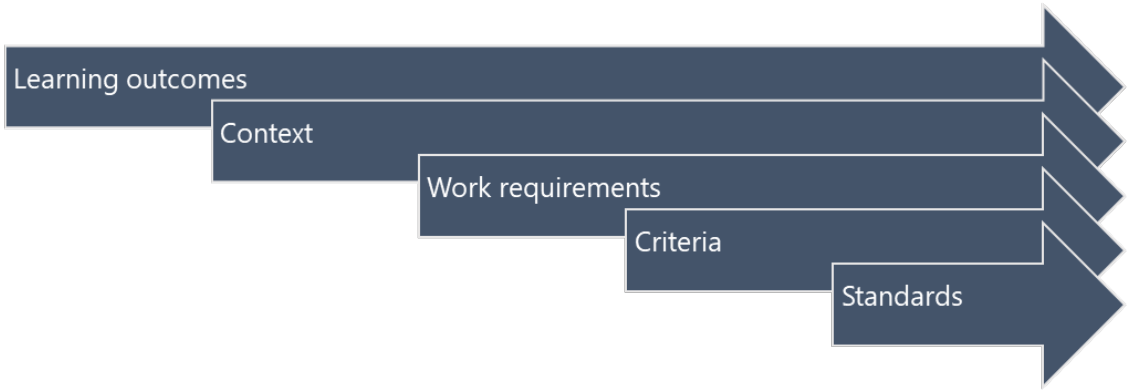
Course developer

This course has been developed by the Department of Education's Years 9-12 Learning Unit in collaboration with Catholic Education Tasmania and Independent Schools Tasmania.

Accreditation and version history

Version 1. Accredited on 31 March 2022 for use from 1 January 2023 to 31 December 2027.

Appendix 1 - Line of sight



Learning outcomes	Course content: module	Work requirements: module	Criterion	Criterion elements	General capabilities
1. set and meet individual and collaborative goals within timeframes	1, 2, 3	1, 2, 3	1	1, 2, 3	
2. access and communicate biological understanding using qualitative and quantitative representations	1, 2, 3	1, 2, 3	2	1, 2, 3, 4, 5	
3. use science inquiry skills to design, conduct, analyse and communicate investigations into biological systems	1	1	3	1, 2, 3, 4, 5	
4. identify how theories and models have developed based on evidence from multiple disciplines and identify the uses and limitations of biological knowledge in a range of contexts	1	1	4	1, 2, 3, 4	
5. identify the structure, components and function of cells	2	2	5	1, 2, 3, 4, 5	
6. identify how cellular processes and biochemistry are related to the need to exchange matter and energy with a cell's immediate environment	2	2	6	1, 2, 3, 4, 5	
7. identify how multicellular organisms reproduce and consist of multiple interdependent, hierarchically organised systems, that enable the exchange of matter and energy with their immediate environment	3	3	7	1, 2, 3, 4, 5	

Learning outcomes	Course content: module	Work requirements: module	Criterion	Criterion elements	General capabilities
8. identify ecosystem diversity and dynamics with reference to biotic and abiotic interactions and use classification to organise and communicate in relation to biodiversity	3	3	8	All	

Appendix 2 - Alignment to curriculum frameworks

Progression from the F-10 Australian curriculum: Science

The senior secondary Biology curriculum continues to develop student understanding and skills from across the three strands of the F-10 Australian curriculum: Science. In the science understanding strand, the biology curriculum draws on knowledge and understanding from across the four sub-strands of biological, physical, chemical and Earth and space sciences.

In particular, the Biology curriculum 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.

Mathematical skills expected of students studying Biology Level 2

The biology curriculum requires students to use the mathematical skills they have developed through the F-10 Australian curriculum: Mathematics, in addition to the numeracy skills they have developed through the science inquiry skills strand of the Australian curriculum: Science.

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.

Senior Secondary Australian curriculum: Biology

Biology Level 2 is aligned to Senior secondary Australian curriculum: *Biology* Units 1 and 2.

Appendix 3 - Work requirements

The work requirements of a course are processes, products or performances that provide a significant demonstration of achievement that is measurable against the course's standards. Work requirements need not be the sole form of assessment for a module.

Module 1 work requirements specifications

Work requirement 1 of 3

Title of work requirement: Science inquiry skills
Mode or format: folio
Description: In preparation and alongside this inquiry it is likely that shorter practical activities or fieldwork will be undertaken. These are designed to support the depth of understanding and engagement in the later longer inquiry for a number of purposes, including:

- learning and practising scientific techniques
- safe practices to avoid health and safety issues to be used independently throughout the year
- illustration of concepts
- exploring components of experimental practice
- meeting the requirements of experimental practice whilst addressing criterion 3.

A digital or physical record of these and other inquiry-based tasks may include, but is not limited to, a laboratory manual or journal, reports, compiled data; for example, images, tables, graphs, or other observations.

On at least two occasions learners will document a minor inquiry to address all elements in criterion 3 in a form that will include:

- risk assessment
- development of a hypothesis
- experimental design and method
- data and conclusions
- recommendations for improvement.

Each of these will take approximately 5 hours and there must be one inquiry corresponding to each of Modules 2 and 3.
Size: 5 hours for each of the two minor inquiries
Timing: concurrent with Modules 2 and 3
External agencies: not applicable
Relevant criteria:

- Criterion 1: E1, 2, 3
- Criterion 2: E1, 2, 3, 4, 5
- Criterion 3: E1, 2, 3, 4, 5

Work requirement 2 of 3

Title of work requirement: Extended inquiry
Mode or format: inquiry
Description: This assessment requires learners to research a question or hypothesis through collection, analysis and synthesis of primary data. This assessment occurs over an extended and defined period of time.

In the experiment, learners design, refine, extend, modify or redirect an experiment in order to address their own related hypothesis or question. It is sufficient that learners use a practical performed in class, fieldwork or a simulation as the basis for their methodology and research question.

Learners will document:

- an introduction with relevant biological concepts, and either a hypothesis and variables, or an investigable question
- the materials and equipment used
- the method that was implemented
- the identification and management of safety and ethical risks
- the results, including tables and/or graphs where appropriate
- an analysis of results, including identifying trends and linking results to concepts
- an assessment of procedures and their effect on data, identifying sources of uncertainty
- a conclusion, with justification.

Size: 10 hours
Timing: concurrent with Modules 2 and 3
External agencies: not applicable
Relevant criteria:

- Criterion 1: E1, 2, 3
- Criterion 2: E1, 2, 3, 4, 5
- Criterion 3: E1, 2, 3, 4, 5

Work requirement 3 of 3

Title of work requirement: Science as a human endeavour investigation
Mode or format: investigation
Description: Learners will complete an investigation that will represent at least 10 hours of design time. This study can be either an individual or a small group task.

Learners will select and explore a recent discovery, innovation, issue, or advance linked to one of the topics in either Module 2 or Module 3. They assess and synthesise information from different sources to explain the science relevant to the focus of their investigation, show its connections to science as a human endeavour and develop a conclusion.

Learners will document in any appropriate format or formats:

- an introduction to identify the focus of the investigation and the key concept or concepts of science as a human endeavour that it links to
- relevant biology concepts or background, including how the concepts have been developed over time by a number of scientists and the impact of technological development
- an explanation of how the focus of the investigation illustrates the interaction between science and society, including a discussion of the negative and positive potential impacts of the focus of the investigation. Examples include further development, effect on quality of life, environmental implications, economic impact, intrinsic interest
- a conclusion
- citations and referencing.

Size: 10 hours
Timing: concurrent with Modules 2 or 3
External agencies: Engagement with scientists and their institutions is optional.
Relevant criteria:

- Criterion 1: E1, 2, 3
- Criterion 2: E1, 2, 3, 4, 5
- Criterion 4: E1, 2, 3, 4

Module 2 work requirements specifications

Work requirement 1 of 2

Title of work requirement: Cell biology: theories and models
Mode or format: extended response
Description: Learners are required to demonstrate their understanding of cell biology through an extended response that may be completed in conjunction with or to support one of the Module 1 work requirements. The extended response will be in the form of a structured and detailed response, in any appropriate format or formats, to a conceptual or factual stimulus to analyse, interpret or apply theories or models related to cell structure, function and/or processes.
Size: 500 words or equivalent, or 4 minutes multimodal presentation, or 6 hours on task
Timing: There is no specified timing for this requirement.
External agencies: not applicable
Relevant criteria:

- Criterion 1: E1, 2, 3
- Criterion 2: E1, 2, 3, 4, 5
- Criterion 5: E1, 2, 3, 4, 5
- Criterion 6: E1, 2, 3, 4, 5

Work requirement 2 of 2

Title of work requirement: Cell biology: ideas and problem solving
Mode or format: short response
Description: Learners are required to demonstrate that they have achieved an understanding of the cell biology and its application to cellular systems. Where possible, learners will use scientific inquiry skills from module 1 as the process of learning and use science as a human endeavour as the context.

Learners will undertake at least two separate assessment tasks each requiring a range of short responses. Each assessment task will require no more than 500 words, or equivalent representations including diagrammatic, data, graphical, statistical or algebraic modelling, to complete all answers.

Note: often the use of other scientific representations, in conjunction with concise and precise language, demonstrates a greater level of understanding than a paragraph.

Short responses will be designed to address a single or discrete group of ideas, solve a simple problem, express ideas, answer closed questions, provide brief descriptions or convey specific information. The focuses for this work requirement are cell structure, function and processes.
Size: 500 words or equivalent for each of the two short response assessments
Timing: throughout module
External agencies: not applicable
Relevant criteria:

- Criterion 1: E1, 2, 3
- Criterion 2: E1, 2, 3, 4, 5
- Criterion 5: E1, 2, 3, 4, 5
- Criterion 6: E1, 2, 3, 4, 5

Module 3 work requirements specifications

Work requirement 1 of 2

Title of work requirement: Multicellular organisms and environmental interactions: theories and models

Mode or format: extended response

Description: Learners are required to demonstrate their understanding of multicellular organisms and environmental interactions through an extended response that may be completed in conjunction with or support from one of the Module 1 work requirements. The extended response will be in the form of a structured and detailed response, in any appropriate format or formats, to a conceptual or factual stimulus to analyse, interpret or apply theories or models related to multicellular organisms, classification, biodiversity and/or ecosystem dynamics.

Size: 500 words or equivalent, or 4 minutes multimodal presentation, or 6 hours on task

Timing: There is no specified timing for this requirement.

External agencies: not applicable

Relevant criteria:

- Criterion 1: E1, 2, 3
- Criterion 2: E1, 2, 3, 4, 5
- Criterion 7: E1, 2, 3, 4, 5
- Criterion 8: E1, 2, 3, 4, 5

Work requirement 2 of 2

Title of work requirement: Multicellular organisms and environmental interactions: ideas and problem solving

Mode or format: short response

Description: Learners are required to demonstrate that they have achieved an understanding of the multicellular organisms and environmental interactions. Where possible, learners will use scientific inquiry skills from module 1 as the process of learning and use science as a human endeavour as the context.

Learners will undertake at least two separate assessment tasks, each requiring a range of short responses. Each assessment task will require no more than 500 words, or equivalent representations including diagrammatic, data, graphical, statistical or algebraic modelling, to complete all answers.

Note: often the use of other scientific representations, in conjunction with concise and precise language, demonstrates a greater level of understanding than a paragraph.

Short responses will be designed to address a single or discrete group of ideas, solve a simple problem, express ideas, answer closed questions, provide brief descriptions or convey specific information. The focuses for this work requirement are multicellular organisms, classification, biodiversity and ecosystem dynamics.

Size: 500 words or equivalent for each of the two short response assessments

Timing: throughout module

External agencies: not applicable

Relevant criteria:

- Criterion 1: E1, 2, 3
- Criterion 2: E1, 2, 3, 4, 5
- Criterion 7: E1, 2, 3, 4, 5
- Criterion 8: E1, 2, 3, 4, 5

Appendix 4 – General capabilities and cross-curriculum priorities

Learning across the curriculum content, including the cross-curriculum priorities and general capabilities, assists students to achieve the broad learning outcomes defined in the *Alice Springs (Mparntwe) Education Declaration (December 2019).*

General capabilities:

The general capabilities play a significant role in the Australian curriculum in equipping young Australians to live and work successfully in the twenty-first century.

In the Australian curriculum, capability encompasses knowledge, skills, behaviours and dispositions. Students develop capability when they apply knowledge and skills confidently, effectively and appropriately in complex and changing circumstances, in their learning at school and in their lives outside school.

The general capabilities include:

- Critical and creative thinking
- Ethical understanding
- Information and communication technology capability
- Intercultural understanding
- Literacy
- Numeracy
- Personal and social capability.

Cross-curriculum priorities:

Cross-curriculum priorities enable students to develop understanding about and address the contemporary issues they face, for their own benefit and for the benefit of Australia as a whole. The priorities provide national, regional and global dimensions which will enrich the curriculum through development of considered and focused content that fits naturally within learning areas. Incorporation of the priorities will encourage conversations between students, teachers and the wider community.

The cross-curriculum priorities include:

- Aboriginal and Torres Strait Islander histories and cultures
- Asia and Australia's engagement with Asia
- Sustainability.

Appendix 5 – Glossary

Term	Definition
adaptation	A physical or behavioural characteristic that is inherited and which results in an individual being more likely to survive and reproduce in its environment.
analyse	To consider in detail for the purpose of finding meaning or relationships and identifying patterns, similarities and differences.
characteristic	A distinguishing aspect, including features and behaviours, of an object material, living thing or event.
chart	A visual display of information.
classify	To arrange items into named categories in order to sort, group or identify them.
collaborate	To work with others to perform a specific task.
communication	To convey scientific information using a range of modes, conventions, formats and structures.
conclusion	A judgement based on evidence.
contemporary science	New and emerging science research and issues of current relevance and interest.
continuous data	Quantitative data with a potentially infinite number of possible values along a continuum.
controlled variable	A variable that is kept constant, or changed in constant ways, during an investigation.
convention	An agreed method of representing concepts, information and behaviours.

Term	Definition
data	The plural of datum; the measurement of an attribute, 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 and these could be quantitative or qualitative.
dependent variable	A variable that changes in response to changes to the independent variable in an investigation.
design	To plan and evaluate the construction of a product or process, including an investigation.
digital technologies	Systems that handle digital data, including hardware and software, for specific purposes.
discrete data	Quantitative data consisting of a number of separate values where intermediate values are not permissible.
environment	All the surroundings, both living and non-living.
evaluate	To examine and judge the merit or significance of something, including processes, events, descriptions, relationships or data.
evidence	In science, evidence is data that is considered reliable and valid and that 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.
experiment/experimental investigation	An investigation that involves carrying out a practical activity.
fair test	An investigation where one variable – the independent variable – is changed and all other conditions – controlled variables – are kept the same; what is measured or observed is referred to as the dependent variable.

Term	Definition
field study / work	An observational or practical research undertaken in a normal environment of the subject of a study; that is, an investigation can be conducted outside the laboratory.
force	A push or pull between objects which may cause one or both objects to change speed and/or direction of their motion; that is, accelerate, or change their shape. All interactions between matter can be explained as an action of one or a combination of forces.
formal measurement	Measurement based on an agreed standard unit; for example, metre, second, gram.
graph	A visual representation of the relationship between quantities plotted with reference to a set of axes.
guided investigation	An investigation partly directed by a teacher.
informal measurement	Measurement that is not based on any agreed standard unit; for example, hand spans, paces, cups.
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.
law	A statement of a relationship based on available evidence.
material	A substance with particular qualities or that is used for specific purposes.
matter	A physical substance; anything that has mass and occupies space.
model	A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.

Term	Definition
natural materials	Products or physical matter that come from plants, animals, or earth and have undergone very little modification by humans.
observable	Something that can be seen, heard, felt, tasted or smelled either directly by an individual or indirectly by a measuring device; for example, a ruler, camera or thermometer.
processed materials	Products of physical matter that have been modified from natural materials by human intervention, or that do not occur at all in the natural environment but have been designed and manufactured to fulfil a particular purpose.
property	An attribute of an object or material, normally used to describe attributes common to a group.
qualitative data	Information that is not numerical in nature.
quantitative data	Numerical information.
relate	To identify connections or associations between ideas or relationships or between components of systems and structures.
relationship	A connection or association between ideas or between components of systems and structures.
report	A written account of an investigation.
scientific literacy	An ability to use scientific knowledge, understanding and inquiry skills to identify questions, acquire new knowledge, explain science phenomena, solve problems and draw evidence-based conclusions in making sense of the world and to recognise how understandings of the nature, development, use and influence of science help us make responsible decisions and shape our interpretations of information.

Term	Definition
self-management	Knowing when and how to use particular strategies to manage oneself in a range of situations.
senses	Hearing, sight, smell, touch and taste.
system	A group of interacting objects, materials or processes that form an integrated whole.
technology	A development of products, services, systems and environments, using various types of knowledge, to meet human needs and wants.
theory	An explanation of a set of observations that is based on one or more proven hypotheses, which has been accepted through consensus by a group of scientists.