DEPARTMENT OF EDUCATION
learners first

Discipline-based Study

Science

Biology 2

COURSE DOCUMENT

PHASE 4

DRAFT FOR CONSULTATION

Catholic Education Tasmania

INDEPENDENT SCHOOLS TASMANIA

Years 9 to 12 Learning

Tasmanian Government

Table of Contents

Phase 4 Consultation Draft Published: August 2021

Biology, 150 hours – Level 2

This course is the Level 2 component of the proposed *Biology* suite.

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. Students 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 proposed *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. Understanding of biological concepts, as well as general science knowledge and skills, is relevant to a range of careers, including those in the 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 to 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 and 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 students 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. describe how theories and models have developed based on evidence from multiple disciplines
5. describe the structure, components and function of cells
6. describe how cellular processes and biochemistry are related to the need to exchange matter and energy with a cell's immediate environment
7. describe 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. describe 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. They will 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 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 Science, and other learning area 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 in 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)

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 Structure and Delivery

Structure

This course consists of three 50-hour modules.

- Core Module 1: Science as a Human Endeavour and Science Inquiry
- Core Module 2: Cell biology
- Core Module 3: Multicellular organisms and environmental interactions

Delivery

Module 1 should be delivered concurrently with Modules 2 and 3.

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 understanding of biology. They investigate how scientific knowledge is used to offer valid explanations and reliable predictions, and 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 of 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. describe how theories and models have developed based on evidence from multiple disciplines.

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/or 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 and/or harmful and/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/s to be followed, the materials required, and the type and amount of primary and/or 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; and 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; and 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

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.

This module includes 1 extended investigation, 1 folio, and 1inquiry.

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.

Learners will use, from Module 1, Science Inquiry skills where possible as the process of learning and Science as a Human Endeavour as the context.

Module 2 Learning Outcomes

The following learning outcomes are a focus of this module:

1. set and meet individual and collaborative goals within timeframes
2. access and communicate biological understanding using qualitative and quantitative representations
5. describe the structure, components and function of cells
6. describe 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 (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 transport (passive only) of soluble substances across the plasma membrane including simple diffusion and osmosis (ACSBL046)
- enzymes are specific to their substrate
- photosynthesis – summary of the inputs and outputs – worded equation only
  carbon dioxide + water glucose → oxygen + water
- cellular respiration occurs in the mitochondria and is necessary to release usable energy in the form of ATP (only aerobic respiration required)
- summarise the reactions of aerobic respiration inputs and outputs -worded equation only
  glucose + oxygen → carbon dioxide + water + energy.

Key Skills – Application of science understanding

Cell structure

- cell theory – demonstrate and apply the concept that cells as 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 cellular respiration occurs in the mitochondria is necessary to release usable energy in the form of ATP (only aerobic respiration required).

Module 2 Work Requirements Summary

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.

This module includes 1 short response and 1 extended response work requirements.

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.

Learners will use, from Module 1, Science Inquiry skills as much as possible as the process of learning and Science as a Human Endeavour as the context.

Module 3 Learning Outcomes

The following learning outcomes are a focus of this module:

1. set and meet individual and collaborative goals within timeframes
2. access and communicate biological understanding using qualitative and quantitative representations

7. describe 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. describe 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
- 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.

Gas Exchange in animals and plants

- to be efficient, gas exchange surfaces must have the following characteristics: large surface area, thin, moist and vascular
- 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
- 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
- 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.

Reproductive system

- the types of asexual reproduction including fission, budding, vegetative propagation and spore formation and the biological advantages and disadvantages of asexual reproduction
- 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
- 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)
- investigate how chemical digestion involves the use of enzymes (amylase, protease and lipase) to chemically break down food for absorption
- apply materials eliminated from the digestive system include indigestible contents, excess materials and some metabolic wastes.

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, for example 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
- investigate the biological advantage of sexual reproduction, specifically the genetic diversity in offspring.

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, the first flowering plants and mammals
- 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.

Ecosystem dynamics

- represent ecosystems using energy flows, food chains, pyramids (biomass, energy, number) (ACSBL029) food webs

- explore and apply the roles of autotrophs, heterotrophs, and decomposers
- research examples where ecosystems have changed over time identifying patterns and relationships (ACSBL027).

Module 3 Work Requirements Summary

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.

This module includes 1 short response and 1 extended response work requirements.

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 end-point 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 end-point 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

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

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. collect and analyse data within biological inquiry
4. explain the local, national, and global context for biology
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

Standards

Criterion 1: work independently and collaboratively towards goals

Standard Element	Rating C	Rating B	Rating A
E1 – manages work within timeframes	uses planning strategies to facilitate completion of key elements of tasks within agreed time frames and makes minor modifications as directed	uses planning strategies to facilitate successful completion of tasks within agreed time frames; suggesting and making minor modifications for improvement	uses planning and self-management strategies to enable the successful completion of tasks within agreed time frames; suggesting and making modifications for improvement
E2 –adapts tasks to complete activities	identifies where tasks were adapted to successfully complete activities	describes where initiative was used and tasks were adapted to successfully complete activities	explains where initiative was used and tasks were adapted to successfully complete activities
E3 – describes own contribution to complete collaborative activities.	identifies own contribution to the successful completion of a product in collaborative activities.	describes own contribution to the successful completion of a product in collaborative activities.	explains own and others' contributions to the successful completion of a product in collaborative activities.

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

Standard Element	Rating C	Rating B	Rating A
E1 – interprets problems and makes predications	interprets simple problems and makes simple predictions in familiar contexts	interprets problems and makes simple valid predictions in familiar contexts	interprets problems and makes valid predictions in familiar contexts
E2 – represents information	represents and records sources of information as directed from a limited range of relevant sources	represents and records sources of information using a variety of relevant sources	represents and accurately records sources of information using a variety of relevant sources
E3 – describes the reliability of data and sources of information	identifies some factors from a given range that influence the reliability of data and information	describes a range of factors that influence the reliability of data and information	explains how a range of factors influence the reliability of data and information

Standard Element	Rating C	Rating B	Rating A
E4 – uses appropriate formats and units	uses appropriate scientific structures, conventions, formats, and units for communication of data and information, as directed	from a range, 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 for communication of data and information
E5 – uses biological terminology.	uses given scientific terminology to clearly communicate key concepts and ideas.	uses key scientific terminology to clearly communicate key concepts and ideas.	selects and uses scientific terminology accurately and correctly to clearly communicate key concepts and ideas.

Criterion 3: collect and analyse data within biological inquiry

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

Criterion 4: explain the local, national, and global context of biological science

Standard Element	Rating C	Rating B	Rating A
E1 – explains broader context of biology	describes 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	analyses 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	identifies 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	explains the roles of collaboration and new evidence in the development of biological knowledge
E3 – explains the role of technology in biology	identifies and compares relationships between the development of technologies and biological knowledge	compares and describes relationships between the development of technologies and biological knowledge	compares and explains relationships between the development of technologies and biological knowledge
E4 – explains ways biology meets needs in society.	describes ways in which biology has been used to meet needs in society.	discusses ways in which biology has been used to meet needs in society.	explains ways in which biology has been used to meet needs in society.

Criterion 5: describe and use concepts of cell structure

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

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

Criterion 6: describe and use concepts of cell processes

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

Criterion 7: describe and use concepts of multicellular organisms

Standard Element	Rating C	Rating B	Rating A
E1 – describes digestion in animals	identifies structures and processes required for digestion in animals	describes structures and processes required for digestion in animals	explains structures and processes required for digestion in animals

Standard Element	Rating C	Rating B	Rating A
E2 – describes gas exchange in plants and animals	identifies structures and processes required for gas exchange in plants and animals	describes structures and processes required for gas exchange in plants and animals	explains structures and processes required for gas exchange in plants and animals
E3 – describes transport in plants and animals	identifies structures and processes required for transport in plants and animals	describes structures and processes required for transport in plants and animals	explains structures and processes required for transport in plants and animals
E4 – describes the functions and processes of cell division	identifies the functions and processes of cell division	describes the functions and processes of cell division	explains the functions and processes of cell division
E5 –describes the functions and processes of sexual and asexual reproduction.	identifies the functions and processes of sexual and asexual reproduction.	describes the functions and processes of sexual and asexual reproduction.	explains the functions and processes of sexual and asexual reproduction.

Criterion 8: describe and use biodiversity and ecosystem concepts

Standard Element	Rating C	Rating B	Rating A
E1 – describes and applies classification techniques	identifies and applies biological classification techniques	describes and applies biological classification techniques	explains and applies biological classification techniques
E2 – describes and applies concepts of biodiversity	identifies and applies concepts of biodiversity	describes and applies concepts of biodiversity	explains and applies concepts of biodiversity
E3 – describes and uses evidence of evolution	identifies and uses evidence in support of evolution	describes and uses evidence in support of evolution	explains and uses evidence in support of evolution
E4 – describes energy flow and matter cycling through ecosystems	identifies energy flow and matter cycling through ecosystems	describes energy flow and matter cycling through ecosystems	explains energy flow and matter cycling through ecosystems
E5 – describes ecosystem change over time.	identifies ecosystem change over time.	describes ecosystem change over time.	explains ecosystem change over time.

Quality Assurance

- This will be determined by TASC at time of accreditation.

Qualifications and Award Requirements

Level 2

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

- This will be confirmed by time of accreditation.

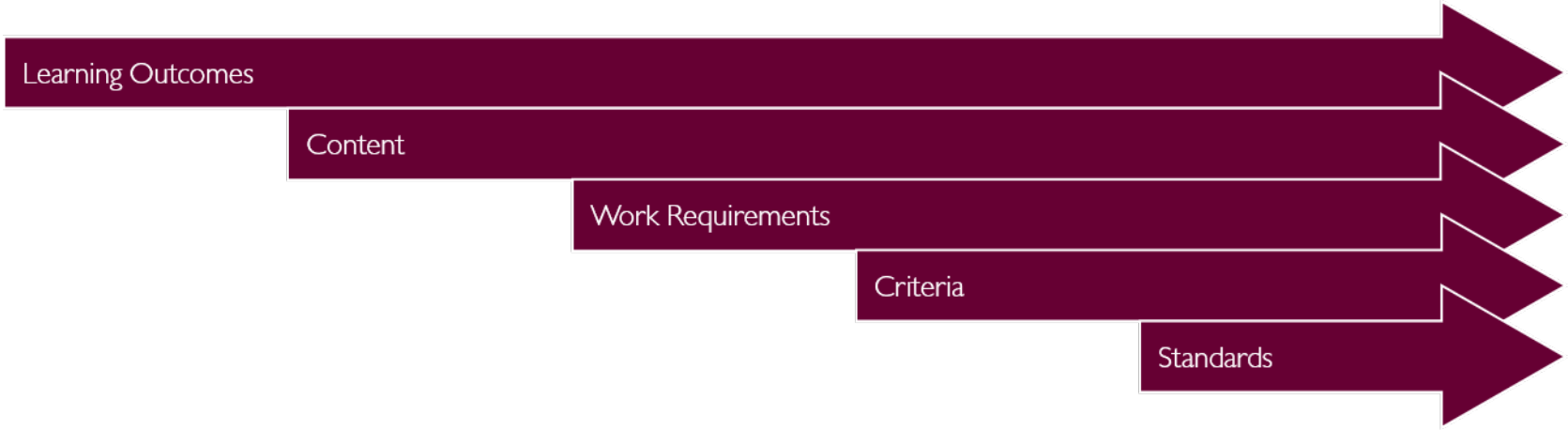
Course Developer

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

Accreditation and Version History

- Details to be determined by TASC at time of accreditation.

Appendix 1 - Line of Sight



Learning Outcomes	Course Content	Work Requirements	Criteria	Standards	General Capabilities (GC)
1. set and meet individual and collaborative goals within timeframes	Module 1, 2, 3	Module 1, 2, 3	C 1	All	GC:
2. access and communicate biological understanding using qualitative and quantitative representations	Module 1, 2, 3	Module 1, 2, 3	C 2	All	GC:
3. use science inquiry skills to design, conduct, analyse and communicate investigations into biological systems	Module 1	Module 1	C 3	All	GC:
4. describe how theories and models have developed based on evidence from multiple disciplines	Module 1	Module 1	C 4	All	GC:
5. describe the structure, components and function of cells	Module 2	Module 2	C 5	All	GC:
6. describe how cellular processes and biochemistry are related to the need to exchange matter and energy with a cell's immediate environment	Module 2	Module 2	C 6	All	GC:

Learning Outcomes	Course Content	Work Requirements	Criteria	Standards	General Capabilities (GC)
7. describe how multicellular organisms reproduce and consist of multiple interdependent, hierarchically organised systems, that enable the exchange of matter and energy with their immediate environment	Module 3	Module 3	C 7	All	GC: 
8. describe ecosystem diversity and dynamics with reference to biotic and abiotic interactions and use classification to organise and communicate in relation to biodiversity	Module 3	Module 3	C 8	All	GC: 

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 *B*iology 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

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

Module 1 Work Requirements Specifications

Focus Area: Discipline

Title of Work Requirement: Science Inquiry skills

Mode /Format: Folio

Description:

In preparation and alongside this inquiry it is likely that shorter practical activities will be engaged. These are designed to support the depth of understanding and engagement in the 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 (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 should take approximately 5 hours and there must be one corresponding to each of Modules 2 and 3.

Size: 30 Hours

Timing: Concurrent with Modules 2 and 3

External agencies: NA

Relevant Criterion/criteria:

- Criterion 1
- Criterion 2
- Criterion 3

Focus Area: Discipline

Title of Work Requirement: Extended inquiry

Mode /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 students use a practical performed in class 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/or 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, and identifying sources of uncertainty
- a conclusion, with justification.

Size: 10 Hours

Timing: Concurrent with Modules 2 and 3

External agencies: NA

Relevant Criterion/criteria:

- Criterion 1
- Criterion 2
- Criterion 3

Focus Area: Discipline

Title of Work Requirement: Science as a Human Endeavour investigation

Mode /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(s) of science as a human endeavour that it links to
- relevant biology concepts or background
- an explanation of how the focus of the investigation illustrates the interaction between science and society, including a discussion of the potential impact of the focus of the investigation, e.g. 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:

Relevant Criterion/criteria:

- Criterion 1
- Criterion 2
- Criterion 4

Module 2 Work Requirements Specifications

Focus Area: Discipline

Title of Work Requirement: Cell biology 1

Mode /Format: Extended response

Description:

Learners are required to demonstrate their understanding of cell biology through an extended response; this may be in conjunction with or 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: NA

Relevant Criterion/criteria:

- Criterion 1
- Criterion 2
- Criterion 5
- Criterion 6

Focus Area: Discipline

Title of Work Requirement: Cell biology 2

Mode /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. Learners will use, from Module 1, Science Inquiry Skills as much as possible as the process of learning and Science as a Human Endeavour as the context.

Learners will undertake at least two separate short response assessment tasks which, in total, will not require more than 1000 words (or equivalent representation including: diagrammatic, data, graphical, statistical or algebraic modelling) to complete.

Short responses should 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: 1000 words in total (or equivalent)

Timing: Throughout module

External agencies: NA

Relevant Criterion/criteria:

- Criterion 1
- Criterion 2

- Criterion 5
- Criterion 6

Module 3 Work Requirements Specifications

Focus Area: Discipline

Title of Work Requirement: Multicellular organisms and environmental interactions 1

Mode /Format: Extended response

Description:

Learners are required to demonstrate their understanding of multicellular organisms and environmental interactions through an extended response this may in conjunction with or 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 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: NA

Relevant Criterion/criteria:

- Criterion 1
- Criterion 2
- Criterion 7
- Criterion 8

Focus Area: Discipline

Title of Work Requirement: Multicellular organisms and environmental interactions 2

Mode /Format: Short response

Description:

Learners are required to demonstrate that they have achieved an understanding of the multicellular organisms and environmental interactions. Learners will use, from Module 1, Science Inquiry Skills as much as possible as the process of learning and Science as a Human Endeavour as the context.

Learners will undertake at least two separate short response assessment tasks which, in total, will not require more than 1000 words (or equivalent representation including: diagrammatic, data, graphical, statistical or algebraic modelling) to complete.

Short responses should 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: 1000 words in total (or equivalent)

Timing: Throughout module

External agencies: NA

Relevant Criterion/criteria:

- Criterion 1
- Criterion 2
- Criterion 7
- Criterion 8

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	Source Acknowledgement	Course Context
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.	ACARA	Modules 1, 2 and 3
analyse	to consider in detail for the purpose of finding meaning or relationships, and identifying patterns, similarities and differences.	ACARA	Modules 1, 2 and 3
characteristic	a distinguishing aspect (including features and behaviours) of an object material, living thing or event.	ACARA	Modules 1, 2 and 3
chart	a visual display of information.	ACARA	Modules 1, 2 and 3
classify	to arrange items into named categories in order to sort, group or identify them.	ACARA	Modules 1, 2 and 3
collaborate	to work with others to perform a specific task.	ACARA	Modules 1, 2 and 3
communication	to convey scientific information using a range of modes, conventions, formats and structures	ACARA (Senior Secondary Achievement Standards)	Modules 1, 2 and 3
conclusion	a judgement based on evidence.	ACARA	Modules 1, 2 and 3
contemporary science	new and emerging science research and issues of current relevance and interest.	ACARA	Modules 1, 2 and 3

Term	Definition	Source Acknowledgement	Course Context
continuous data	quantitative data with a potentially infinite number of possible values along a continuum.	ACARA	Modules 1, 2 and 3
controlled variable	a variable that is kept constant (or changed in constant ways) during an investigation.	ACARA	Modules 1, 2 and 3
convention	an agreed method of representing concepts, information and behaviours.	ACARA	Modules 1, 2 and 3
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.	ACARA	Modules 1, 2 and 3
dependent variable	a variable that changes in response to changes to the independent variable in an investigation.	ACARA	Modules 1, 2 and 3
design	to plan and evaluate the construction of a product or process, including an investigation.	ACARA	Modules 1, 2 and 3
digital technologies	systems that handle digital data, including hardware and software, for specific purposes.	ACARA	Modules 1, 2 and 3
discrete data	quantitative data consisting of a number of separate values where intermediate values are not permissible.	ACARA	Modules 1, 2 and 3
environment	all the surroundings, both living and non-living.	ACARA	Modules 1, 2 and 3
evaluate	to examine and judge the merit or significance of something, including processes, events, descriptions, relationships or data.	ACARA	Modules 1, 2 and 3

Term	Definition	Source Acknowledgement	Course Context
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.	ACARA	Modules 1, 2 and 3
experiment/experimental investigation	an investigation that involves carrying out a practical activity.	ACARA	Modules 1, 2 and 3
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.	ACARA	Modules 1, 2 and 3
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.	ACARA	Modules 1, 2 and 3
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.	ACARA	Modules 1, 2 and 3
formal measurement	measurement based on an agreed standard unit (metre, second, gram).	ACARA	Modules 1, 2 and 3
graph	a visual representation of the relationship between quantities plotted with reference to a set of axes.	ACARA	Modules 1, 2 and 3
guided investigation	an investigation partly directed by a teacher.	ACARA	Modules 1, 2 and 3

Term	Definition	Source Acknowledgement	Course Context
informal measurement	measurement that is not based on any agreed standard unit (for example, hand spans, paces, cups).	ACARA	Modules 1, 2 and 3
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.	ACARA	Modules 1, 2 and 3
law	a statement of a relationship based on available evidence.	ACARA	Modules 1, 2 and 3
material	a substance with particular qualities or that is used for specific purposes.	ACARA	Modules 1, 2 and 3
matter	a physical substance; anything that has mass and occupies space.	ACARA	Modules 1, 2 and 3
model	a representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.	ACARA	Modules 1, 2 and 3
natural materials	products or physical matter that come from plants, animals, or earth and have undergone very little modification by humans.	ACARA	Modules 1, 2 and 3
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.	ACARA	Modules 1, 2 and 3
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.	ACARA	Modules 1, 2 and 3

Term	Definition	Source Acknowledgement	Course Context
property	an attribute of an object or material, normally used to describe attributes common to a group.	ACARA	Modules 1, 2 and 3
qualitative data	information that is not numerical in nature.	ACARA	Modules 1, 2 and 3
quantitative data	numerical information.	ACARA	Modules 1, 2 and 3
relate	to identify connections or associations between ideas or relationships or between components of systems and structures.	ACARA	Modules 1, 2 and 3
relationship	a connection or association between ideas or between components of systems and structures.	ACARA	Modules 1, 2 and 3
report	a written account of an investigation.	ACARA	Modules 1, 2 and 3
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.	ACARA	Modules 1, 2 and 3
senses	hearing, sight, smell, touch and taste.	ACARA	Modules 1, 2 and 3
system	a group of interacting objects, materials or processes that form an integrated whole.	ACARA	Modules 1, 2 and 3
technology	a development of products, services, systems and environments, using various types of knowledge, to meet human needs and wants.	ACARA	Modules 1, 2 and 3

Term	Definition	Source Acknowledgement	Course Context
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.	ACARA	Modules 1, 2 and 3