DEPARTMENT OF EDUCATION
learners first

Discipline-based Study

Science

Biology 2

COURSE DOCUMENT

DRAFT

PHASE 3 CONSULTATION

Catholic Education Tasmania

INDEPENDENT SCHOOLS TASMANIA

Years 9 to 12 Learning

Tasmanian Government

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Phase 3 Consultation Draft Published: March 2021

Biology, 150 hours – Level 2

This course is the *Biology* Level 2 component of the Biology program.

Aims

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 supports 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 highly flexible range of learning opportunities suited to their level of readiness, interests and aspirations.

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.

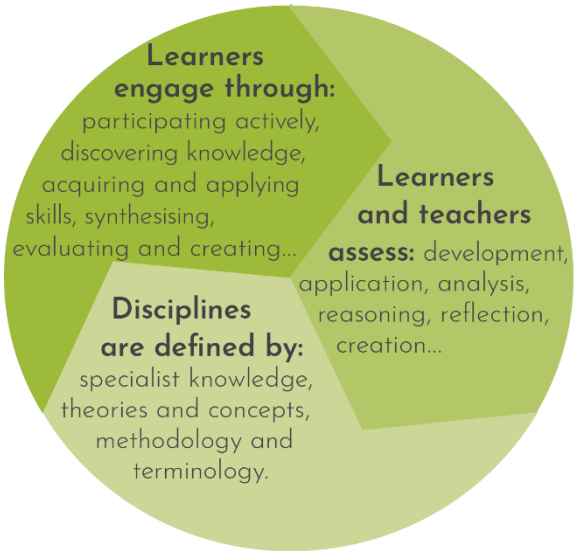
Biology Level 2 is a Discipline-based Study course.

Focus Area – Discipline-based Study

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
- the development of biological knowledge; how scientists use biology; and how biological knowledge influences society
- fieldwork, laboratory and other research investigations; collecting and analysing qualitative and quantitative data and interpretating evidence
- evidence-based arguments creatively and analytically when evaluating claims and applying biological knowledge
- communication of biological understanding, findings, arguments and conclusions.

Rationale

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. 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.

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. Learners 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.

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.

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 are enabled through this course are:

- Aboriginal and Torres Strait Islander Histories and Cultures
- Asia and Australia's Engagement with Asia
- Sustainability

Course Description

Biology Level 2 provides learners with the opportunity to engage with foundational understanding of biology including cells and their processes, organ systems, their functions and place within organisms, and ecosystems and biodiversity. Learners may use these concepts to explore one or more contexts or themes, for example:

- human biology
- agriculture
- environmental biology
- biochemistry
- marine studies.

Learners will do this using practical inquiry to engage with and understand the natural world. While applying their knowledge learners will come to understand where biological knowledge is central to society, the relationships between biology and society, and the processes of biological discovery.

Pathways

Biology Level 2 has a clear pathway from Australian Curriculum Science F-10 and other TASC Science courses as well as some TASC HaSS, HPE, Technologies and Mathematics courses.

As the study of all life *Biology* Level 2 has a clear pathway to a large range of TASC and vocational pathways.

Course Requirements

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

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

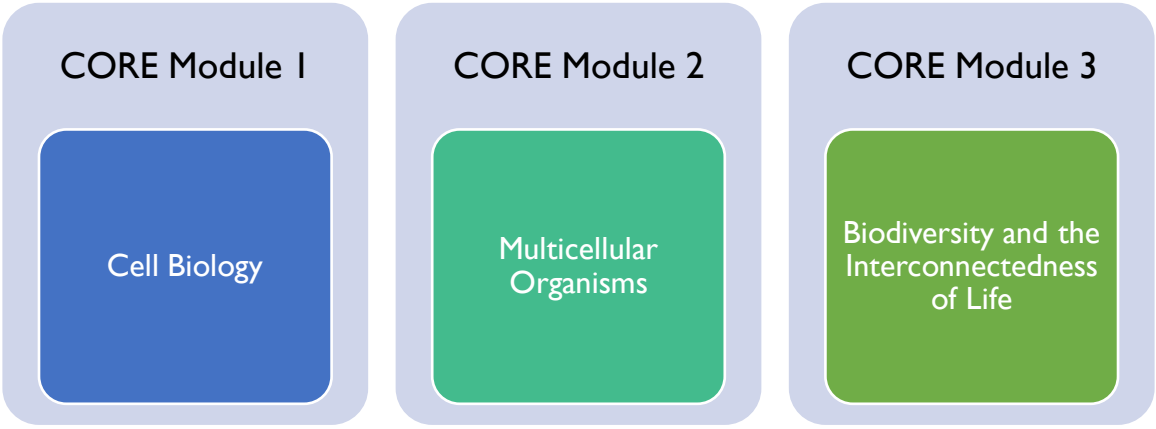
This course requires learners to collaborate with others.

Course Structure, Delivery and Progression

Structure

This course consists of three 50-hour modules.

Modules available
Core Module 1: Cell Biology
Core Module 2: Multicellular Organisms
Core Module 3: Biodiversity and the Interconnectedness of Life



Delivery

There is no specific recommended delivery sequence for the modules

Developmental Progression

Each module introduces and builds upon key ideas, concepts, skills, knowledge and understanding leading to a culminating performance of understanding reflected in the work requirements within each module.

Module 1 - Cell Biology

The cell is the basic unit of life. Although cell structure and function are very 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 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 investigate the ways in which matter moves and energy is transformed and transferred in the biochemical processes of photosynthesis and respiration, and some of the role of enzymes in controlling biochemical systems.

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 the structure and function of cells and multicellular organisms. 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 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

On successful completion of this module, learners will be able to:

1. work independently and with others to explore, analyse and communicate cell biology concepts
2. design, implement, evaluate and adapt inquiries into cell biology
3. analyse the interrelationships of the development and applications of cell biology with technology and the values broader community
4. apply and analyse models and theories used to explain cell biology processes including biochemistry and respiration.

Module 1 Content

Cells are the building blocks of all life of Earth. The different types of cells in a multicellular organism form a range of tissues that are part of organs and organ systems. In this unit by applying knowledge, including practically, of the common and distinct features of different types of cells some of the processes that underpin life will be explained at a cellular level. These include some application of biochemical, respiratory and photosynthetic processes. Science Understanding and Science as a Human Endeavour describe the key knowledge in Module 1, and Science Inquiry Skills are the key skills.

Learners may use these concepts to explore one or more contexts or themes and by the end of this module, learners will:

- understand that the structure and function of cells and their components are related to the need to exchange matter and energy with their immediate environment
- understand how theories and models have developed based on evidence from multiple disciplines, and the uses and limitations of biological knowledge in a range of contexts
- use science inquiry skills to design, conduct, evaluate and communicate investigations into the structure and function of cells
- evaluate, with reference to empirical evidence, claims about cellular processes
- communicate biological understanding using qualitative and quantitative representations in appropriate modes and genres.

Science Understanding (see Appendix 6 for content in detail)

- cell theory
- Biochemistry
- basics of respiration and photosynthesis (for carbon & energy transfer).

Science as a Human Endeavour (see Appendix 6 for content in detail)

- development and collaboration within Biology
- science and technology
- science and the broader community.

Science Inquiry (see Appendix 6 for content in detail)

- design of inquiry
- implementation of inquiry
- evaluation of inquiry.

Module 1 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.

This module includes one (1) extended response and one (1) inquiry as work requirements.

See Appendix 3 for summary of Work Requirement specifications for this course.

Module 1 Assessment

This module will assess criteria 1, 2, 3, 4.

Module 2 - Multicellular Organisms

The cell is the basic unit of life. Multicellular organisms typically consist of a number of interdependent systems of cells organised into tissues, organs and organ systems. In Module 2 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.

Through the investigation of appropriate contexts, learners explore how the use of ICT and other technologies have contributed to developing understanding of the structure and function of cells and multicellular organisms. 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 use science inquiry skills to explore the relationship between structure and function, by conducting real or virtual dissections and carrying out microscopic examination of tissues. 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 2 Learning Outcomes

On successful completion of this module, learners will be able to:

1. work independently and with others to explore, analyse and communicate multicellular organism concepts
2. design, implement, evaluate and adapt inquiries into multicellular organisms
3. analyse the interrelationships of the development and applications of multicellular organism concepts with technology and the values broader community
5. apply and analyse models and theories used to explain systems and processes within multicellular organisms.

Module 2 Content

There are some key organ systems within multicellular organisms. In this unit by applying knowledge, including practically, of the features, functions and processes of these key organ systems their roles and mechanisms can be explained. Respiratory, digestive, excretory, circulatory and plant transport systems will be explored. Science Understanding and Science as a Human Endeavour describe the key knowledge in Module 2, and Science Inquiry Skills are the key skills.

Learners may use these concepts to explore one or more contexts or themes and by the end of this module, learners will:

- understand that multicellular organisms consist of multiple interdependent and hierarchically-organised systems that enable exchange of matter and energy with their immediate environment
- understand how theories and models have developed based on evidence from multiple disciplines and the uses and limitations of biological knowledge in a range of contexts
- use science inquiry skills to design, conduct, evaluate and communicate investigations multicellular organisms
- evaluate, with reference to empirical evidence, claims about the structure and function of multicellular organisms
- communicate biological understanding using qualitative and quantitative representations in appropriate modes and genres.

Science Understanding (see Appendix 6 for content in detail)

- respiratory and digestive systems
- excretory and circulatory systems
- plant transport.

Science as a Human Endeavour (see Appendix 6 for content in detail)

- science and technology
- science and the broader community.

Science Inquiry Skills (see Appendix 6 for content in detail)

- design of inquiry
- implementation of inquiry
- evaluation of inquiry.

Module 2 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.

This module includes one (1) extended response and one (1) inquiry as work requirements.

See Appendix 3 for summary of Work Requirement specifications for this course.

Module 2 Assessment

This module will assess criteria 1, 2, 3, 5.

Module 3 - Biodiversity and the Interconnectedness of Life

In Module 3 learners 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 use classification keys to identify organisms, describe the biodiversity in ecosystems, investigate patterns in relationships between organisms, and aid scientific communication.

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 the study and conservation of national, regional and global biodiversity. 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. Fieldwork is an important part of this unit, providing valuable opportunities for learners to work together to collect first-hand data and to experience local ecosystem interactions. In order to understand the interconnectedness of organisms, the physical environment and human activity, learners analyse and interpret data collected through investigation of a local environment and from sources relating to other Australian, regional and global environments.

Module 3 Learning Outcomes

On successful completion of this module, learners will be able to:

1. work independently and with others to explore, analyse and communicate ecosystem concepts
2. design, implement, evaluate and adapt inquiries into cell biology
3. analyse the interrelationships of the development and applications of cell biology with technology and the values broader community
6. apply and analyse models and theories used to explain biodiversity and the interconnectedness of life.

Module 3 Content

The current view of the biosphere as a dynamic system composed of Earth's diverse, interrelated and interacting ecosystems developed from the work of eighteenth and nineteenth century naturalists, who collected, classified, measured and mapped the distribution of organisms and environments around the world. In this module, learners investigate and describe a number of diverse ecosystems, exploring the range of biotic and abiotic components to understand the dynamics, diversity and underlying unity of these systems.

Learners may use these concepts to explore one or more contexts or themes and by the end of this module, learners will:

- understand how classification helps to organise, analyse and communicate data about biodiversity
- understand that ecosystem diversity and dynamics can be described and compared with reference to biotic and abiotic components and their interactions
- understand how theories and models have developed based on evidence from multiple disciplines, and the uses and limitations of biological knowledge in a range of contexts
- use science inquiry skills to design, conduct, evaluate and communicate investigations into biodiversity and flows of matter and energy in a range of ecosystems
- evaluate, with reference to empirical evidence, claims about relationships between and within species, diversity of and within ecosystems, and energy and matter flows
- communicate biological understanding using qualitative and quantitative representations in appropriate modes and genres.

Science Understanding (see Appendix 6 for content in detail)

- classification of life

- ecosystem dynamics and modelling
- biogeochemical cycling
- human activities.

Science as a Human Endeavour (see Appendix 6 for content in detail)

- development and collaboration within Biology
- science and technology.

Science Inquiry Skills (see Appendix 6 for content in detail)

- design of inquiry
- implementation of inquiry
- evaluation of inquiry.

Module 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.

This module includes one (1) extended response and one (1) inquiry as work requirements.

See Appendix 3 for summary of Work Requirement specifications for this course.

Module 3 Assessment

This module will assess criteria 1, 2, 3, 6.

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	Notes
Criteria Assessed	1,2,3,4	1,2,3,5	1,2,3,6	Three common in all modules and one focus criterion per module.

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

1. explore, analyse and communicate biology concepts and practices as an individual and within a group
2. design, implement and evaluate inquiry into biological systems
3. compare the development and applications of biology with technologies and the broader community
4. apply and analyse models and theories for cell biology structure and function
5. apply and analyse models and theories for multicellular organisms
6. apply and analyse models and theories for biodiversity and the interconnectedness of life.

Standards

Criterion 1: explore, analyse and communicate biology concepts and practices as an individual and within a group

Rating C	Rating B	Rating A
refines approaches to tasks to take account of unexpected or difficult situations and/or safety considerations	analyses and refines approaches to tasks to take account of unexpected or difficult situations and/or safety considerations	analyses, rethinks and refines approaches to tasks to take account of unexpected or difficult situations and/or safety considerations
analyses the extent to which their roles and responsibilities contributed to the achievement of personal and group objectives	analyses the extent to which individual roles and responsibilities contributed to the achievement of personal and group objectives	analyses the extent to which individual roles and responsibilities contributed to group cohesion and the achievement of personal and group objectives
selects and uses appropriate representations to describe relationships and solve problems	selects and uses appropriate representations to describe relationships and to solve unfamiliar problems	selects, constructs and uses appropriate representations to describe relationships and to solve unfamiliar problems
communicates effectively in a range of modes, styles and genres for specific purposes.	communicates clearly in a range of modes, styles and genres for specific purposes.	communicates clearly in a broad range of modes, styles and genres for specific purposes.

Criterion 2: design, implement and analyse inquiry into biological systems

Rating C	Rating B	Rating A
plans and conducts safe, ethical investigations that collect valid data in response to a familiar question or problem	designs, conducts and improves safe, ethical investigations that collect valid data in response to a familiar question or problem	designs, conducts and improves safe, ethical investigations that efficiently collect valid data in response to an unfamiliar question or problem
analyses data to identify trends and anomalies, and sources of error	analyses data to identify causal relationships, anomalies, and sources of error	analyses data to explain causal relationships, the reliability of the data, and sources of error
selects data to demonstrate trends and presents simple conclusions based on data	selects data as evidence for conclusions with reference to models and/or theories	selects of data as evidence conclusions with reference to models and/or theories and identify limitations
considers processes and claims and suggests improvements or alternatives.	analyses processes and claims and uses evidence to identify possible improvements or alternatives.	evaluates processes and claims and provides an evidence-based discussion of improvements or alternatives.

Criterion 3: compare the development and applications of biology with technologies and the broader community

Rating C	Rating B	Rating A
describes the role of collaboration and new evidence in developing biological knowledge	compares the role of collaboration and review in the development of biological theories and models	analyses the role of collaboration and review in the development of biological theories and models
describes ways in which biological science has been used in society to meet needs and identifies some social, economic and ethical implications of these applications	compares how biological science has been used in society to meet needs and identifies social, economic and ethical implications of these applications	analyses how biological science has been used in society to meet diverse needs and to inform decision making and is influenced by social, economic and ethical factors
describes the role of technologies in the development of biological knowledge.	compares the roles of technologies in the development of biological knowledge.	analyses the role of technologies in the development of biological knowledge.

Criterion 4: apply and analyse models and theories for cell biology structure and function

Rating C	Rating B	Rating A
applies theories or models of cell structure and function to explain phenomena, interpret simple problems and make simple predictions in familiar contexts	applies theories and models of cell structure and function to discuss phenomena, interpret problems and make plausible predictions in familiar contexts	applies theories and models of cell structure and function to analyse phenomena, interpret problems and make plausible predictions in unfamiliar contexts
applies theories or models of biochemistry to explain phenomena, interpret simple problems and make simple predictions in familiar contexts	applies theories and models of biochemistry to discuss phenomena, interpret problems and make plausible predictions in familiar contexts	applies theories and models of biochemistry to analyse phenomena, interpret problems and make plausible predictions in unfamiliar contexts
applies theories or models of respiration and photosynthesis to explain phenomena, interpret simple problems and make simple predictions in familiar contexts.	applies theories and models of respiration and photosynthesis to discuss phenomena, interpret problems and make plausible predictions in familiar contexts.	applies theories and models of respiration and photosynthesis to analyse phenomena, interpret problems and make plausible predictions in unfamiliar contexts.

Criterion 5: apply and analyse models and theories for multicellular organisms

Rating C	Rating B	Rating A
applies theories or models of respiratory and digestive systems to explain phenomena, interpret simple problems and make simple predictions in familiar contexts	applies theories and models of respiratory and digestive systems to discuss phenomena, interpret problems and make plausible predictions in familiar contexts	applies theories and models of respiratory and digestive systems to analyse phenomena, interpret problems and make plausible predictions in unfamiliar contexts
applies theories or models of excretory systems to explain phenomena, interpret simple problems and make simple predictions in familiar contexts	applies theories and models of excretory systems to discuss phenomena, interpret problems and make plausible predictions in familiar contexts	applies theories and models of excretory systems to analyse phenomena, interpret problems and make plausible predictions in unfamiliar contexts
applies theories or models of circulatory and plant transport systems to explain phenomena, interpret simple problems and make simple predictions in familiar contexts.	applies theories and models of circulatory and plant transport systems to discuss phenomena, interpret problems and make plausible predictions in familiar contexts.	applies theories and models of circulatory and plant transport systems to analyse phenomena, interpret problems and make plausible predictions in unfamiliar contexts.

Criterion 6: apply and analyse ecosystems models and theories for biodiversity and the interconnectedness of life

Rating C	Rating B	Rating A
applies theories or models of classification and biogeochemical cycling to explain phenomena, interpret simple problems and make simple predictions in familiar contexts	applies theories and models of classification and biogeochemical cycling to discuss phenomena, interpret problems and make plausible predictions in familiar contexts	applies theories and models of classification and biogeochemical cycling to analyse phenomena, interpret problems and make plausible predictions in unfamiliar contexts
applies theories or models of ecosystems to explain phenomena, interpret simple problems and make simple predictions in familiar contexts	applies theories and models of ecosystems to discuss phenomena, interpret problems and make plausible predictions in familiar contexts	applies theories and models of ecosystems to analyse phenomena, interpret problems and make plausible predictions in unfamiliar contexts
applies theories or models of human impact on ecosystems to explain phenomena, interpret simple problems and make simple predictions in familiar contexts.	applies theories and models of human impact on ecosystems to discuss phenomena, interpret problems and make plausible predictions in familiar contexts.	applies theories and models of human impact on ecosystems systems to analyse phenomena, interpret problems and make plausible predictions in unfamiliar contexts.

Quality Assurance

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

Qualifications and Award Requirements

The final award will be determined by the Office of Tasmanian Assessment, Standards and Certification from 6 ratings.

The minimum requirements for an award in *Biology* Level 2 are as follows:

EXCEPTIONAL ACHIEVEMENT (EA)
5 ‘A’ ratings, 1 ‘B’ rating

HIGH ACHIEVEMENT (HA)
3 ‘A’ ratings, 2 ‘B’ ratings, 1 ‘C’ rating

COMMENDABLE ACHIEVEMENT (CA)
3 ‘B’ ratings, 3 ‘C’ ratings

SATISFACTORY ACHIEVEMENT (SA)
5 ‘C’ ratings

PRELIMINARY ACHIEVEMENT (PA)
3 ‘C’ ratings

A learner who otherwise achieves the ratings for an 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.

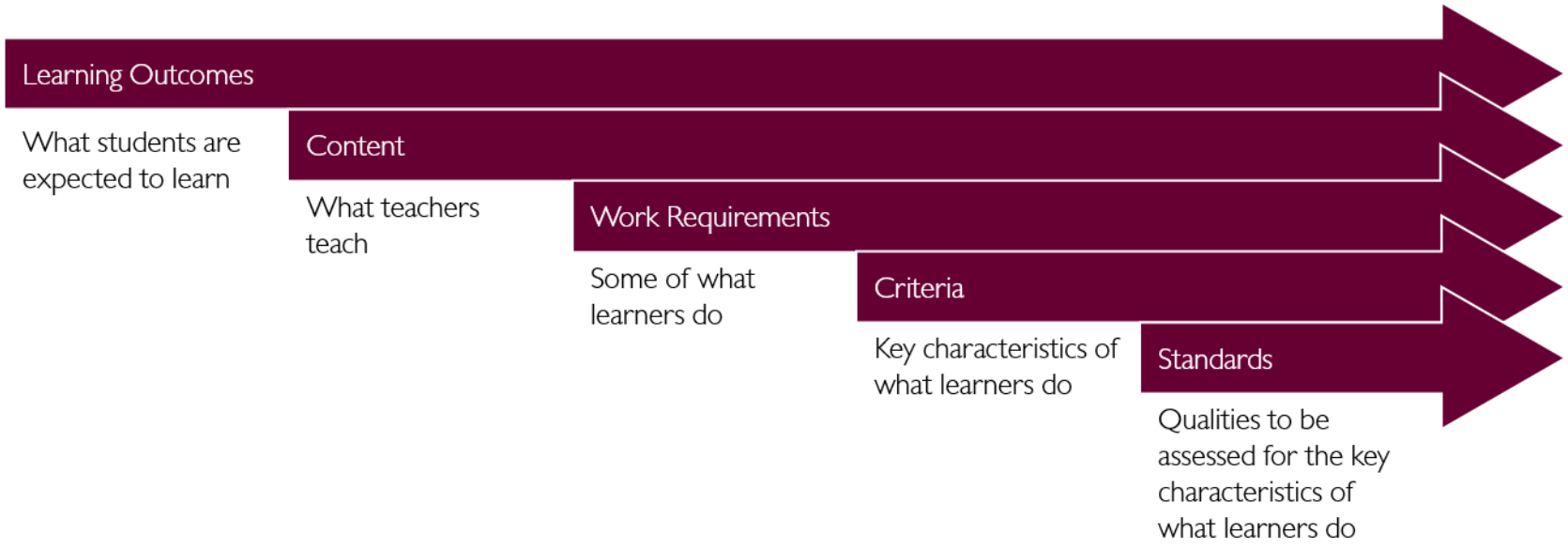
Course Developer

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. Work independently and with others to explore, analyse and communicate cell biology concepts.	Module 1, 2, 3	Module 1, 2, 3	C 1	All	GC:
2. Design, implement, evaluate and adapt inquiries into cell biology.	Module 1, 2, 3	Module 1, 2, 3	C 2	All	GC:
3. Analyse the interrelationships of the development and applications of cell biology with technology and the values broader community.	Module 1, 2, 3	Module 1, 2, 3	C 3	All	GC:
4. Apply and analyse models and theories used to explain cell biology processes including biochemistry and respiration.	Module 1	Module 1	C 4	All	GC:

5. Apply and analyse models and theories used to explain systems and processes within multicellular organisms.	Module 2	Module 2	C 5	All	GC:
6. Apply and analyse models and theories used to explain biodiversity and the interconnectedness of life.	Module 3	Module 3	C 6	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 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

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.

Students may need to be taught when it is appropriate to join points on a graph and when it is appropriate to use a line of best fit. They may also need to be taught how to construct a straight line that will serve as the line of best fit for a set of data presented graphically.

Senior Secondary Australian Curriculum Biology

Biology Level 2 is aligned to *S*enior Secondary Australian Curriculum *Biology* Units 1 and 2.

Appendix 3 - Work Requirements

Module 1 Work Requirements Specifications

Focus Area: Discipline-based Study
Title of Work Requirement: Science Inquiry Skills – Cell Biology
Mode /Format: Inquiry
Learning Outcomes: 1, 2 and 4
Description:
Learners will undertake an inquiry related to cell biology structure and function where they design, implement, evaluate and communicate their thinking and findings at each stage.

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.

Size: 15 hours
Timing: Throughout the Module
External agencies: NA
Relevant criterion/criteria:

- Criterion 1
- Criterion 2
- Criterion 4.

Focus Area: Discipline-based Study
Title of Work Requirement: Science as a Human Endeavour – Cell Biology
Mode /Format: Extended Response
Learning Outcomes: 1, 3 and 4
Description:
As part of another task or tasks (or as a stand-alone assignment) learners must address the *development and collaboration within biology, science and technology,* and/or *science and the broader community* aspects of the *Science as a Human Endeavour* in relation to cell biology structure and function topics such as: stem cells and the ethical treatment of animals.
Size: 5 Hours
Timing: Throughout the module
External agencies: NA
Relevant criterion/criteria:

- Criterion 1
- Criterion 3
- Criterion 4.

Module 2 Work Requirements Specifications

Focus Area: Discipline-based Study
Title of Work Requirement: Science Inquiry Skills – multicellular organisms
Mode /Format: Inquiry
Learning Outcomes: 1, 2 and 5
Description:
Learners will undertake an inquiry related to multicellular organisms where they design, implement, evaluate and communicate their thinking and findings at each stage.

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.

Size: 15 hours
Timing: Throughout the module

External agencies: NA
Relevant criterion/criteria:

- Criterion 1
- Criterion 2
- Criterion 5.

Focus Area: Discipline-based Study
Title of Work Requirement: Science as a Human Endeavour – multicellular organisms
Mode /Format: Extended Response
Learning Outcomes: 1, 3 and 5
Description:
As part of another task or tasks (or as a stand-alone assignment) learners must address the *science and technology* and/or *science and the broader community* aspects of the *Science as a Human Endeavour* in relation to multicellular organism topics such as: organ and tissue transplantation or bioartificial organs.
Size: 5 Hours
Timing: Throughout the module
External agencies: NA
Relevant criterion/criteria:

- Criterion 1
- Criterion 3
- Criterion 5.

Module 3 Work Requirements Specifications

Focus Area: Discipline-based Study
Title of Work Requirement: Science Inquiry Skills – biodiversity and the interconnectedness of life
Mode /Format: Inquiry
Learning Outcomes: 1, 2 and 6
Description:

Learners will undertake an inquiry related to biodiversity and the interconnectedness of life where they design, implement, evaluate and communicate their thinking and findings at each stage.

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.

Size: 15 hours
Timing: Throughout the module
External agencies: NA
Relevant criterion/criteria: individual elements. Select as relevant]

- Criterion 1

- Criterion 2
- Criterion 6.

Focus Area: Discipline-based Study
Title of Work Requirement: Science as a Human Endeavour – Homeostasis and Immunology
Mode /Format: Extended Response
Learning Outcomes: 1, 3 and 6
Description:
As part of another task or tasks (or as a stand-alone assignment) learners must address the *development and collaboration within biology* and/or *science and technology* aspects of the Science as a Human Endeavour in relation to biodiversity and the interconnectedness of life topics such as: Human activity and bio-accumulation and biomagnification, indigenous knowledge of environmental change, or biodiversity targets.
Size: 5 Hours
Timing: Throughout the module
External agencies: NA
Relevant criterion/criteria:

- Criterion 1
- Criterion 3
- Criterion 6.

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

- A central glossary will be added to the final draft of the course for consultation.

Appendix 6 – Content in Detail

Module 1

Science Understanding

Cell Theory

- Multicellular organisms have a hierarchical structural organisation of cells, tissues, organs and systems. (ACSBL054)
- The specialised structure and function of tissues, organs and systems can be related to cell differentiation and cell specialisation. (ACSBL055)
- Stem cells. (ACSBL037)
- Prokaryotic and eukaryotic cells have many features in common, which is a reflection of their common evolutionary past, but prokaryotes lack internal membrane bound organelles, do not have a nucleus, are significantly smaller than eukaryotes, usually have a single circular chromosome, and exist as single cells. (ACSBL048)
- Cell membrane (phospholipid bilayer, protein channels, fluid mosaic model basics, feature/characteristic of semi-permeability). (ACSBL039) (ACSBL044) (ACSBL045)
- Transport across membranes (focus on passive transport). (ACSBL046)
- Factors that affect exchange of materials across membranes include the surface-area-to-volume ratio of the cell, concentration gradients, and the physical and chemical nature of the materials being exchanged. (ACSBL047)

Biochemistry

- In eukaryotic cells, specialised organelles facilitate biochemical processes of photosynthesis, cellular respiration, the synthesis of complex molecules (including carbohydrates, proteins, lipids and other biomacromolecules), and the removal of cellular products and wastes. (ACSBL049)
- Enzymes – Biochemical processes in the cell are controlled by the nature and arrangement of internal membranes, the presence of specific enzymes, and environmental factors. (ACSBL050)

Basics of respiration and photosynthesis (for carbon & energy transfer).

- Photosynthesis is a biochemical process that in plant cells occurs in the chloroplast and that uses light energy to synthesise organic compounds; the overall process can be represented as a balanced chemical equation. (ACSBL052)
- Cellular respiration is a biochemical process that occurs in different locations in the cytosol and mitochondria and metabolises organic compounds, aerobically or anaerobically, to release useable energy in the form of ATP; the overall process can be represented as a balanced chemical equation. (ACSBL053)

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)

Science and technology

- The use of scientific knowledge is influenced by social, economic, cultural and ethical considerations. (ACSBL011)

Science and the broader community

- Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability. (ACSBL014)

Science Inquiry

Design of inquiry

- Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes. (ACSBL030)
- 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. (ACSBL031)

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, genres and modes, including scientific reports. (ACSBL036)

Module 2

Science Understanding

Respiratory

- The respiratory system is structured to facilitate the exchange of gases between the external environment and the blood.
- To be efficient, gas exchange surfaces must have the following characteristics:
  - large surface area
  - thin
  - moist

- vascular.
- The mechanics of breathing help to maintain the efficient exchange of gases in the lungs.
- The function of the respiratory system can be compromised by diseases and conditions that reduce the efficiency of gas exchange.

Digestive (ACSBL058)

- 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.
- Chemical digestion involves the use of enzymes (amylase, protease and lipase) to chemically break down food for absorption.
- Materials eliminated from the digestive system include indigestible contents, excess materials and some metabolic wastes.
- The function of the digestive system can be compromised by diseases and conditions that reduce the efficiency of digestion or absorption of food.

Excretory (ACSBL057)

- The urinary system facilitates the removal of toxic nitrogenous wastes and excess water from the blood.
- nephron structure and function
- The urinary system works with other systems and organs, including the digestive system, the skin and lungs, to maintain the correct water balance within the body.
- Dysfunction of the kidneys may result in death due to accumulation of toxic substances in the blood; treatment using dialysis machines or kidney transplants help to preserve life.
- The excretory system regulates the chemical composition of body fluids by removing metabolic wastes and retaining the proper amounts of water, salts, and nutrients; components of this system include the kidneys, liver, lungs, and skin functioning at the organ level.
- Deamination of amino acids in the liver produces urea, which then is transported to the kidneys for removal.
- The nephrons in the kidney facilitate three basic processes: filtration, reabsorption and secretion during urine formation to maintain the composition of body fluids (hormone control is not required).

Circulatory (ACSBL056) (ACSBL058)

- 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.
- 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

- defence against pathogens
- the function of the circulatory system can be compromised by cardiovascular diseases that reduce the efficiency of transport of materials around the body.

Plant transport

- In plants, transport of water and mineral nutrients from the roots occurs via xylem involving root pressure, transpiration and cohesion of water molecules; transport of the products of photosynthesis and some mineral nutrients occurs by translocation in the phloem. (ACSBL060)
- plant gas exchange
- In plants, gases are exchanged via stomata and the plant surface; their movement within the plant by diffusion does not involve the plant transport system. (ACSBL059)

Science as a Human Endeavour

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)

Science Inquiry Skills

Design of inquiry

- Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes. (ACSBL030)
- 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. (ACSBL031)

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, genres and modes, including scientific reports. (ACSBL036)

Science Understanding

Classification of life.

- Why classify?
- Phylogenetic trees and evolutionary relationships. (ACSBL017) (ACSBL016)
- Species concept. (ACSBL015) (ACSBL018)

Ecosystem dynamics and modelling

- habitats, biotic & abiotic factors (ACSBL021) (ACSBL019)
- niche concept and competitive exclusion principle. (ACSBL023)
- interactions of organisms with their environment
- energy, energy flows, food chains, role of autotrophs.
- food webs, heterotrophs, decomposers
- Relationships between organisms which include predation, competition, symbiosis and disease. (ACSBL020)
- keystone species (ACSBL024) (ACSBL012)
- pyramids (biomass, energy, number). (ACSBL029)
- population growth, density dependent and independent factors, environmental resistance, carrying capacity (ACSBL025)
- ecosystems change over time. (ACSBL027)
- ecological succession. (ACSBL026)

Biogeochemical cycling

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

Human activities

- Human activities can reduce biodiversity and can impact on the magnitude, duration and speed of ecosystem change (ACSBL028), for example:
  - over-exploitation
  - habitat destruction
  - monocultures
  - pollution.

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

- The use of scientific knowledge is influenced by social, economic, cultural and ethical considerations. (ACSBL011)

Science Inquiry Skills

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 using ecosystem surveying techniques, safely, competently and methodically for the collection of valid and reliable data. (ACSBL003)
- 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. (ACSBL004)

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. (ACSBL005)
- Select, construct and use appropriate representations, including classification keys, food webs and biomass pyramids, to communicate conceptual understanding, solve problems and make predictions. (ACSBL006)
- Communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports. (ACSBL007)