DEPARTMENT OF EDUCATION
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Discipline-based Study

Science

Biology 3

COURSE DOCUMENT

DRAFT

PHASE 3 CONSULTATION

Catholic Education Tasmania

INDEPENDENT SCHOOLS TASMANIA

Years 9 to 12 Learning

Tasmanian Government

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Biology, 150 hours – Level 3

This course is the Level 3 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 3 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, continuity of life, 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 3 provides learners with the opportunity to engage in depth with biology including cells and their structures and functions, reproduction, genetics and evolution, and how life maintains itself and immune responses. 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 3 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..
- *Biology* Level 3 has a clear pathway to a large range of tertiary as well as vocational pathways.

Course Requirements

Learners enrolled in this course are required to be able to work responsibly and safely in practical situations.

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

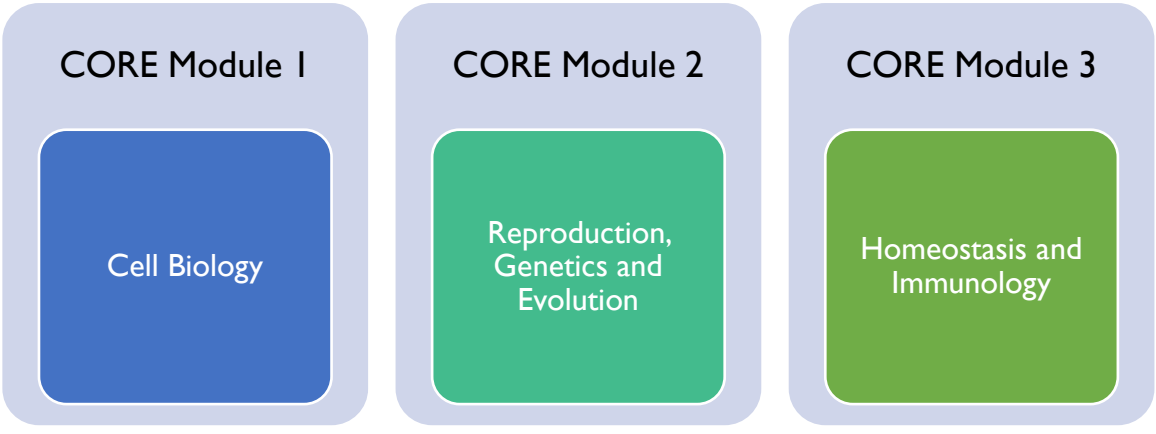
This course requires learners to collaborate with others.

Course Structure, Delivery and Progression

Structure

This course consists of three 50-hour modules.

Modules available
Core Module 1: Cell Biology
Core Module 2: Reproduction, Genetics and Evolution
Core Module 3: Homeostasis and Immunology



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

In this module, learners investigate some of the biochemical and cellular systems and processes involved in the transmission of genetic material to the next generation of cells and to offspring.

Through the investigation of appropriate contexts, learners explore the ways in which models and theories have developed over time and through interactions with social, cultural, economic and ethical considerations. They investigate the ways in which science contributes to contemporary debate about local, regional and international issues, including evaluation of risk and action for sustainability, and recognise the limitations of science to provide definitive answers in different contexts. Learners use science inquiry skills to design and conduct investigations into how different factors affect cellular processes; they construct and use models to analyse the data gathered; and they continue to develop their skills in constructing plausible predictions and valid, reliable conclusions.

Module 1 Learning Outcomes

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

1. work independently and with others to explore, evaluate and communicate cell biology concepts
2. design, implement, evaluate and refine inquiries into cell biology
3. analyse the impact of 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 understand cell biology processes, including DNA and protein synthesis, and function of enzymes and coenzymes.

Module 1 Content

Cells are the building blocks of all life of Earth. There are a number of key cellular processes that underpin life in multicellular organisms. In this Module by applying knowledge, including practically, of key cellular processes some complex functions within and between cells will be analysed. These include some application of DNA and protein synthesis, and the function of enzymes and co-enzymes. Science Understanding and Science as a Human Endeavour describe the key knowledge in Module 1, and Science Inquiry Skills are the key skills.

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 the cellular processes and mechanisms that ensure the continuity of life
- understand how models and theories have developed over time; and the ways in which biological knowledge interacts with social, economic, cultural and ethical considerations in a range of contexts
- use science inquiry skills to design, conduct, evaluate and communicate investigations into gene technology applications
- evaluate with reference to empirical evidence, claims about technology, and population gene pool processes, and justify evaluations
- communicate biological understanding using qualitative and quantitative representations in appropriate modes and genres.

Science Understanding (see Appendix 6 for content in detail)

- key cellular processes
- DNA and protein synthesis
- Biochemistry – function of enzymes and co-enzymes in metabolism.

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

- development and collaboration within biology
- 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 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 work requirement.

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 - Reproduction, Genetics and Evolution

Heredity is an important biological principle as it explains why offspring (cells or organisms) resemble their parent cell or organism. Organisms require cellular division and differentiation for growth, development, repair and sexual reproduction. In this module, learners investigate processes involved in the transmission of genetic material to the next generation of cells and to offspring. They consider different patterns of inheritance by analysing the possible genotypes and phenotypes of offspring. Learners link their observations to explanatory models that describe patterns of inheritance, and explore how the use of predictive models of inheritance enables decision making. Learners investigate the genetic basis for the theory of evolution by natural selection through constructing, using and evaluating explanatory and predictive models for gene pool diversity of populations. They explore genetic variation in gene pools, selection pressures and isolation effects in order to explain speciation and extinction events and to make predictions about future changes to populations.

Through the investigation of appropriate contexts, learners explore the ways in which models and theories related to heredity and population genetics have developed over time and through interactions with social, cultural, economic and ethical considerations. They investigate the ways in which science contributes to contemporary debate about local, regional and international issues, including evaluation of risk and action for sustainability, and recognise the limitations of science to provide definitive answers in different contexts. Learners use science inquiry skills to design and conduct investigations into how different factors affect cellular processes and gene pools; they construct and use models to analyse the data gathered; and they continue to develop their skills in constructing plausible predictions and valid, reliable conclusions.

Module 2 Learning Outcomes

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

1. work independently and with others to explore, evaluate and communicate reproduction, genetics and evolution concepts
2. design, implement, evaluate and refine inquiries into reproduction, genetics and evolution
3. analyse the impact of the interrelationships of the development and applications of reproduction, genetics and evolution with technology and the values broader community
5. apply and analyse models and theories used to understand reproduction, genetics and evolution.

Module 2 Content

Reproduction is a key process for all life and genetics underpins the understanding of continuity of life and evolution. In this module by applying knowledge, including practically, of reproductive processes, concepts and mechanisms for gene transfer and function, the natural selection of gene expression over large timescales both the stability and diversity of life can be analysed. Science Understanding and Science as a Human Endeavour describe the key knowledge in Module 2, and Science Inquiry Skills are the key skills.

By the end of this module, learners will:

- understand the mechanisms that ensure the continuity of life, and how these processes contribute to unity and diversity within a species
- understand the processes and mechanisms that explain how life on Earth has persisted, changed and diversified over the last 3.5 billion years
- understand how models and theories have developed over time; and the ways in which biological knowledge interacts with social, economic, cultural and ethical considerations in a range of contexts
- use science inquiry skills to design, conduct, evaluate and communicate investigations into heredity, gene technology applications, and population gene pool changes
- evaluate with reference to empirical evidence, claims about heredity processes, gene technology, and population gene pool processes, and justify evaluations
- communicate biological understanding using qualitative and quantitative representations in appropriate modes and genres.

Science Understanding (see Appendix 6 for content in detail)

- Reproduction
- Genetics
- Evolution

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

- development and collaboration within Biology
- 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 work requirement.

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 - Homeostasis and Immunology

In order to survive, organisms must be able to maintain system structure and function in the face of changes in their external and internal environments. Changes in temperature and water availability, and the incidence and spread of infectious disease, present significant challenges for organisms and require coordinated system responses. In this module, learners investigate how homeostatic response systems control organisms' responses to environmental change – internal and external – in order to survive in a variety of environments, as long as the conditions are within their tolerance limits. Learners study how the invasion of an organism's internal environment by pathogens challenges the effective functioning of cells, tissues and body systems, and triggers a series of responses or events in the short and long-term in order to maintain system function. They consider the factors that contribute to the spread of infectious disease and how outbreaks of infectious disease can be predicted, monitored and contained.

Through the investigation of appropriate contexts, learners explore the ways in which models and theories of organisms' and populations' responses to environmental change have developed over time and through interactions with social, economic, cultural and ethical considerations. They investigate the ways in which science contributes to contemporary debate about local, regional and international issues, including evaluation of risk and action for sustainability, and recognise the limitations of science to provide definitive answers in different contexts. Learners use science inquiry skills to investigate a range of responses by plants and animals to changes in their environments and to invasion by pathogens; they construct and use appropriate representations to analyse the data gathered; and they continue to develop their skills in constructing plausible predictions and valid conclusions.

Module 3 Learning Outcomes

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

1. work independently and with others to explore, evaluate and communicate concepts of homeostasis and immunology
2. design, implement, evaluate and refine inquiries into homeostasis and immunology
3. analyse the impact of the interrelationships of the development and applications of homeostasis and immunology with technology and the values broader community
6. apply and analyse models and theories used to understand homeostasis and immunology.

Module 3 Content

In complex organisms, such as humans, our systems work to maintain an internal environment that sustains life and to engage processes when exposed to external threats. In this module by applying knowledge, including practically, of the nervous, endocrine, lymphatic and immune systems the maintenance of the internal environment can be analysed. Science Understanding and Science as a Human Endeavour describe the key knowledge of Module 3, and Science Inquiry Skills are the key skills.

By the end of this module, learners will:

- understand the mechanisms by which plants and animals use homeostasis to control their internal environment in a changing external environment
- understand how plants and animals respond to the presence of pathogens, and the ways in which infection, transmission and spread of disease occur
- understand how models and theories have developed over time, and the ways in which biological knowledge interacts with social, economic, cultural and ethical considerations in a range of contexts
- use science inquiry skills to design, conduct, evaluate and communicate investigations into organisms' responses to changing environmental conditions and infectious disease
- evaluate, with reference to empirical evidence, claims about organisms' responses to changing environmental conditions and infectious disease and justify evaluations
- communicate biological understanding using qualitative and quantitative representations in appropriate modes and genres.

Science Understanding (see Appendix 6 for content in detail)

- Nervous System
- Endocrine System
- Lymphatic System
- Homeostasis
- Immunology.

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 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 work requirement.

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.

TASC will supervise the external assessment of designated criteria which will be indicated by an asterisk (*). The ratings obtained from the external assessments will be used in addition to internal ratings from the provider to determine the final award.

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 3 will be based on the degree to which the learner can:

1. explore, analyse and communicate biology concepts as an individual and within a group
2. design, implement and evaluate inquiry into biological systems
3. analyse the development and applications of biology with technologies and the broader community
4. apply and synthesise models and theories used to explain cell biology processes*
5. apply and synthesise models and theories used to explain reproduction, genetics and evolution*
6. apply and synthesise models and theories used to explain homeostasis and immunology.*

*denotes criteria that are both internally and externally assessed.

Standards

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

Rating C	Rating B	Rating A
sets personal priorities and manage resources effectively to achieve personal goals and learning outcomes	set and adapt personal priorities and manage resources effectively to achieve personal goals and learning outcomes	establish personal priorities, manage resources effectively and demonstrate initiative to achieve personal goals and learning outcomes
set and apply criteria to complete complex tasks and evaluate the outcomes of individual and group decisions	develop and apply criteria to complete complex tasks and evaluate the outcomes of individual and group decisions	develop, apply and adapt criteria to complete complex tasks and evaluate the outcomes of individual and group decisions
selects, constructs and uses appropriate representations to describe relationships and solve problems	selects, constructs and uses appropriate representations to describe complex relationships and to solve unfamiliar problems	selects, constructs and uses appropriate representations to describe complex relationships and to solve complex and unfamiliar problems
communicates clearly in a range of modes, styles and genres for specific purposes.	communicates clearly and accurately in a range of modes, styles and genres for specific audiences and purposes.	communicates effectively and accurately in a range of modes, styles and genres for specific audiences and purposes.

Criterion 2: design, implement and evaluate inquiry into biological systems.

Rating C	Rating B	Rating A
designs and conducts safe, ethical investigations that collect valid data in response to a question or problem	designs, conducts and improves safe, ethical investigations that collect valid, reliable data in response to a question or problem	designs, conducts and improves safe, ethical investigations that efficiently collect valid, reliable data in response to a complex question or problem
analyses data to identify relationships, anomalies, and sources of error	analyses data sets to identify causal and correlational relationships, anomalies, and sources of error	analyses data sets to explain causal and correlational relationships, the reliability of the data, and sources of error
selects data to demonstrate relationships linked to biological knowledge, and provides conclusions based on data	selects appropriate data as evidence, interprets evidence with reference to models and/or theories, and provides evidence for conclusions	justifies their selection of data as evidence, analyses evidence with reference to models and/or theories, and develops evidence-based conclusions that identify limitations
evaluates processes and claims, and suggests improvements or alternatives.	evaluates processes and claims, provides a critique with reference to evidence, and identifies possible improvements or alternatives.	evaluates processes and claims, and provides an evidence-based critique and discussion of improvements or alternatives.

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

Rating C	Rating B	Rating A
describes the roles of collaboration and review in the development of biological theories or models	explains the roles of collaboration, debate and review in the development of biological theories and models	analyses the roles of collaboration, debate and review in the development of biological theories and models
discusses how biological science has been used to meet needs and to inform decision making, and some social, economic or ethical implications of these applications	explains how biological science has been used to meet diverse needs and to inform decision making; and how these applications are influenced by social, economic and ethical factors	evaluates how biological science has been used in concert with other sciences to meet diverse needs and to inform decision making; and how these applications are influenced by interacting social, economic and ethical factors
describes the role of technologies in the development of biological theories or models.	explains the role of technologies in the development of biological theories and models.	analyses the role of technologies in the development of biological theories and models.

Criterion 4*: apply and synthesise models and theories used to explain cell biology processes.

This criterion is both internally and externally assessed.

Rating C	Rating B	Rating A
applies theories or models of cell process and function to explain phenomena, interpret problems and make plausible predictions in familiar contexts	applies theories and models of cell process and function to discuss phenomena, interpret problems and make plausible predictions in unfamiliar contexts	applies theories and models of cell process and function to analyse phenomena, interpret complex problems and make reasoned, plausible predictions in unfamiliar contexts
applies theories or models of DNA and protein synthesis to explain phenomena, interpret problems and make plausible predictions in familiar contexts	applies theories and models of DNA and protein synthesis to discuss phenomena, interpret problems and make plausible predictions in unfamiliar contexts	applies theories and models of DNA and protein synthesis to analyse phenomena, interpret complex problems and make reasoned, plausible predictions in unfamiliar contexts
applies theories or models of biochemistry to explain phenomena, interpret problems and make plausible predictions in familiar contexts.	applies theories and models of biochemistry to discuss phenomena, interpret problems and make plausible predictions in unfamiliar contexts.	applies theories and models of biochemistry and function to analyse phenomena, interpret complex problems and make reasoned, plausible predictions in unfamiliar contexts.

Criterion 5*: apply and synthesise models and theories used to explain reproduction, genetics and evolution.

This criterion is both internally and externally assessed.

Rating C	Rating B	Rating A
applies theories or models of reproduction to explain phenomena, interpret problems and make plausible predictions in familiar contexts	applies theories and models of reproduction to discuss phenomena, interpret problems and make plausible predictions in unfamiliar contexts	applies theories and models of reproduction to analyse phenomena, interpret complex problems and make reasoned, plausible predictions in unfamiliar contexts
applies genetic theories or models to describe how system components function and the processes that enable continuity of the individual, population and species in familiar contexts	applies genetic theories and models to explain how system components are interrelated and how they function to enable continuity of the individual, population and species in unfamiliar contexts	applies genetic theories and models to analyse how system components function and are interrelated across a range of scales to enable continuity of the individual, population and species in unfamiliar contexts
applies the theory of evolution to describe how system components function and the processes that enable continuity of the individual, population and species in familiar contexts.	applies the theory of evolution to explain how system components are interrelated and how they function to enable continuity of the individual, population and species in unfamiliar contexts.	applies the theory of evolution to analyse how system components function and are interrelated across a range of scales to enable continuity of the individual, population and species in unfamiliar contexts.

Criterion 6*: apply and synthesise models and theories used to explain homeostasis and immunology.

This criterion is both internally and externally assessed.

Rating C	Rating B	Rating A
applies theories or models of nervous, endocrine and lymphatic systems to explain phenomena, interpret problems and make plausible predictions in familiar contexts	applies theories and models of nervous, endocrine and lymphatic systems to discuss phenomena, interpret problems and make plausible predictions in unfamiliar contexts	applies theories and models of nervous, endocrine and lymphatic systems to explain phenomena, interpret complex problems and make reasoned, plausible predictions in unfamiliar contexts
applies theories or models of homeostasis to describe how system components or processes are affected by external factors, and how the system responds	applies theories or models of homeostasis to explain how the function and interrelationships of system components are affected by external factors, and how the system responds	applies theories or models of homeostasis to analyse how the function and interrelationships of system components are affected by external factors across a range of scales, and how the system responds over time
applies theories or models of immunology to describe how system components or processes are affected by external factors, and how the system responds.	applies theories or models of immunology to explain how the function and interrelationships of system components are affected by external factors, and how the system responds.	applies theories or models of immunology to analyse how the function and interrelationships of system components are affected by external factors across a range of scales, and how the system responds over time.

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 the 9 ratings (6 ratings from the internal assessment and 3 ratings from the external assessment).

The minimum requirements for an award in *Biology* Level 3 are as follows:

EXCEPTIONAL ACHIEVEMENT (EA)
8'A' ratings, 1 'B' rating (2 'A' ratings, 1 'B' rating from external assessment)

HIGH ACHIEVEMENT (HA)
4 'A' ratings, 4 'B' ratings, 1 'C' ratings (1 'A' rating, 1 'B' rating and 1 'C' rating from external assessment)

COMMENDABLE ACHIEVEMENT (CA)
4 'B' ratings, 4 'C' ratings (1 'B' ratings, 2 'C' ratings from external assessment)

SATISFACTORY ACHIEVEMENT (SA)
7 'C' ratings (2 'C' ratings from external assessment)

PRELIMINARY ACHIEVEMENT (PA)
5 'C' ratings

A learner who otherwise achieves the ratings 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.

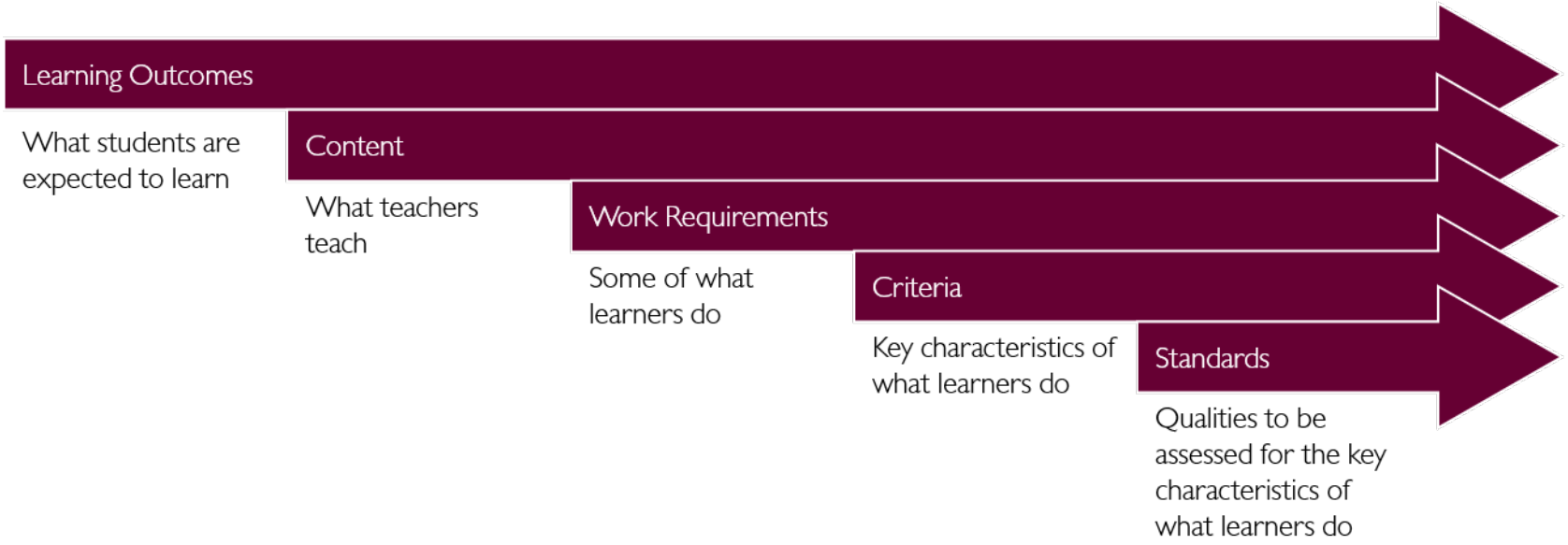
Course Developer

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. Work independently and with others to explore, evaluate and communicate cell biology concepts.	Module 1, 2, 3	Module 1, 2, 3	C 1	All	GC:
2. Design, implement, evaluate and refine inquiries into cell biology.	Module 1, 2, 3	Module 1, 2, 3	C 2	All	GC:
3. Analyse the impact of 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 understand cell biology processes, including DNA and protein synthesis, and function of enzymes and coenzymes.	Module 1	Module 1	C 4	All	GC:

5.	Apply and analyse models and theories used to understand reproduction, genetics and evolution.	Module 2	Module 2	C 5	All	GC:
6.	Apply and analyse models and theories used to understand homeostasis and immunology.	Module 3	Module 3	C 6	All	GC:

Appendix 2 - Alignment to Curriculum Frameworks

Links to Foundation to Year 10

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.

It is assumed that students will be able to competently:

- perform calculations involving addition, subtraction, multiplication and division of quantities
- perform approximate evaluations of numerical expressions
- express fractions as percentages, and percentages as fractions
- calculate percentages
- recognise and use ratios
- transform decimal notation to power of ten notation
- substitute physical quantities into an equation using consistent units so as to calculate one quantity and check the dimensional consistency of such calculations
- solve simple algebraic equations
- comprehend and use the symbols/notations <,>, Δ, ≈
- translate information between graphical, numerical and algebraic forms
- distinguish between discrete and continuous data then select appropriate forms, variables and scales for constructing graphs
- construct and interpret frequency tables and diagrams, pie charts and histograms
- describe and compare data sets using mean, median and inter-quartile range
- interpret the slope of a linear graph.

Senior Secondary Australian Curriculum Biology

Biology Level 3 is aligned to mostly *Senior Secondary Australian Curriculum Biology Units 3 and 4* with some elements from *Unit 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 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.

Relationship to External Assessment: No relevance

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* and/or *science and the broader community* aspects of the *Science as a Human Endeavour* in relation to cell biology topics such as: the Human Genome Project, DNA sequencing, PCR Testing
Size: 5 Hours
Timing: Anytime during the module
External agencies: NA
Relevant criterion/criteria:

- criterion 1
- criterion 3
- criterion 4.

Relationship to External Assessment: No relevance

Module 2 Work Requirements Specifications

Focus Area: Discipline-based study
Title of Work Requirement: Science Inquiry Skills – Reproduction, Genetics and Evolution
Mode /Format: Inquiry
Learning Outcomes: 1, 2 and 5
Description:
Learners will undertake an inquiry related to reproduction, genetics and evolution 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

Relationship to External Assessment: No relevance

Focus Area: Discipline-based study
Title of Work Requirement: Science as a Human Endeavour – Reproduction, Genetics and Evolution
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 *development and collaboration within biology* and/or *science and the broader community* aspects of the *Science as a Human Endeavour* in relation to reproduction, genetics and evolution topics such as: monocultures, genetically modified organisms, chemotherapy, mechanisms of cancer, genetic testing or evidence for evolution.
Size: 5 Hours
Timing: Throughout
External agencies: NA
Relevant criterion/criteria:

- criterion 1
- criterion 3
- criterion 5

Relationship to External Assessment: No relevance

Module 3 Work Requirements Specifications

Focus Area: Discipline-based study
Title of Work Requirement: Science Inquiry Skills – Homeostasis and Immunology
Mode /Format: Inquiry
Learning Outcomes: 1, 2 and 6
Description:
Learners will undertake an inquiry related to homeostasis and immunology 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
- meeting the requirements of experimental practice while addressing Criterion 2.

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

- criterion 1
- criterion 2
- criterion 6

Relationship to External Assessment: No relevance

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 the broader community* and *science and technology* aspects of the Science as a Human Endeavour in relation to homeostasis and immunology topics such as: modelling thermoregulation, modelling, diagnosing and treating hormonal control systems, managing pandemics.
Size: 5 Hours
Timing: Throughout the module
External agencies: NA
Relevant criterion/criteria:

- criterion 1
- criterion 3
- criterion 6

Relationship to External Assessment: No relevance

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

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

Module 1

Science Understanding

Key cellular processes

Cell membrane structure and function (to prepare students for homeostasis and immunology)

- fluid mosaic model (extension) – movement of substances based on polarity and size
- function of protein channels in active transport – sodium potassium pumps
- glycolipids for cellular recognition
- glycoproteins as receptors for chemical signals
- exocytosis, endocytosis (phagocytosis).

DNA and protein synthesis

- DNA is a helical double-stranded molecule that occurs bound to proteins in chromosomes in the nucleus, and as unbound circular DNA in the cytosol of prokaryotes and in the mitochondria and chloroplasts of eukaryotic cells. (ACSBL076)
- The structural properties of the DNA molecule, including nucleotide composition and pairing and the weak bonds between strands of DNA, allow for replication. (ACSBL077)
- Genes include 'coding' and 'non-coding' DNA, and many genes contain information for protein production. (ACSBL078)
- Protein synthesis involves transcription of a gene into messenger RNA in the nucleus, and translation into an amino acid sequence at the ribosome. Role of organelles in protein production and transport out of cell. (ACSBL079)
- The phenotypic expression of genes depends on factors controlling transcription and translation during protein synthesis, the products of other genes, and the environment. (ACSBL081)
- Mutations in genes and chromosomes can result from errors in DNA replication or cell division, or from damage by physical or chemical factors in the environment. (ACSBL082)
- Differential gene expression controls cell differentiation for tissue formation, as well as the structural changes that occur during growth. (ACSBL083)
- cell specialisation – neurons and leukocytes..

Biochemistry – function of enzymes and co-enzymes in metabolism

- Proteins, including enzymes, are essential to cell structure and functioning. (ACSBL080)
- Enzymes as biological catalysts. (ACSBL050)
- Competitive and non-competitive inhibition including reversible and non-reversible inhibition. (ACSBL051)
- Co-enzymes NAD and NADP as electron carriers.
- Photosynthesis – extension – light dependent and light independent stages (individual steps not required). (ACSBL052)
- Cellular respiration (aerobic and anaerobic)– extension – glycolysis, Kreb's cycle and electron transport chain (individual steps not required). (ACSBL053)

Science as a Human Endeavour

Development and collaboration within biology

- International collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region. (ACSBL073)

Science and the broader community

- The acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered. (ACSBL070)
- People can use scientific knowledge to inform the monitoring, assessment and evaluation of risk. (ACSBL071)

Science Inquiry Skills

Design of inquiry

- Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes. (ACSBL061)
- 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. (ACSBL062)

Implementation of Inquiry

- Conduct investigations, including real or virtual gel electrophoresis, safely, competently and methodically for the collection of valid and reliable data. (ACSBL063)
- Represent data in meaningful and useful ways, including the use of mean, median, range and probability; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and the sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions. (ACSBL064)

Evaluation of inquiry

- Interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, including interpreting confidence intervals in secondary data; and use reasoning to construct scientific arguments. (ACSBL065)
- Select, construct and use appropriate representations, including models of DNA replication, transcription and translation, Punnett squares and probability models of expression of a specific gene in a population, to communicate conceptual understanding, solve problems and make predictions. (ACSBL066)
- Communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports. (ACSBL067)

Module 2

Science Understanding

Reproduction

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)

- asexual and sexual - advantages and disadvantages
- meiosis and mitosis (including all stages).

Genetics

Frequencies of genotypes and phenotypes of offspring can be predicted using probability models, including Punnett squares, and by taking into consideration patterns of inheritance, including:

- the effects of dominance
- autosomal alleles
- X-linked alleles
- multiple alleles
- polygenic inheritance (ACSBL085)
- monohybrid crosses only.

Use of pedigree charts.

Evolution

- Variations in the genotype of offspring arise as a result of the processes of meiosis and fertilisation, as well as a result of mutations. (ACSBL084)
- Life has existed on Earth for approximately 3.5 billion years and has changed and diversified over time. (ACSBL088)
- Comparative genomics provides evidence for the theory of evolution. (ACSBL089)
- Natural selection occurs when selection pressures in the environment confer a selective advantage on a specific phenotype to enhance its survival and reproduction; this results in changes in allele frequency in the gene pool of a population. (ACSBL090)
- In additional to environmental selection pressures, mutation, gene flow and genetic drift can contribute to changes in allele frequency in a population gene pool and results in micro-evolutionary change. (ACSBL091)
- Mutation is the ultimate source of genetic variation as it introduces new alleles into a population. (ACSBL092)
- Speciation and macro-evolutionary changes result from an accumulation of micro-evolutionary changes over time. (ACSBL093)
- Differing selection pressures between geographically isolated populations may lead to allopatric speciation. (ACSBL094)
- Populations with reduced genetic diversity face increased risk of extinction. (ACSBL095).

Science as a Human Endeavour

Development and collaboration within Biology

- Models and theories are contested and refined or replaced when new evidence challenges them, or when a new model or theory has greater explanatory power. (ACSBL069)

Science and the broader community

- The acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered. (ACSBL070)
- People can use scientific knowledge to inform the monitoring, assessment and evaluation of risk. (ACSBL071)
- Science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question. (ACSBL072).

Science Inquiry Skills

Design of inquiry

- Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes. (ACSBL061)
- 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. (ACSBL062)

Implementation of Inquiry

- Conduct investigations, including the use of probabilities to predict inheritance patterns, and population simulations to predict population changes, safely, competently and methodically for the collection of valid and reliable data. (ACSBL063)
- Represent data in meaningful and useful ways, including the use of mean, median, range and probability; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and the sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions. (ACSBL064)

Evaluation of inquiry

- Interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, including interpreting confidence intervals in secondary data; and use reasoning to construct scientific arguments. (ACSBL065)
- Select, construct and use appropriate representations, Punnett squares and probability models of expression of a specific gene in a population, to communicate conceptual understanding, solve problems and make predictions. (ACSBL066)
- Communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports. (ACSBL067)

Science Understanding

Nervous system

- sensory receptors, neurons, effectors
- passage of nerve impulses involving transmission of action potential along nerve axons
- Neurotransmitters and signal transduction. (ACSBL112)

Endocrine System

- endocrine glands
- Action of hormone on target tissues and organs. (ACSBL113)

Lymphatic System

- lymphatic vessels, organs and tissues
- role of lymph nodes.

Homeostasis

- Stimulus response model – negative feedback. (ACSBL110)
- Receptors and effectors are linked by nervous and hormonal pathways. (ACSBL110)
- Maintain internal environment within tolerance limits:
  - glucose regulation (ACSBL111)
  - maintain water balance (ACSBL115)
- Endothermic animals have thermoregulatory abilities:
  - temperature regulation (ACSBL114).

Immunology

- Infectious disease differs from other disease (for example, genetic and lifestyle diseases) in that it is caused by invasion by a pathogen and can be transmitted from one host to another. (ACSBL116)
- Pathogens include prions, viruses, bacteria, fungi, protists and parasites. (ACSBL117)
- Pathogens transmission occurs by various mechanisms including through direct contact, contact with body fluids, and via contaminated food, water or disease-specific vectors. (ACSBL118)
- When a pathogen enters a host, it causes physical or chemical changes (for example, the introduction of foreign chemicals via the surface of the pathogen, or the production of toxins) in the cells or tissues; these changes stimulate the host immune responses. (ACSBL119)
- All plants and animals have innate (general) immune responses to the presence of pathogens; vertebrates also have adaptive immune responses. (ACSBL120)
- Innate responses in animals target pathogens, including through the inflammation response, which involves the actions of phagocytes, defensins and the complement system. (ACSBL121)
- In vertebrates, adaptive responses to specific antigens include the production of humoral immunity through the production of antibodies by B lymphocytes, and the provision of cell-mediated immunity by T lymphocytes; in both cases memory cells are produced that confirm long-term immunity to the specific antigen. (ACSBL122)
- In vertebrates, immunity may be passive (for example, antibodies gained via the placenta or via antibody serum injection) or active (for example, acquired through actions of the immune system as a result of natural exposure to a pathogen or through the use of vaccines). (ACSBL123)

- Transmission and spread of disease is facilitated by regional and global movement of organisms. (ACSBL124)
- The spread of a specific disease involves a wide range of interrelated factors (for example, persistence of the pathogen within hosts, the transmission mechanism, the proportion of the population that are immune or have been immunised, and the mobility of individuals of the affected population); analysis of these factors can enable prediction of the potential for an outbreak, as well as evaluation of strategies to control the spread of disease. (ACSBL125)

Science as a Human Endeavour

Development and collaboration within Biology

- Models and theories are contested and refined or replaced when new evidence challenges them, or when a new model or theory has greater explanatory power. (ACSBL104)
- International collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region. (ACSBL108)

Science and technology

- ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work. (ACSBL103)

Science and the broader community

- People can use scientific knowledge to inform the monitoring, assessment and evaluation of risk. (ACSBL106)
- Science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question. (ACSBL107)

Science Inquiry Skills

Design of inquiry

- Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes. (ACSBL096)
- 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 the rights of living organisms. (ACSBL097)

Implementation of Inquiry

- Conduct investigations, including using models of homeostasis and disease transmission, safely, competently and methodically for valid and reliable collection of data. (ACSBL098)
- Represent data in meaningful and useful ways, including the use of mean, median, range and probability; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions. (ACSBL099)

Evaluation of inquiry

- Interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments. (ACSBL100)

- Select, construct and use appropriate representations, including diagrams and flow charts, to communicate conceptual understanding, solve problems and make predictions. (ACSBL101)
- Communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports. (ACSBL102)