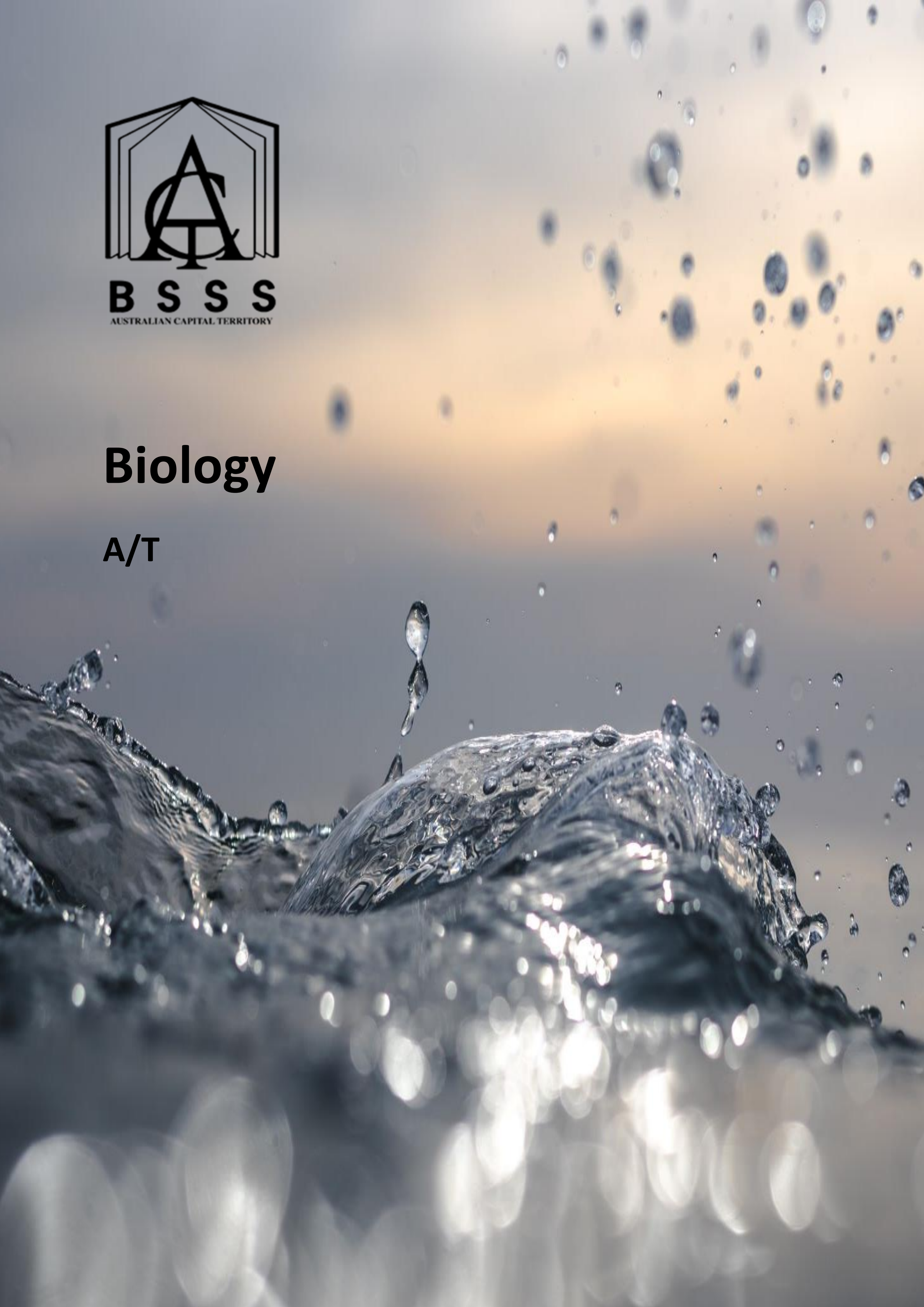
BSSS
AUSTRALIAN CAPITAL TERRITORY

Biology

A/T



Cover Art provided by Canberra College student Aidan Giddings

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The ACT Senior Secondary System

The ACT senior secondary system recognises a range of university, vocational or life skills pathways.

The system is based on the premise that teachers are experts in their area: they know their students and community and are thus best placed to develop curriculum and assess students according to their needs and interests. Students have ownership of their learning and are respected as young adults who have a voice.

A defining feature of the system is school-based curriculum and continuous assessment. School-based curriculum provides flexibility for teachers to address students' needs and interests. College teachers have an opportunity to develop courses for implementation across ACT schools. Based on the courses that have been accredited by the BSSS, college teachers are responsible for developing programs of learning. A program of learning is developed by individual colleges to implement the courses and units they are delivering.

Teachers must deliver all content descriptions; however, they do have flexibility to emphasise some content descriptions over others. It is at the discretion of the teacher to select the texts or materials to demonstrate the content descriptions. Teachers can choose to deliver course units in any order and teach additional (not listed) content provided it meets the specific unit goals.

School-based continuous assessment means that students are continually assessed throughout years 11 and 12, with both years contributing equally to senior secondary certification. Teachers and students are positioned to have ownership of senior secondary assessment. The system allows teachers to learn from each other and to refine their judgement and develop expertise.

Senior secondary teachers have the flexibility to assess students in a variety of ways. For example: multimedia presentation, inquiry-based project, test, essay, performance and/or practical demonstration may all have their place. College teachers are responsible for developing assessment instruments with task specific rubrics and providing feedback to students.

The integrity of the ACT Senior Secondary Certificate is upheld by a robust, collaborative and rigorous structured consensus-based peer reviewed moderation process. System moderation involves all Year 11 and 12 teachers from public, non-government and international colleges delivering the ACT Senior Secondary Certificate.

Only students who desire a pathway to university are required to sit a general aptitude test, referred to as the ACT Scaling Test (AST), which moderates student course scores across subjects and colleges. Students are required to use critical and creative thinking skills across a range of disciplines to solve problems. They are also required to interpret a stimulus and write an extended response.

Senior secondary curriculum makes provision for student-centred teaching approaches, integrated and project-based learning inquiry, formative assessment and teacher autonomy. ACT Senior Secondary Curriculum makes provision for diverse learners and students with mild to moderate intellectual disabilities, so that all students can achieve an ACT Senior Secondary Certificate.

The ACT Board of Senior Secondary Studies (BSSS) leads senior secondary education. It is responsible for quality assurance in senior secondary curriculum, assessment and certification. The Board consists of representatives from colleges, universities, industry, parent organisations and unions. The Office of the Board of Senior Secondary Studies (OBSSS) consists of professional and administrative staff who support the Board in achieving its objectives and functions.

ACT Senior Secondary Certificate

Courses of study for the ACT Senior Secondary Certificate:

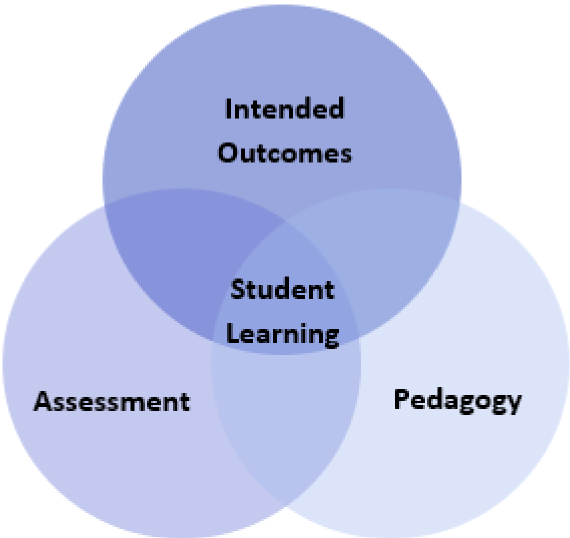
- provide a variety of pathways, to meet different learning needs and encourage students to complete their secondary education
- enable students to develop the essential capabilities for twenty-first century learners
- empower students as active participants in their own learning
- engage students in contemporary issues relevant to their lives
- foster students' intellectual, social and ethical development
- nurture students' wellbeing, and physical and spiritual development
- enable effective and respectful participation in a diverse society.

Each course of study:

- comprises an integrated and interconnected set of knowledge, skills, behaviours and dispositions that students develop and use in their learning across the curriculum
- is based on a model of learning that integrates intended student outcomes, pedagogy and assessment
- outlines teaching strategies which are grounded in learning principles and encompass quality teaching
- promotes intellectual quality, establish a rich learning environment and generate relevant connections between learning and life experiences
- provides formal assessment and certification of students' achievements.

Underpinning beliefs

- All students are able to learn.
- Learning is a partnership between students and teachers.
- Teachers are responsible for advancing student learning.



Learning Principles

1. Learning builds on existing knowledge, understandings and skills.
   (Prior knowledge)
2. When learning is organised around major concepts, principles and significant real-world issues, within and across disciplines, it helps students make connections and build knowledge structures.
   (Deep knowledge and connectedness)
3. Learning is facilitated when students actively monitor their own learning and consciously develop ways of organising and applying knowledge within and across contexts.
   (Metacognition)
4. Learners' sense of self and motivation to learn affects learning.
   (Self-concept)
5. Learning needs to take place in a context of high expectations.
   (High expectations)
6. Learners learn in different ways and at different rates.
   (Individual differences)
7. Different cultural environments, including the use of language, shape learners' understandings and the way they learn.
   (Socio-cultural effects)
8. Learning is a social and collaborative function as well as an individual one.
   (Collaborative learning)
9. Learning is strengthened when learning outcomes and criteria for judging learning are made explicit and when students receive frequent feedback on their progress.
   (Explicit expectations and feedback)

General Capabilities

All courses of study for the ACT Senior Secondary Certificate should enable students to develop essential capabilities for twenty-first century learners. These 'capabilities' comprise an integrated and interconnected set of knowledge, skills, behaviours and dispositions that students develop and use in their learning across the curriculum.

The capabilities include:

- literacy
- numeracy
- information and communication technology (ICT)
- critical and creative thinking
- personal and social
- ethical behaviour
- intercultural understanding

Courses of study for the ACT Senior Secondary Certificate should be both relevant to the lives of students and incorporate the contemporary issues they face. Hence, courses address the following three priorities. These priorities are:

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

Elaboration of these General Capabilities and priorities is available on the ACARA website at www.australiancurriculum.edu.au.

Literacy

Literacy is important in students' development of *Science Inquiry Skills* and their understanding of content presented through the *Science Understanding* and *Science as a Human Endeavour* strands. Students gather, interpret, synthesise and critically analyse information presented in a wide range of genres, modes and representations (including text, flow diagrams, symbols, graphs and tables). They evaluate information sources and compare and contrast ideas, information and opinions presented within and between texts. They communicate processes and ideas logically and fluently and structure evidence-based arguments, selecting genres and employing appropriate structures and features to communicate for specific purposes and audiences.

Numeracy

Numeracy is key to students' ability to apply a wide range of *Science Inquiry Skills*, including making and recording observations; ordering, representing and analysing data; and interpreting trends and relationships. They employ numeracy skills to interpret complex spatial and graphic representations, and to appreciate the ways in which biological systems are structured, interact and change across spatial and temporal scales. They engage in analysis of data, including issues relating to reliability and probability, and they interpret and manipulate mathematical relationships to calculate and predict values.

Information and Communication Technology (ICT)

Information and Communication Technology (ICT) capability is a key part of *Science Inquiry Skills*. Students use a range of strategies to locate, access and evaluate information from multiple digital sources; to collect, analyse and represent data; to model and interpret concepts and relationships; and to communicate and share science ideas, processes and information. Through exploration of *Science as a Human Endeavour* concepts, students assess the impact of ICT on the development of science and the application of science in society, particularly with regard to collating, storing, managing and analysing large data sets.

Critical and Creative Thinking

Critical and creative thinking is particularly important in the science inquiry process. Science inquiry requires the ability to construct, review and revise questions and hypotheses about increasingly complex and abstract scenarios and to design related investigation methods. Students interpret and evaluate data; interrogate, select and cross-reference evidence; and analyse processes, interpretations, conclusions and claims for validity and reliability, including reflecting on their own processes and conclusions. Science is a creative endeavour and students devise innovative solutions to problems, predict possibilities, envisage consequences and speculate on possible outcomes as they develop *Science Understanding* and *Science Inquiry Skills.* They also appreciate the role of critical and creative individuals and the central importance of critique and review in the development and innovative application of science.

Personal and Social Capability

Personal and social capability is integral to a wide range of activities in Biology, as students develop and practise skills of communication, teamwork, decision-making, initiative-taking and self-discipline with increasing confidence and sophistication. In particular, students develop skills in both independent and collaborative investigation; they employ self-management skills to plan effectively, follow procedures efficiently and work safely; and they use collaboration skills to conduct investigations, share research and discuss ideas. In considering aspects of *Science as a Human Endeavour,* students also recognise the role of their own beliefs and attitudes in their response to science issues and applications, consider the perspectives of others, and gauge how science can affect people's lives.

Ethical Understanding

Ethical understanding is a vital part of science inquiry. Students evaluate the ethics of experimental science, codes of practice, and the use of scientific information and science applications. They explore what integrity means in science, and they understand, critically analyse and apply ethical guidelines in their investigations. They consider the implications of their investigations on others, the environment and living organisms. They use scientific information to evaluate the claims and actions of others and to inform ethical decisions about a range of social, environmental and personal issues and applications of science.

Intercultural Understanding

Intercultural understanding is fundamental to understanding aspects of *Science as a Human Endeavour*, as students appreciate the contributions of diverse cultures to developing science understanding and the challenges of working in culturally diverse collaborations. They develop awareness that raising some debates within culturally diverse groups requires cultural sensitivity, and they demonstrate open-mindedness to the positions of others. Students also develop an understanding that cultural factors affect the ways in which science influences and is influenced by society.

Cross-Curriculum Priorities

While the significance of the cross-curriculum priorities for Biology varies, there are opportunities for teachers to select contexts that incorporate the key concepts from each priority.

Aboriginal and Torres Strait Islander Histories and Cultures

Through an investigation of contexts that draw on Aboriginal and Torres Strait Islander histories and cultures students could investigate the importance of Aboriginal and Torres Strait Islander Peoples' knowledge in developing a richer understanding of the Australian environment. Students could develop an appreciation of the unique Australian biota and its interactions, the impacts of Aboriginal and Torres Strait Islander Peoples on their environments and the ways in which the Australian landscape has changed over tens of thousands of years. They could examine the ways in which Aboriginal and Torres Strait Islander knowledge of ecosystems has developed over time and the spiritual significance of Country/Place.

Asia and Australia's Engagement with Asia

Contexts that draw on Asian scientific research and development and collaborative endeavours in the Asia Pacific region provide an opportunity for students to investigate Asia and Australia's engagement with Asia. Students could explore the diverse environments of the Asia region and develop an appreciation that interaction between human activity and these environments continues to influence the region, including Australia, and has significance for the rest of the world. By examining developments in biological science, students could appreciate that the Asia region plays an important role in scientific research and development, including through collaboration with Australian scientists, in such areas as medicine, natural resource management, biosecurity and food security.

Sustainability

The Sustainability cross-curriculum priority is explicitly addressed in the Biology curriculum. Biology provides authentic contexts for exploring, investigating and understanding the function and interactions of biotic and abiotic systems across a range of spatial and temporal scales. By investigating the relationships between biological systems and system components, and how systems respond to change, students develop an appreciation for the interconnectedness of the biosphere. Students appreciate that biological science provides the basis for decision making in many areas of society and that these decisions can impact the Earth system. They understand the importance of using science to predict possible effects of human and other activity, and to develop management plans or alternative technologies that minimise these effects and provide for a more sustainable future.

AC Biology

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Rationale

Biology is the study of the fascinating diversity of life as it has evolved and as it interacts and functions. Investigation of biological systems and their interactions, from cellular processes to ecosystem dynamics, has led to biological knowledge and understanding that enable us to explore and explain everyday observations, find solutions to biological issues, and understand the processes of biological continuity and change over time.

Living systems are all interconnected and interact at a variety of spatial and temporal scales, from the molecular level to the ecosystem level. Investigation of living systems involves classification of key components within the system, and analysis of how those components interact, particularly with regard to the movement of matter and the transfer and transformation of energy within and between systems. Analysis of the ways living systems change over time involves understanding of the factors that impact the system, and investigation of system mechanisms to respond to internal and external changes and ensure continuity of the system. The theory of evolution by natural selection is critical to explaining these patterns and processes in biology and underpins the study of all living systems.

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. Students 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.

This subject 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. Students 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.

Studying Senior Secondary Science provides students with a suite of skills and understandings that are valuable to a wide range of further study pathways and careers. Understanding of biological concepts, as well as general science knowledge and skills, is relevant to a range of careers, including those in medical, veterinary, food and marine sciences, agriculture, biotechnology, environmental rehabilitation, biosecurity, quarantine, conservation and eco-tourism. This subject will also provide a foundation for students to critically consider and to make informed decisions about contemporary biological issues in their everyday lives.

Goals

Biology aims to develop students

- sense of wonder and curiosity about life and respect for all living things and the environment
- understanding of how biological systems interact and are interrelated; the flow of matter and energy through and between these systems; and the processes by which they persist and change
- understanding of major biological concepts, theories and models related to biological systems at all scales, from subcellular processes to ecosystem dynamics
- appreciation of how biological knowledge has developed over time and continues to develop; how scientists use biology in a wide range of applications; and how biological knowledge influences society in local, regional and global contexts
- ability to plan and carry out fieldwork, laboratory and other research investigations including the collection and analysis of qualitative and quantitative data and the interpretation of evidence
- ability to use sound, evidence-based arguments creatively and analytically when evaluating claims and applying biological knowledge
- ability to communicate biological understanding, findings, arguments and conclusions using appropriate representations, modes and genres.

Student Group

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 $<, >, \Delta, \approx$
- 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.

Unit Titles

- Biodiversity and Interconnectedness
- Cells and Multicellular Organisms
- Heredity and Continuity of Life
- Maintaining the Internal Environment.

Organisation of Content

In Biology, students develop their understanding of biological systems, the components of these systems and their interactions, how matter flows and energy is transferred and transformed in these systems, and the ways in which these systems are affected by change at different spatial and temporal scales. There are four units:

Units 1 and 2 - Biodiversity and Interconnectedness / Cells and Multicellular Organisms

In these 2 units, students build on prior learning to develop their understanding of relationships between structure and function in a range of biological systems, from ecosystems to single cells and multicellular organisms. In *Biodiversity and Interconnectedness*, students analyse abiotic and biotic ecosystem components and their interactions, using classification systems for data collection, comparison and evaluation. In *Cells and Multicellular Organisms*, students investigate the interdependent components of the cell system and the multiple interacting systems in multicellular organisms.

Units 3 and 4 - Heredity and Continuity of Life / Maintaining the Internal Environment

In these units, students examine the continuity of biological systems and how they change over time in response to external factors. They examine and connect system interactions at the molecular level to system change at the organism and population levels. In *Heredity and Continuity of Life*, students investigate mechanisms of heredity and the ways in which inheritance patterns can be explained, modelled and predicted; they connect these patterns to population dynamics and apply the theory of evolution by natural selection in order to examine changes in populations. In *Maintaining the Internal Environment*, students investigate system change and continuity in response to changing external conditions and pathogens; they investigate homeostasis and the transmission and impact of infectious disease at cellular and organism levels; and they consider the factors that encourage or reduce the spread of infectious disease at the population level.

Each unit includes:

- Unit descriptions – short descriptions of the purpose of and rationale for each unit
- Learning outcomes – six to eight statements describing the learning expected as a result of studying the unit
- Content descriptions – descriptions of the core content to be taught and learned, organised into three strands:
    - Science Inquiry Skills
    - Science as a Human Endeavour
    - Science Understanding (organised in sub-units).

Assessment

The identification of criteria within the achievement standards, and assessment tasks types and weightings, provide a common and agreed basis for the collection of evidence of student achievement.

Assessment Criteria (the dimensions of quality that teachers look for in evaluating student work) provide a common and agreed basis for judgement of performance against unit and course goals, within and across colleges. Over a course, teachers must use all these criteria to assess students' performance but are not required to use all criteria on each task. Assessment criteria are to be used holistically on a given task and in determining the unit grade.

Assessment Tasks elicit responses that demonstrate the degree to which students have achieved the goals of a unit based on the assessment criteria. The Common Curriculum Elements (CCE) is a guide to developing assessment tasks that promote a range of thinking skills (see Appendix C). It is highly desirable that assessment tasks engage students in demonstrating higher order thinking.

Rubrics are constructed for individual tasks, informing the assessment criteria relevant for a particular task and can be used to assess a continuum that indicates levels of student performance against each criterion.

Assessment Criteria

Students will be assessed on the degree to which they demonstrate an understanding of:

- concepts, models and application
- contexts
- inquiry skills.

Assessment Task Types

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Suggested tasks

Individual tasks may incorporate one or more of the following:

- models
- commentary
- debate
- portfolio/journal
- field work
- investigation
- document/source analysis
- practical report
- role play
- research report
- test/quiz
- seminar/workshop/lecture
- poster
- response to stimulus
- essay
- multimedia presentation
- creative response
- interview
- discussion forum
- rationale/validation
- practical skills

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<tr><td>It is recommended that a student conceived investigation be undertaken at least once during a minor and twice during a major. This investigation may either be theoretical or practical, or a combination of both.</td></tr>
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Weightings in A/T/M 1.0 and 0.5 Units:

No task to be weighted more than 45% for a standard 1.0 unit.

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Additional Assessment Information

Requirements

- For a standard unit (1.0), students must complete a minimum of three assessment tasks and a maximum of five.
- For a half standard unit (0.5), students must complete a minimum of two and a maximum of three assessment tasks.
- Students must experience a variety of task types and different modes of communication to demonstrate the Achievement Standards in both theoretical and practical tasks.
- All Achievement Standards must be demonstrated in standard (1.0) or half-standard (0.5) units.
- Task types need to be selected to address all Achievement Standards within the Concepts, Models and Applications, Contexts and Inquiry Skills strands across a standard (1.0) or half-standard (0.5) unit.
- For tasks completed in unsupervised conditions, schools need to have mechanisms to uphold academic integrity, for example: student declaration, plagiarism software, oral defence, interview, or other validation tasks.

Achievement Standards

Years 11 and 12 achievement standards are written for A/T courses. A single achievement standard is written for M courses.

A Year 12 student in any unit is assessed using the Year 12 achievement standards. A Year 11 student in any unit is assessed using the Year 11 achievement standards. Year 12 achievement standards reflect higher expectations of student achievement compared to the Year 11 achievement standards. Years 11 and 12 achievement standards are differentiated by cognitive demand, the number of dimensions and the depth of inquiry.

An achievement standard cannot be used as a rubric for an individual assessment task. Assessment is the responsibility of the college. Student tasks may be assessed using rubrics or marking schemes devised by the college. A teacher may use the achievement standards to inform development of rubrics. The verbs used in achievement standards may be reflected in the rubric. In the context of combined Years 11 and 12 classes, it is best practice to have a distinct rubric for Years 11 and 12. These rubrics should be available for students prior to completion of an assessment task so that success criteria are clear.

BSSS Achievement Standards for Science A Course – Year 11

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models and	• analyses the fundamental properties and functions of system components, processes and interactions, and how they are affected by factors across a range of temporal and spatial scales	• explains the fundamental properties and functions of system components, processes and interactions, and how they are affected by factors across a range of temporal and spatial scales	• describes the fundamental properties and functions of system components, processes and interactions, and how they are affected by factors across a range of temporal and spatial scales	• identifies the fundamental properties and functions with some identification of system components and factors that affect processes across a range of temporal and spatial scales	• identifies the fundamental properties and functions with little or no identification of system components, processes, interactions and contextual scales
	• analyses the nature, functions, limitations and applications of theories and models using evidence, in unfamiliar contexts	• explains the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts	• describes the nature, functions, limitations and applications of theories and models with supporting evidence	• identifies the nature, functions, applications, and some possible limitations of theories and models, with some evidence	• identifies the nature, function of theories and models, with an assertion of a few possible limitations
	• assesses evidence with reference to models and/or theories, and develops evidence-based conclusions and assesses limitations	• explains evidence with reference to models and/or theories, and develops evidence-based conclusions and explains limitations	• describes evidence with reference to models and/or theories, and develops evidence-based conclusions and describes limitations	• identifies evidence, and develops conclusions with some reference to models and/or theories	• identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• analyses how the practice and applications of science meet needs, make decisions; and is influenced by social, economic, technological, and ethical factors	• explains how the practice and applications of science meet needs, make decisions, and is influenced by social, economic, technological, and ethical factors	• describes how the applications of science meet needs, make decisions, and is influenced by social, economic, technological, and ethical factors	• identifies ways in the applications of science meet needs, and is influenced by some factors	• identifies ways in which the application of science has been used in society to meet needs
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that efficiently collect valid and reliable data in response to a complex question	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid data in response to a complex question	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a question	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a question with varying success	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question
	• analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and analyses errors	• explains causal and correlational relationships, anomalies, reliability and validity of data and representations, and explains errors	• describes relationships in data sets, reliability and validity of data and representations, and describes common errors	• identifies trends and anomalies in data and representations, with general comments about errors	• identifies trends in data and representations, with little or no reference to anomalies and errors
	• assesses processes and claims, provides a critique based on evidence, and discusses alternatives	• explains processes and claims, provides a critique with reference to evidence, and identifies alternatives	• describes processes and claims, and identifies alternatives with some reference to evidence	• identifies processes and claims, and identifies the need for improvements with some reference to evidence	• identifies processes and the need for some improvements, with little or no reference to evidence
	• reflects with insight on their own thinking and learning and evaluates planning, time management and use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking and analyses planning, time management, use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking and explains planning, time management, use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking with some reference to planning, time management, use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking with little or no reference to planning, time management, use of appropriate strategies to work independently and collaboratively
	• communicates concisely, effectively and accurately, demonstrating scientific literacy in a range of modes, styles, representations, and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates clearly and accurately, demonstrating scientific literacy in a range of modes, styles, representations and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates accurately demonstrating scientific literacy, in a range of modes, styles, representations, and genres for specific purposes, with appropriate evidence and mostly consistent referencing	• communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

BSSS Achievement Standards for Science T Course – Year 11

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models and	• evaluates the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales	• analyses the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales	• explains the fundamental properties and functions of system components, processes and interactions and the effects of factors across a range of scales	• describes the fundamental properties and functions, and with some description of system components, processes and interactions, and the effects of factors across a range of scales	• identifies the fundamental properties and functions of system and identifies components, processes and interactions, and the effects of factors across a range of scales
	• evaluates the nature, functions, limitations and applications of theories and models using evidence, in unfamiliar contexts	• analyses the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts	• explains the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts	• describes the nature, functions, limitations and applications of theories and models with supporting evidence	• identifies the nature, functions, applications, and some possible limitations of theories and models, with some evidence
	• analyses evidence with reference to models and/or theories, and develops evidence-based conclusions and evaluates limitations	• assesses evidence with reference to models and/or theories, and develops evidence-based conclusions and discusses limitations	• explains evidence with reference to models and/or theories, and develops evidence-based conclusions and identifies limitations	• describes evidence, and develops conclusions with some reference to models and/or theories	• identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• evaluates epistemology, role of peer review, collaboration and technology in developing knowledge	• analyses epistemology, role of peer review and technology in developing knowledge	• explain epistemology, role of peer review and technology in developing knowledge	• describes the role of peer review in developing knowledge	• identifies that scientific knowledge has changed over time
	• evaluates the influence of social, economic, ethical and cultural factors on Science	• analyses the influence of social, economic, ethical and cultural factors on Science	• explains the influence of social, economic, ethical and cultural factors on Science	• describes the influence of social, economic, ethical and cultural factors on Science	• identifies the influence of social, economic, ethical and cultural factors on Science
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that collect valid, reliable data in response to a complex question	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid, reliable data in response to a question	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a familiar question	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a simple question with varying success	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question
	• analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and analyses errors	• analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and discusses errors	• explains causal and correlational relationships, anomalies, reliability and validity of data and representations, and cites common errors	• describes trends, relationships and anomalies in data, identifies anomalies, and some possible sources of error	• identifies trends and relationships in data, with little or no reference to sources of error
	• analyses processes and claims, and provides a critique based on evidence, and analyses alternatives	• assesses processes and claims, and provides a critique with reference to evidence, and analyses alternatives	• explains processes and claims, and identifies alternatives with reference to reliable evidence	• describes processes and claims, and identifies the need for improvements with some reference to evidence	• identifies processes and the need for some improvements, with little or no reference to evidence
	• reflects with insight on own thinking and that of others, and evaluates planning, time management, and use of appropriate work strategies to work independently and collaboratively	• reflects on their own thinking and analyses planning, time management, use of appropriate work strategies to work independently and collaboratively	• reflects on their own thinking and explains planning, time management, use of appropriate work strategies to work independently and collaboratively	• reflects on their own thinking, with reference to planning and the use of appropriate work strategies to work independently and collaboratively	• reflects on their own thinking with little or no reference to planning, time management, and use of work strategies to work independently and collaboratively
	• communicates concisely, effectively and accurately, demonstrating scientific literacy in a range of modes, styles, representations, and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates clearly and accurately, demonstrating scientific literacy in a range of modes, styles, representations and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates accurately demonstrating scientific literacy, in a range of modes, styles, representations, and genres for specific purposes, with appropriate evidence and mostly consistent referencing	• communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

BSSS Achievement Standards for Science A Course – Year 12

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models and Applications	• analyses the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales	• explains the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales	• describes the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales	• describes the fundamental properties and functions of system components, processes and interactions, and the effects of one or more factors	• identifies the fundamental properties and functions of system components, processes and interactions, and the effects of factors
	• analyse the nature, functions, limitations and applications of theories and models using evidence, in unfamiliar contexts	• explains the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts	• describes the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts	• describes the nature, functions, limitations and applications of theories and models with supporting evidence	• identifies the nature, functions, applications, and some limitations of theories and models with some evidence
	• assesses evidence with reference to models and/or theories, and develops evidence-based conclusions and evaluates limitations	• explains evidence with reference to models and/or theories, and develops evidence-based conclusions and discusses limitations	• describes evidence with reference to models and/or theories, and develops evidence-based conclusions and identifies limitations	• describes evidence, and develops conclusions with some reference to models and/or theories	• identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• analyses epistemology, role of peer review, collaboration and technology in developing knowledge	• explains epistemology, role of peer review and technology in developing knowledge	• describes epistemology, role of peer review and technology in developing knowledge	• describes role of peer review and technology in developing knowledge	• identifies that scientific knowledge has changed over time
	• analyses the influence of social, economic, ethical and cultural factors on Science	• explains the influence of social, economic, ethical and cultural factors on Science	• describes the influence of social, economic, ethical and cultural factors on Science	• describes the influence of social, economic, ethical and cultural factors on Science	• identifies the influence of social, economic, ethical and cultural factors on Science
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that collect valid, reliable data in response to a complex question	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid, reliable data in response to a question	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a familiar question	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a simple question with varying success	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question
	• analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and analyses errors	• analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and discusses errors	• describes causal and correlational relationships, anomalies, reliability and validity of data and representations, and cites common errors	• describes trends, relationships and anomalies in data, identifies anomalies, and some possible sources of error	• identifies trends and relationships in data, with little or no reference to sources of error
	• analyses processes and claims, and provides a critique based on evidence, and analyses alternatives	• explains processes and claims, and provides a critique with reference to evidence, and proposes alternatives	• describes processes and claims, and identifies alternatives with reference to reliable evidence	• describes processes and claims, and identifies the need for improvements with some reference to evidence	• identifies processes and the need for some improvements, with little or no reference to evidence
	• reflects with insight on own thinking and that of others and, evaluates planning, time management and use of appropriate independent and collaborative work strategies	• reflects on their own thinking and analyses planning, time management, and use of appropriate independent and collaborative work strategies	• reflects on their own thinking and explains planning, time management, and use of appropriate independent and collaborative work strategies	• reflects on their own thinking, with reference to planning and the use of appropriate independent and collaborative work strategies	• reflects on their own thinking with little or no reference to planning, time management, and use of appropriate independent and collaborative work strategies
	• communicates concisely, effectively and accurately, demonstrating scientific literacy in a range of modes, styles, representations, and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates clearly and accurately, demonstrating scientific literacy in a range of modes, styles, representations and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates accurately demonstrating scientific literacy, in a range of modes, styles, representations, and genres for specific purposes, with appropriate evidence and mostly consistent referencing	• communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

BSSS Achievement Standards for Science T Course – Year 12

	A student who achieves an **A** grade typically	A student who achieves a **B** grade typically	A student who achieves a **C** grade typically	A student who achieves a **D** grade typically	A student who achieves an **E** grade typically
Concepts, Models and Applications	• evaluates the properties and functions of system components, processes and interactions, and the interplay and effects of factors across a range of scales	• analyses the properties and functions of system components, processes and interactions, and the interplay and effects of factors across a range of scales	• explains the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales	• describes the fundamental properties and functions of system components, processes and interactions, and the effects of one or more factors	• identifies the fundamental properties and functions of system components, processes and interactions, and some affective factors
	• evaluates applications, limitations, and predictions of theories and models to explain systems and create solutions, with evidence, in unfamiliar contexts	• analyses applications, limitations, and predictions of theories and models to explain systems and create plausible solutions, with evidence in familiar contexts	• explains applications, limitations, and predictions of theories and models to explain systems and create plausible solutions in familiar contexts	• describes the nature, functions, limitations and applications of theories and models to create solutions to problems with supporting evidence	• identifies the nature, functions, limitations and applications of theories and models, and suggest solutions to problems with supporting evidence
	• evaluates evidence with reference to analysis of models and/or theories, and develops evidence-based conclusions and evaluates limitations	• analyses evidence with reference to models and/or theories, and develops evidence-based conclusions and discusses limitations	• explains evidence with reference to models and/or theories, and develops evidence-based conclusions and identifies limitations	• describes evidence, and develops conclusions with some reference to models and/or theories	• identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• evaluates epistemology, role of peer review, collaboration, and technology in developing knowledge	• analyses epistemology, role of peer review and technology in developing knowledge	• explains epistemology, role of peer review and technology in developing knowledge	• describes role of peer review and technology in developing knowledge	• identifies that scientific knowledge has changed over time
	• evaluates the influence of social, economic, ethical and cultural factors on Science	• analyses the influence of social, economic, ethical and cultural factors on Science	• explains the influence of social, economic, ethical and cultural factors on Science	• describes the influence of social, economic, ethical and cultural factors on Science	• identifies the influence of social, economic, ethical and cultural factors on Science
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that collect valid, reliable data in response to a complex question	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid, reliable data in response to a question	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a familiar question	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a simple question with varying success	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question
	• evaluates cause and correlation, anomalies, reliability and validity of data and representations, and evaluates errors	• analyses cause and correlation, anomalies, reliability and validity of data and representations, and analyses errors	• explains causal and correlational relationships, anomalies, reliability and validity of data and representations, and discusses common errors	• describes trends, relationships and anomalies in data, identifies anomalies, and cites sources of error	• identifies trends and relationships in data with reference to sources of error
	• evaluates processes and claims, and provides a critique based on evidence, and evaluates alternatives	• analyses processes and claims, and provides a critique with reference to evidence, and analyses alternatives	• explains processes and claims, and identifies alternatives with reference to reliable evidence	• describes processes and claims, and identifies the need for improvements with some reference to evidence	• identifies processes and the need for some improvements, with little or no reference to evidence
	• reflects with insight on own thinking and that of others, evaluates planning, time management, and use of appropriate independent and collaborative work strategies	• reflects on their own thinking and analyses planning, time management, and use of appropriate independent and collaborative work strategies	• reflects on their own thinking and explains planning, time management, and use of appropriate independent and collaborative work strategies	• reflects on their own thinking, with reference to planning and the use of appropriate independent and collaborative work strategies	• reflects on their own thinking with little or no reference to planning, time management, and use of appropriate independent and collaborative work strategies
	• communicates concisely, effectively and accurately, with scientific literacy in a range of modes, representations, and genres for specific audiences and purposes, and accurate referencing	• communicates clearly and accurately, with scientific literacy in a range of modes, representations and genres for specific audiences and purposes, and accurate referencing	• communicates accurately demonstrating scientific literacy, in a range of modes, representations, and genres for specific purposes, and mostly consistent referencing	• communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

Biodiversity and Connectedness — Value 1.0

Biodiversity and the Connectedness a — **Value 0.5**

Biodiversity and the Connectedness b — **Value 0.5**

Unit Description

The current view of the biosphere as a dynamic system composed of Earth's diverse, interrelated and ENG 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 unit, students 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.

Students 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. Students 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, students 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 students 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, students analyse and interpret data collected through investigation of a local environment and from sources relating to other Australian, regional and global environments.

Specific Unit Goals

By the end of this unit, students:

A Course	T Course
• understand how classification helps to organise, identify and communicate data about biodiversity	• 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 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	• 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

A Course	T Course
• use science inquiry skills to conduct, interpret and communicate investigations into biodiversity and flows of matter and energy in a range of ecosystems	• use science inquiry skills to design, conduct, evaluate and communicate investigations into biodiversity and flows of matter and energy in a range of ecosystems
• describe claims about relationships between and within species, diversity of and within ecosystems, and energy and matter flows	• 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 representations in appropriate modes and genres	• communicate biological understanding using qualitative and quantitative representations in appropriate modes and genres

Content Descriptions

Further elaboration of the content of this unit is available on the ACARA Australian Curriculum website.

All knowledge, understanding and skills below must be delivered:

A course	T course
Science Inquiry Skills	
• identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes	• identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes
• conduct 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	• 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
• conduct investigations, including using ecosystem surveying techniques, safely, competently and methodically for the collection of valid and reliable data	• conduct investigations, including using ecosystem surveying techniques, safely, competently and methodically for the collection of valid and reliable data
• represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships	• 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

A course	T course
• interpret a range of scientific and media texts, and describe processes, claims and conclusions with the use of evidence	• 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
• select and use appropriate representations, including classification keys, food webs and biomass pyramids	• select, construct and use appropriate representations, including classification keys, food webs and biomass pyramids, to communicate conceptual understanding, solve problems and make predictions
• communicate to general audiences and use appropriate language, nomenclature, genres and modes, including scientific reports	• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports
Science as a Human Endeavour	
• science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility	• science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility
• recognise that the development of models and/or theories often requires evidence from multiple individuals and disciplines	• development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines
• advances in science understanding in one field which can influence other areas of science, technology and engineering	• advances in science understanding in one field can influence other areas of science, technology and engineering
• the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations	• the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations
• the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences	• the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences
	• scientific knowledge can enable scientists to offer valid explanations and make reliable predictions
• scientific knowledge can be used to predict economic, social and environmental impacts and to modify actions for sustainability	• scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability

A course	T course
Science Understanding	
Describing biodiversity • biodiversity includes the diversity of species and ecosystems; measures of biodiversity rely on classification and are used to make comparisons • biological classification is hierarchical and based on different levels of similarity of physical features, methods of reproduction and molecular sequences • biological classification systems reflect evolutionary relatedness between groups of organisms • most common definitions of species rely on morphological or genetic similarity or the ability to interbreed to produce fertile offspring in natural conditions • ecosystems are diverse, composed of varied habitats and can be described in terms of their component species, species interactions and the abiotic factors that make up the environment • relationships and interactions between species in ecosystems include predation, competition, symbiosis and disease • in addition to biotic factors, abiotic factors including climate and substrate can be used to describe and classify environments	**Describing biodiversity** • biodiversity includes the diversity of species and ecosystems; measures of biodiversity rely on classification and are used to make comparisons across spatial and temporal scales • biological classification is hierarchical and based on different levels of similarity of physical features, methods of reproduction and molecular sequences • biological classification systems reflect evolutionary relatedness between groups of organisms • most common definitions of species rely on morphological or genetic similarity or the ability to interbreed to produce fertile offspring in natural conditions – but, in all cases, exceptions are found • ecosystems are diverse, composed of varied habitats and can be described in terms of their component species, species interactions and the abiotic factors that make up the environment • relationships and interactions between species in ecosystems include predation, competition, symbiosis and disease • in addition to biotic factors, abiotic factors including climate and substrate can be used to describe and classify environments
Ecosystem dynamics • the biotic components of an ecosystem transfer and transform energy originating primarily from the sun to produce biomass, and interact with abiotic components to facilitate carbon and nitrogen cycling; these interactions can be represented using food webs, biomass pyramids, water and nutrient cycles • species or populations, including those of microorganisms, fill specific ecological niches	**Ecosystem dynamics** • the biotic components of an ecosystem transfer and transform energy originating primarily from the sun to produce biomass, and interact with abiotic components to facilitate biogeochemical cycling, including carbon and nitrogen cycling; these interactions can be represented using food webs, biomass pyramids, water and nutrient cycles • species or populations, including those of microorganisms, fill specific ecological niches; the competitive exclusion principle postulates that no two species can occupy the same niche in the same environment for an extended period of time

A course	T course
• keystone species play a critical role in maintaining the structure of the community	• keystone species play a critical role in maintaining the structure of the community; the impact of a reduction in numbers or the disappearance of keystone species on an ecosystem is greater than would be expected based on their relative abundance or total biomass
• ecosystems have carrying capacities that limit the number of organisms (within populations) they support, and can be impacted by changes to abiotic and biotic factors, including climatic events	• ecosystems have carrying capacities that limit the number of organisms (within populations) they support, and can be impacted by changes to abiotic and biotic factors, including climatic events
• ecological succession involves changes in the populations of species present in a habitat; these changes impact the abiotic and biotic interactions in the community, which in turn influence further changes in the species present and their population size	• ecological succession involves changes in the populations of species present in a habitat; these changes impact the abiotic and biotic interactions in the community, which in turn influence further changes in the species present and their population size
• ecosystems can change dramatically over time; the fossil record and sedimentary rock characteristics provide evidence of past ecosystems and changes in biotic and abiotic components	• ecosystems can change dramatically over time; the fossil record and sedimentary rock characteristics provide evidence of past ecosystems and changes in biotic and abiotic components
• human activities can reduce biodiversity and can impact on the magnitude, duration and speed of ecosystem change	• human activities (for example, over-exploitation, habitat destruction, monocultures, pollution) can reduce biodiversity and can impact on the magnitude, duration and speed of ecosystem change
• models of ecosystem interactions (for example, food webs, successional models) can be used to predict the impact of change	• models of ecosystem interactions (for example, food webs, successional models) can be used to predict the impact of change and are based on interpretation of and extrapolation from sample data (for example, data derived from ecosystem surveying techniques); the reliability of the model is determined by the representativeness of the sampling

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasis some content descriptions over others. The teacher may teach additional (not listed) content provided it meets the specific unit goals. This will be informed by the student needs and interests.

Assessment

Refer to pages 11-13.

Cells and Organisms Value 1.0

Cells and Organisms a Value 0.5

Cells and Organisms b Value 0.5

Unit Description

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 unit, students 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. Students investigate the ways in which matter moves and energy is transformed and transferred in the biochemical processes of photosynthesis and respiration, and the role of enzymes in controlling biochemical systems.

Multicellular organisms typically consist of a number of interdependent systems of cells organised into tissues, organs and organ systems. Students 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, students 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.

Students 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 and tissues. Students 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.

Specific Unit Goals

By the end of this unit, students:

A course	T course
• 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 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	• 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 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

A course	T course
• use science inquiry skills to conduct, interpret and communicate investigations into the structure and function of cells and multicellular organisms • describe claims about cellular processes and the structure and function of multicellular organisms • communicate biological understanding using qualitative representations in appropriate modes and genres	• use science inquiry skills to design, conduct, evaluate and communicate investigations into the structure and function of cells and multicellular organisms • evaluate, with reference to empirical evidence, claims about cellular processes and the structure and function of multicellular organisms • communicate biological understanding using qualitative and quantitative representations in appropriate modes and genres

Content Descriptions

Further elaboration of the content of this unit is available on the ACARA Australian Curriculum website.

All knowledge, understanding and skills below must be delivered:

A Course	T Course
Science Inquiry Skills	
• identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes • conduct 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 • conduct investigations, including microscopy techniques, real or virtual dissections and chemical analysis, safely, competently and methodically for the collection of valid and reliable data • represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships	• identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes • 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 • conduct investigations, including microscopy techniques, real or virtual dissections and chemical analysis, safely, competently and methodically for the collection of valid and reliable data • 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

A Course	T Course
• interpret a range of scientific and media texts, and describe processes, claims and conclusions by considering evidence	• 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
• select and use appropriate representations, including diagrams of structures and processes; and images from different imaging techniques	• 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
• communicate to general audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports	• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports
Science as a Human Endeavour	
• science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility	• science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility
• development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines	• development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines
• advances in science understanding in one field can influence other areas of science, technology and engineering	• advances in science understanding in one field can influence other areas of science, technology and engineering
• the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations	• the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations
	• the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences
• scientific knowledge can enable scientists to offer reliable explanations and make reliable predictions	• scientific knowledge can enable scientists to offer reliable explanations and make reliable predictions
	• scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability

A Course	T Course
Science Understanding	
Cells as the basis of life • cells require inputs of suitable forms of energy, including light energy or chemical energy in complex molecules, and matter, including gases, simple nutrients, ions, and removal of wastes, to survive • the cell membrane separates the cell from its surroundings and controls the exchange of materials, including gases, nutrients and wastes, between the cell and its environment • movement of materials across membranes occurs via diffusion, osmosis, active transport and/or endocytosis • 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 • 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 • in eukaryotic cells, specialised organelles facilitate biochemical processes of photosynthesis, cellular respiration, and the removal of cellular products and wastes • biochemical processes in the cell are controlled by the nature and arrangement of internal membranes, the presence of specific enzymes, and environmental factors • enzymes have specific functions, which can be affected by factors including temperature, ph and the concentrations of reactants and products	**Cells as the basis of life** • cells require inputs of suitable forms of energy, including light energy or chemical energy in complex molecules, and matter, including gases, simple nutrients, ions, and removal of wastes, to survive • the cell membrane separates the cell from its surroundings and controls the exchange of materials, including gases, nutrients and wastes, between the cell and its environment • movement of materials across membranes occurs via diffusion, osmosis, active transport and/or endocytosis • 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 • 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 • 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 • biochemical processes in the cell are controlled by the nature and arrangement of internal membranes, the presence of specific enzymes, and environmental factors • enzymes have specific functions, which can be affected by factors including temperature, ph, the presence of inhibitors, and the concentrations of reactants and products

A Course	T Course
• 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 word chemical equation • cellular respiration is a biochemical process that occurs in different locations. Mitochondria metabolises organic compounds, aerobically or anaerobically, to release useable energy in the form of atp; the overall process can be represented as a word equation	• 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 • 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
Multicellular organisms • multicellular organisms have a hierarchical structural organisation of cells, tissues, organs and systems • the specialised structure and function of tissues, organs and systems can be related to cell differentiation and cell specialisation • in animals, the exchange of gases between the internal and external environments of the organism is facilitated by the structure and function of the respiratory system at cell and tissue levels • in animals, the exchange of nutrients and wastes between the internal and external environments of the organism is facilitated by the structure and function of the cells and tissues of the digestive system (for example, villi structure and function), and the excretory system (for example, nephron structure and function) • in animals, the transport of materials within the internal environment for exchange with cells is facilitated by the structure and function of the circulatory system at cell and tissue levels (for example, the structure and function of capillaries) • 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	**Multicellular organisms** • multicellular organisms have a hierarchical structural organisation of cells, tissues, organs and systems • the specialised structure and function of tissues, organs and systems can be related to cell differentiation and cell specialisation • in animals, the exchange of gases between the internal and external environments of the organism is facilitated by the structure and function of the respiratory system at cell and tissue levels • in animals, the exchange of nutrients and wastes between the internal and external environments of the organism is facilitated by the structure and function of the cells and tissues of the digestive system (for example, villi structure and function), and the excretory system (for example, nephron structure and function) • in animals, the transport of materials within the internal environment for exchange with cells is facilitated by the structure and function of the circulatory system at cell and tissue levels (for example, the structure and function of capillaries) • 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

A Course	T Course
• 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	• 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

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasis some content descriptions over others. The teacher may teach additional (not listed) content provided it meets the specific unit goals. This will be informed by the student needs and interests.

Assessment

Refer to pages 11-13.

Heredity and Continuity of Life — Value 1.0

Heredity and Continuity of Life a — Value 0.5

Heredity and Continuity of Life b — Value 0.5

Unit Description

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 unit, students investigate the biochemical and cellular systems and 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. Students link their observations to explanatory models that describe patterns of inheritance, and explore how the use of predictive models of inheritance enables decision making.

Students 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, students explore the ways in which models and theories related to heredity and population genetics, and associated technologies, 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.

Students 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.

Specific Unit Goals

By the end of this unit, students:

A Course	T Course
• understand the cellular processes and 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	• understand the cellular processes and 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

A Course	T Course
• use science inquiry skills to conduct, interpret and communicate investigations into heredity, gene technology applications, and population gene pool changes	• use science inquiry skills to design, conduct, evaluate and communicate investigations into heredity, gene technology applications, and population gene pool changes
• describe claims about heredity processes, gene technology, and population gene pool processes, and justify evaluations	• 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 representations in appropriate modes and genres	• communicate biological understanding using qualitative and quantitative representations in appropriate modes and genres

Content Descriptions

Further elaboration of the content of this unit is available on the ACARA Australian Curriculum website.

All knowledge, understanding and skills below must be delivered:

A Course	T Course
Science Inquiry Skills	
• identify, research and construct questions for investigation; propose basic hypotheses; and predict possible outcomes	• identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes
• conduct 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	• 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
• conduct investigations, including the use of probabilities to predict inheritance patterns, real or virtual gel electrophoresis, and population simulations to predict population changes, safely, competently and methodically for the collection of valid and reliable data	• conduct investigations, including the use of probabilities to predict inheritance patterns, real or virtual gel electrophoresis, and population simulations to predict population changes, safely, competently and methodically for the collection of valid and reliable data

A Course	T Course
• represent data in meaningful and useful ways; organise data to identify trends	• 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
• interpret a range of scientific and media texts, and describe processes, claims and conclusions by considering the quality of available evidence	• 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
• select, construct and use appropriate representations, including models of DNA replication, transcription and translation, punnett squares of a specific gene in a population, to communicate understanding	• 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
• communicate to general audiences for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports	• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports
Science as a Human Endeavour	
• ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work • 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 • the acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered • people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk	• ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work • 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 • the acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered • people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk

A Course	T Course
• 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 • international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region • scientific knowledge can be used to develop projected economic, social and environmental impacts and to modify actions for sustainability	• 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 • international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability
Science Understanding	
DNA, genes and the continuity of life • 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 • DNA is a helical double-stranded molecule that occurs bound to proteins in chromosomes in the nucleus, and as unbound circular DNA in prokaryotes • the structural properties of the DNA molecule, including nucleotide composition and pairing and the weak bonds between strands of DNA, allow for replication • genes include ‘coding’ and ‘non-coding’ DNA, and many genes contain information for protein production • protein synthesis involves transcription of a gene into messenger RNA in the nucleus, and translation into an amino acid sequence at the ribosome • proteins, including enzymes, are essential to cell structure and functioning • the phenotypic expression of genes depends on factors controlling transcription and translation during protein synthesis, the products of other genes, and the environment	**DNA, genes and the continuity of life** • 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 • 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 • the structural properties of the DNA molecule, including nucleotide composition and pairing and the weak bonds between strands of DNA, allow for replication • genes include ‘coding’ and ‘non-coding’ DNA, and many genes contain information for protein production • protein synthesis involves transcription of a gene into messenger RNA in the nucleus, and translation into an amino acid sequence at the ribosome • proteins, including enzymes, are essential to cell structure and functioning • the phenotypic expression of genes depends on factors controlling transcription and translation during protein synthesis, the products of other genes, and the environment

A Course	T Course
• 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	• 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 • differential gene expression controls cell differentiation for tissue formation, as well as the structural changes that occur during growth
• variations in the genotype of offspring arise as a result of the processes of meiosis and fertilisation, as well as a result of mutations	• variations in the genotype of offspring arise as a result of the processes of meiosis and fertilisation, as well as a result of mutations
• 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 dominant, autosomal and sex-linked alleles and multiple alleles	• 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 dominant, autosomal and sex-linked alleles and multiple alleles, and polygenic inheritance
• DNA sequencing enables mapping of species genomes; DNA profiling identifies the unique genetic makeup of individuals	• DNA sequencing enables mapping of species genomes; DNA profiling identifies the unique genetic makeup of individuals
• biotechnology can involve the use of bacterial enzymes, plasmids as vectors, and techniques including gel electrophoresis, bacterial transformations and PCR	• biotechnology can involve the use of bacterial enzymes, plasmids as vectors, and techniques including gel electrophoresis, bacterial transformations and PCR
Continuity of life on Earth • life has existed on Earth for approximately 3.5 billion years and has changed and diversified over time • comparative genomics provides evidence for the theory of evolution • natural selection occurs when selection pressures in the environment confer a selective advantage on a specific phenotype to enhance its survival and reproduction	**Continuity of life on Earth** • life has existed on Earth for approximately 3.5 billion years and has changed and diversified over time • comparative genomics provides evidence for the theory of evolution • 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 • 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

A Course	T Course
• mutation is the ultimate source of genetic variation as it introduces new alleles into a population	• mutation is the ultimate source of genetic variation as it introduces new alleles into a population • speciation and macro-evolutionary changes result from an accumulation of micro-evolutionary changes over time • differing selection pressures between geographically isolated populations may lead to allopatric speciation
• populations with reduced genetic diversity face increased risk of extinction	• populations with reduced genetic diversity face increased risk of extinction

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasis some content descriptions over others. The teacher may teach additional (not listed) content provided it meets the specific unit goals. This will be informed by the student needs and interests.

Assessment

Refer to pages 11-13.

The Internal Environment Value 1.0

The Internal Environment a Value 0.5

The Internal Environment b Value 0.5

Unit Description

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 unit, students 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. Students 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, students 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.

Students 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.

Specific Unit Goals

By the end of this unit, students:

A Course	T Course
• 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 conduct, interpret and communicate investigations into organisms' responses to changing environmental conditions and infectious disease	• 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

A Course	T Course
• describe, claims about 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 representations in appropriate modes and genres	• communicate biological understanding using qualitative and quantitative representations in appropriate modes and genres

Content Descriptions

Further elaboration of the content of this unit is available on the ACARA Australian Curriculum website.

All knowledge, understanding and skills below must be delivered:

A course	T course
Science Inquiry Skills	**Science Inquiry Skills**
• identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes	• identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes
• conduct 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	• 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
• conduct investigations, including using models of homeostasis and disease transmission, safely, competently and methodically for valid and reliable collection of data	• conduct investigations, including using models of homeostasis and disease transmission, safely, competently and methodically for valid and reliable collection of data
• organise and interpret data to identify trends	• 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
• interpret a range of scientific and media texts, and describe models, processes, and conclusions by considering the evidence	• 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

A course	T course
	• select, construct and use appropriate representations, including diagrams and flow charts, to communicate conceptual understanding, solve problems and make predictions
• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports	• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports
Science as a Human Endeavour	
• ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work	• ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work
• 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	• 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
• people can use scientific knowledge to inform the monitoring, and assessment of risk	• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk
	• 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
• international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region	• international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region
• scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability	• scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability
Science Understanding	**Science Understanding**
Homeostasis • homeostasis involves a stimulus-response model in which change in external or internal environmental conditions is detected and appropriate responses occur via negative feedback; in vertebrates, receptors and effectors are linked via a control centre by nervous and/or hormonal pathways	**Homeostasis** • homeostasis involves a stimulus-response model in which change in external or internal environmental conditions is detected and appropriate responses occur via negative feedback; in vertebrates, receptors and effectors are linked via a control centre by nervous and/or hormonal pathways

A course	T course
• changes in an organism's metabolic activity, in addition to structural features and changes in physiological processes and behaviour, enable the organism to maintain its internal environment within tolerance limits • neural pathways consist of cells that transport nerve impulses from sensory receptors to neurons and on to effectors • endothermic animals have varying thermoregulatory mechanisms that involve structural features, behavioural responses and physiological and homeostatic mechanisms to control heat exchange and metabolic activity • animals, whether osmoregulators or osmoconformers, and plants, have various mechanisms to maintain water balance that involve structural features, and behavioural, physiological and homeostatic responses	• changes in an organism's metabolic activity, in addition to structural features and changes in physiological processes and behaviour, enable the organism to maintain its internal environment within tolerance limits • neural pathways consist of cells that transport nerve impulses from sensory receptors to neurons and on to effectors; the passage of nerve impulses involves transmission of an action potential along a nerve axon and synaptic transmission by neurotransmitters and signal transduction • endothermic animals have varying thermoregulatory mechanisms that involve structural features, behavioural responses and physiological and homeostatic mechanisms to control heat exchange and metabolic activity • animals, whether osmoregulators or osmoconformers, and plants, have various mechanisms to maintain water balance that involve structural features, and behavioural, physiological and homeostatic responses
Infectious disease • 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 • pathogens include prions, viruses, bacteria, fungi, protists and parasites • pathogens have adaptations that facilitate their entry into cells and tissues and their transmission between hosts; transmission occurs by various mechanisms including through direct contact, contact with body fluids, and via contaminated food, water or disease-specific vectors • 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	**Infectious disease** • 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 • pathogens include prions, viruses, bacteria, fungi, protists and parasites • pathogens have adaptations that facilitate their entry into cells and tissues and their transmission between hosts; transmission occurs by various mechanisms including through direct contact, contact with body fluids, and via contaminated food, water or disease-specific vectors • 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

A course	T course
• all plants and animals have innate (general) immune responses to the presence of pathogens; vertebrates also have adaptive immune responses	• all plants and animals have innate (general) immune responses to the presence of pathogens; vertebrates also have adaptive immune responses
• innate responses in animals target pathogens, including through the inflammation response, which involves the actions of phagocytes	• innate responses in animals target pathogens, including through the inflammation response, which involves the actions of phagocytes, defensins and the complement system
• 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	• 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
• 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)	• 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)
• transmission and spread of disease is facilitated by regional and global movement of organisms	• transmission and spread of disease is facilitated by regional and global movement of organisms
• 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); knowledge of these factors can be used to predict outbreaks and strategies to control the spread of disease	• 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

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasis some content descriptions over others. The teacher may teach additional (not listed) content provided it meets the specific unit goals. This will be informed by the student needs and interests.

Assessment

Refer to pages 11-13.

Appendix A – Implementation Guidelines

Available course patterns

A standard 1.0 value unit is delivered over at least 55 hours. To be awarded a course, students must complete at least the minimum units over the whole minor, major, major/minor or double major course.

Course	Number of standard units to meet course requirements
Minor	Minimum of 2 units
Major	Minimum of 3.5 units

Units in this course can be delivered in any order.

Prerequisites for the course or units within the course

Nil.

Arrangements for students continuing study in this course

Students who studied the previous course may undertake any units in this course provided there is no duplication of content.

Duplication of Content Rules

Students cannot be given credit towards the requirements for a Senior Secondary Certificate for a unit that significantly duplicates content in a unit studied in another course. The responsibility for preventing undesirable overlap of content studied by a student, rests with the principal and the teacher delivering the course. Students will only be given credit for covering the content once.

Guidelines for Delivery

Program of Learning

A program of learning is what a school provides to implement the course for a subject. This meets the requirements for context, scope and sequence set out in the Board endorsed course. Students follow programs of learning in a college as part of their senior secondary studies. The detail, design and layout of a program of learning are a college decision.

The program of learning must be documented to show the planned learning activities and experiences that meet the needs of particular groups of students, taking into account their interests, prior knowledge, abilities and backgrounds. The program of learning is a record of the learning experiences that enable students to achieve the knowledge, understanding and skills of the content descriptions. There is no requirement to submit a program of learning to the OBSSS for approval. The Principal will need to sign off at the end of Year 12 that courses have been delivered as accredited.

Content Descriptions

Are all content descriptions of equal importance? No. It depends on the focus of study. Teachers can customise their program of learning to meet their own students' needs, adding additional content descriptions if desired or emphasising some over others. A teacher must balance student needs with their responsibility to teach all content descriptions. It is mandatory that teachers address all content descriptions and that students engage with all content descriptions.

Half standard 0.5 units

Half standard units appear on the course adoption form but are not explicitly documented in courses. It is at the discretion of the college principal to split a standard 1.0 unit into two half standard 0.5 units. Colleges are required to adopt the half standard 0.5 units. However, colleges are not required to submit explicit documentation outlining their half standard 0.5 units to the BSSS. Colleges must assess students using the half standard 0.5 assessment task weightings outlined in the framework. It is the responsibility of the college principal to ensure that all content is delivered in units approved by the Board.

Moderation

Moderation is a system designed and implemented to:

- provide comparability in the system of school-based assessment
- form the basis for valid and reliable assessment in senior secondary schools
- involve the ACT Board of Senior Secondary Studies and colleges in cooperation and partnership
- maintain the quality of school-based assessment and the credibility, validity and acceptability of Board certificates.

Moderation commences within individual colleges. Teachers develop assessment programs and instruments, apply assessment criteria, and allocate Unit Grades, according to the relevant Course Framework. Teachers within course teaching groups conduct consensus discussions to moderate marking or grading of individual assessment instruments and unit grade decisions.

The Moderation Model

Moderation within the ACT encompasses structured, consensus-based peer review of Unit Grades for all accredited courses, as well as statistical moderation of course scores, including small group procedures, for T courses.

Moderation by Structured, Consensus-based Peer Review

Review is a subcategory of moderation, comprising the review of standards and the validation of Unit Grades. In the review process, Unit Grades, determined for Year 11 and Year 12 student assessment portfolios that have been assessed in schools by teachers under accredited courses, are moderated by peer review against system wide criteria and standards. This is done by matching student performance with the criteria and standards outlined in the unit grade descriptors as stated in the Course Framework. Advice is then given to colleges to assist teachers with, and/or reassure them on, their judgments.

Preparation for Structured, Consensus-based Peer Review

Each year, teachers teaching a Year 11 class are asked to retain originals or copies of student work completed in Semester 2. Similarly, teachers teaching a Year 12 class should retain originals or copies of student work completed in Semester 1. Assessment and other documentation required by the Office of the Board of Senior Secondary Studies should also be kept. Year 11 work from Semester 2 of the previous year is presented for review at Moderation Day 1 in March, and Year 12 work from Semester 1 is presented for review at Moderation Day 2 in August.

In the lead up to Moderation Day, a College Course Presentation (comprised of a document folder and a set of student portfolios) is prepared for each A, T and M course/units offered by the school and is sent in to the Office of the Board of Senior Secondary Studies.

The College Course Presentation

The package of materials (College Course Presentation) presented by a college for review on moderation days in each course area will comprise the following:

- a folder containing supporting documentation as requested by the Office of the Board through memoranda to colleges
- a set of student portfolios containing marked and/or graded written and non-written assessment responses and completed criteria and standards feedback forms. Evidence of all assessment responses on which the unit grade decision has been made is to be included in the student review portfolios.

Specific requirements for subject areas and types of evidence to be presented for each Moderation Day will be outlined by the Board Secretariat through memoranda and Information Papers.

Visual evidence for judgements made about practical performances

(also refer to BSSS Website Guidelines)

It is a requirement that schools' judgements of standards to practical performances (A/T/M) be supported by visual evidence (still photos or video).

The photographic evidence submitted must be drawn from practical skills performed as part of the assessment process.

Teachers should consult the BSSS website for current information regarding all moderation requirements including subject specific and photographic evidence.

Appendix B – Course Developers

Name	College
Naga Thayalakrishnan	Daramalan College
Lynne Bean	Dickson College

Appendix C – Common Curriculum Elements

Common curriculum elements assist in the development of high-quality assessment tasks by encouraging breadth and depth and discrimination in levels of achievement.

Organisers	Elements	Examples
create, compose and apply	apply	ideas and procedures in unfamiliar situations, content and processes in non-routine settings
	compose	oral, written and multimodal texts, music, visual images, responses to complex topics, new outcomes
	represent	images, symbols or signs
	create	creative thinking to identify areas for change, growth and innovation, recognise opportunities, experiment to achieve innovative solutions, construct objects, imagine alternatives
	manipulate	images, text, data, points of view
analyse, synthesise and evaluate	justify	arguments, points of view, phenomena, choices
	hypothesise	statement/theory that can be tested by data
	extrapolate	trends, cause/effect, impact of a decision
	predict	data, trends, inferences
	evaluate	text, images, points of view, solutions, phenomenon, graphics
	test	validity of assumptions, ideas, procedures, strategies
	argue	trends, cause/effect, strengths and weaknesses
	reflect	on strengths and weaknesses
	synthesise	data and knowledge, points of view from several sources
	analyse	text, images, graphs, data, points of view
	examine	data, visual images, arguments, points of view
	investigate	issues, problems
organise, sequence and explain	sequence	text, data, relationships, arguments, patterns
	visualise	trends, futures, patterns, cause and effect
	compare/contrast	data, visual images, arguments, points of view
	discuss	issues, data, relationships, choices/options
	interpret	symbols, text, images, graphs
	explain	explicit/implicit assumptions, bias, themes/arguments, cause/effect, strengths/weaknesses
	translate	data, visual images, arguments, points of view
	assess	probabilities, choices/options
	select	main points, words, ideas in text
identify, summarise and plan	reproduce	information, data, words, images, graphics
	respond	data, visual images, arguments, points of view
	relate	events, processes, situations
	demonstrate	probabilities, choices/options
	describe	data, visual images, arguments, points of view
	plan	strategies, ideas in text, arguments
	classify	information, data, words, images
	identify	spatial relationships, patterns, interrelationships
	summarise	main points, words, ideas in text, review, draft and edit

Appendix D – Glossary of Verbs

Verbs	Definition
Analyse	Consider in detail for the purpose of finding meaning or relationships, and identifying patterns, similarities and differences
Apply	Use, utilise or employ in a particular situation
Argue	Give reasons for or against something
Assess	Make a Judgement about the value of
Classify	Arrange into named categories in order to sort, group or identify
Compare	Estimate, measure or note how things are similar or dissimilar
Compose	The activity that occurs when students produce written, spoken, or visual texts
Contrast	Compare in such a way as to emphasise differences
Create	Bring into existence, to originate
Critically analyse	Analysis that engages with criticism and existing debate on the issue
Demonstrate	Give a practical exhibition an explanation
Describe	Give an account of characteristics or features
Discuss	Talk or write about a topic, taking into account different issues or ideas
Evaluate	Examine and judge the merit or significance of something
Examine	Determine the nature or condition of
Explain	Provide additional information that demonstrates understanding of reasoning and /or application
Extrapolate	Infer from what is known
Hypothesise	Put forward a supposition or conjecture to account for certain facts and used as a basis for further investigation by which it may be proved or disproved
Identify	Recognise and name
Interpret	Draw meaning from
Investigate	Planning, inquiry into and drawing conclusions about
Justify	Show how argument or conclusion is right or reasonable
Manipulate	Adapt or change
Plan	Strategize, develop a series of steps, processes
Predict	Suggest what might happen in the future or as a consequence of something
Reflect	The thought process by which students develop an understanding and appreciation of their own learning. This process draws on both cognitive and affective experience
Relate	Tell or report about happenings, events or circumstances
Represent	Use words, images, symbols or signs to convey meaning
Reproduce	Copy or make close imitation
Respond	React to a person or text
Select	Choose in preference to another or others
Sequence	Arrange in order
Summarise	Give a brief statement of the main points
Synthesise	Combine elements (information/ideas/components) into a coherent whole
Test	Examine qualities or abilities
Translate	Express in another language or form, or in simpler terms
Visualise	The ability to decode, interpret, create, question, challenge and evaluate texts that communicate with visual images as well as, or rather than, words

Appendix E – Glossary for ACT Senior Secondary Curriculum

Courses will detail what teachers are expected to teach and students are expected to learn for year 11 and 12. They will describe the knowledge, understanding and skills that students will be expected to develop for each learning area across the years of schooling.

Learning areas are broad areas of the curriculum, including English, mathematics, science, the arts, languages, health and physical education.

A **subject** is a discrete area of study that is part of a learning area. There may be one or more subjects in a single learning area.

Frameworks are system documents for Years 11 and 12 which provide the basis for the development and accreditation of any course within a designated learning area. In addition, frameworks provide a common basis for assessment, moderation and reporting of student outcomes in courses based on the framework.

The **course** sets out the requirements for the implementation of a subject. Key elements of a course include the rationale, goals, content descriptions, assessment, and achievement standards as designated by the framework.

BSSS courses will be organised into units. A unit is a distinct focus of study within a course. A standard 1.0 unit is delivered for a minimum of 55 hours generally over one semester.

Core units are foundational units that provide students with the breadth of the subject.

Additional units are avenues of learning that cannot be provided for within the four core 1.0 standard units by an adjustment to the program of learning.

An **independent study unit** is a pedagogical approach that empowers students to make decisions about their own learning. Independent study units can be proposed by a student and negotiated with their teacher but must meet the specific unit goals and content descriptions as they appear in the course.

An **elective** is a lens for demonstrating the content descriptions within a standard 1.0 or half standard 0.5 unit.

A **lens** is a particular focus or viewpoint within a broader study.

Content descriptions refer to the subject-based knowledge, understanding and skills to be taught and learned.

A **program of learning** is what a college develops to implement the course for a subject and to ensure that the content descriptions are taught and learned.

Achievement standards provide an indication of typical performance at five different levels (corresponding to grades A to E) following completion of study of senior secondary course content for units in a subject.

ACT senior secondary system **curriculum** comprises all BSSS approved courses of study.

Appendix F – Course Adoption

Conditions of Adoption

The course and units of this course are consistent with the philosophy and goals of the college and the adopting college has the human and physical resources to implement the course.

Adoption Process

Course adoption must be initiated electronically by an email from the principal or their nominated delegate to bssscertification@ed.act.edu.au. A nominated delegate must CC the principal.

The email will include the **Conditions of Adoption** statement above, and the table below adding the **College** name, and circling the **Classification/s** required.

College:	
Course Title:	Biology
Classification/s:	A T
Accredited from:	2014
Framework:	Science