BOSTES
BOARD OF STUDIES TEACHING & EDUCATIONAL STANDARDS NSW

BIOLOGY
STAGE 6

DRAFT SYLLABUS FOR CONSULTATION

20 JULY – 31 AUGUST 2016

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THE BOSTES SYLLABUS DEVELOPMENT PROCESS

BOSTES began its syllabus development process for Stage 6 English, Mathematics, Science and History in 2014. This followed state and territory Education Ministers' endorsement of senior secondary Australian curriculum.

The development of the Stage 6 syllabuses involved expert writers and opportunities for consultation with teachers and other interest groups across NSW in order to receive the highest-quality advice across the education community.

A number of key matters at consultations were raised, including the need for the curriculum to cater for the diversity of learners, the broad range of students undertaking Stage 6 study in NSW, development of skills and capabilities for the future, school-based assessment and providing opportunities for assessing and reporting student achievement relevant for post-school pathways.

There was broad support that changes to curriculum and assessment would contribute to the reduction of student stress. BOSTES will continue to use NSW credentialling processes aligned with Stage 6 assessment and HSC examination structures.

A summary of the BOSTES syllabus development process is available at http://www.boardofstudies.nsw.edu.au/syllabuses/syllabus-development.

ASSISTING RESPONDENTS

The following icons are used to assist respondents:

 for your information	This icon indicates general information that assists in reading or understanding the information contained in the document. Text introduced by this icon will not appear in the final syllabus.
 consult	This icon indicates material on which responses and views are sought through consultation.

CONSULTATION

The *Biology Stage 6 Draft Syllabus* is accompanied by an online consultation survey on the BOSTES website. The purpose of the survey is to obtain detailed comments from individuals and systems/organisations on the syllabus. Please comment on both the strengths and the weaknesses of the draft syllabus. Feedback will be considered when the draft syllabus is revised.

The consultation period is from 20 July to 31 August 2016.

Written responses may be forwarded to:

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INTRODUCTION

STAGE 6 CURRICULUM

Board of Studies, Teaching and Educational Standards NSW (BOSTES) Stage 6 syllabuses have been developed to provide students with opportunities to further develop skills which will assist in the next stage of their lives, whether that is academic study, vocational education or employment.
The purpose of the Higher School Certificate program of study is to:

- provide a curriculum structure which encourages students to complete secondary education
- foster the intellectual, social and moral development of students, in particular developing their:
  - knowledge, skills, understanding, values and attitudes in the fields of study they choose
  - capacity to manage their own learning
  - desire to continue learning in formal or informal settings after school
  - capacity to work together with others
  - respect for the cultural diversity of Australian society
- provide a flexible structure within which students can prepare for:
  - further education and training
  - employment
  - full and active participation as citizens
- provide formal assessment and certification of students' achievements
- provide a context within which schools also have the opportunity to foster students' physical and spiritual development.

The Stage 6 syllabuses reflect the principles of the BOSTES *K–10 Curriculum Framework* and *Statement of Equity Principles*, and the *Melbourne Declaration on Educational Goals for Young Australians* (December 2008). The syllabuses build on the continuum of learning developed in the K–10 syllabuses.

The Stage 6 syllabuses provide a set of broad learning outcomes that summarise the knowledge, understanding, skills, values and attitudes essential for students to succeed in and beyond their schooling. In particular, the literacy and numeracy skills needed for future study, employment and life are provided in Stage 6 syllabuses in alignment with the *Australian Core Skills Framework (ACSF)*.

The syllabuses have considered agreed Australian curriculum content and included content that clarifies the scope and depth of learning in each subject.

Stage 6 syllabuses support a standards-referenced approach to assessment by detailing the essential knowledge, understanding, skills, values and attitudes students will develop and outlining clear standards of what students are expected to know and be able to do. In accordance with the *Statement of Equity Principles*, Stage 6 syllabuses take into account the diverse needs of all students. The syllabuses provide structures and processes by which teachers can provide continuity of study for all students.

DIVERSITY OF LEARNERS

NSW Stage 6 syllabuses are inclusive of the learning needs of all students. Syllabuses accommodate teaching approaches that support student diversity including Students with special education needs, Gifted and talented students and Students learning English as an additional language or dialect (EAL/D).

STUDENTS WITH SPECIAL EDUCATION NEEDS

All students are entitled to participate in and progress through the curriculum. Schools are required to provide additional support or adjustments to teaching, learning and assessment activities for some students. Adjustments are measures or actions taken in relation to teaching, learning and assessment that enable a student to access syllabus outcomes and content and demonstrate achievement of outcomes.

Students with special education needs can access the Stage 6 outcomes and content in a range of ways. Students may engage with:

- syllabus outcomes and content with adjustments to teaching, learning and/or assessment activities
- selected outcomes and content appropriate to their learning needs
- selected Stage 6 Life Skills outcomes and content appropriate to their learning needs.

Decisions regarding adjustments should be made in the context of collaborative curriculum planning with the student, parent/carer and other significant individuals to ensure that syllabus outcomes and content reflect the learning needs and priorities of individual students.

Further information can be found in support materials for:

- Science
- Special education needs
- Life Skills.

GIFTED AND TALENTED STUDENTS

Gifted students have specific learning needs that may require adjustments to the pace, level and content of the curriculum. Differentiated educational opportunities assist in meeting the needs of gifted students.

Generally, gifted students demonstrate the following characteristics:

- the capacity to learn at faster rates
- the capacity to find and solve problems
- the capacity to make connections and manipulate abstract ideas.

There are different kinds and levels of giftedness. Gifted and talented students may also possess learning difficulties and/or disabilities that should be addressed when planning appropriate teaching, learning and assessment activities.

Curriculum strategies for gifted and talented students may include:

- differentiation: modifying the pace, level and content of teaching, learning and assessment activities
- acceleration: promoting a student to a level of study beyond their age group
- curriculum compacting: assessing a student's current level of learning and addressing aspects of the curriculum that have not yet been mastered.

School decisions about appropriate strategies are generally collaborative and involve teachers, parents and students with reference to documents and advice available from BOSTES and the education sectors.

Gifted and talented students may also benefit from individual planning to determine the curriculum options, as well as teaching, learning and assessment strategies, most suited to their needs and abilities.

STUDENTS LEARNING ENGLISH AS AN ADDITIONAL LANGUAGE OR DIALECT (EAL/D)

Many students in Australian schools are learning English as an additional language or dialect (EAL/D). EAL/D students are those whose first language is a language or dialect other than Standard Australian English and who require additional support to assist them to develop English language proficiency.

EAL/D students come from diverse backgrounds and may include:

- overseas and Australian-born students whose first language is a language other than English, including creoles and related varieties
- Aboriginal and Torres Strait Islander students whose first language is Aboriginal English, including Kriol and related varieties.

EAL/D students enter Australian schools at different ages and stages of schooling and at different stages of Australian Standard English language learning. They have diverse talents and capabilities and a range of prior learning experiences and levels of literacy in their first language and in English. EAL/D students represent a significant and growing percentage of learners in NSW schools, for some, school is the only place they use Australian Standard English.

EAL/D students are simultaneously learning a new language and the knowledge, understanding and skills of the Biology Stage 6 syllabus through that new language. They require additional time and support, along with informed teaching that explicitly addresses their language needs, and assessments that take into account their developing language proficiency.

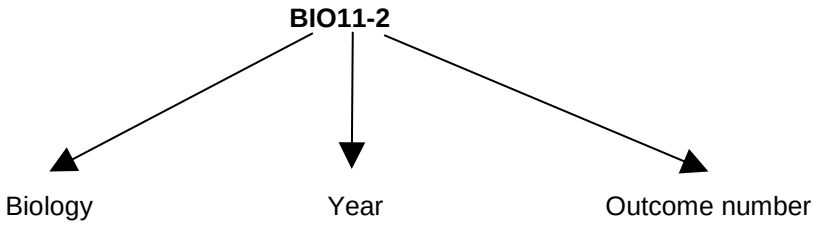
BIOLOGY KEY

The following codes and icons are used in the *Biology Stage 6 Draft Syllabus*.

OUTCOME CODING

Syllabus outcomes have been coded in a consistent way. The code identifies the subject, Year and outcome number.

In the *Biology Stage 6 Biology Draft Syllabus*, outcome codes indicate the subject, Year and outcome number, for example:

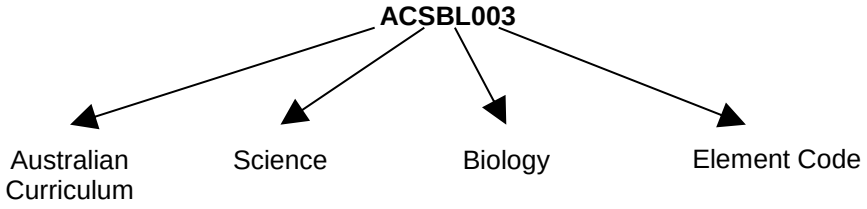


Outcome code	Interpretation
BIO11-1	Biology, Year 11 – Outcome number 1
BIO12-4	Biology, Year 12 – Outcome number 4

CODING OF AUSTRALIAN CURRICULUM CONTENT

Australian curriculum content descriptions included in the syllabus are identified by an Australian curriculum code which appears in brackets at the end of each content description, for example:

> Conduct investigations, including using ecosystem surveying techniques, safely, competently and methodically for the collection of valid and reliable data (ACSBL003).



Where a number of content descriptions are jointly represented, all description codes are included, eg (ACSBL001, ACSBL002, ACSBL003).

LEARNING ACROSS THE CURRICULUM ICONS

Learning across the curriculum content, including cross-curriculum priorities, general capabilities and other areas identified as important learning for all students, is incorporated and identified by icons in the *Biology Stage 6 Draft Syllabus*.

Cross-curriculum priorities	
	Aboriginal and Torres Strait Islander histories and cultures
	Asia and Australia's engagement with Asia
	Sustainability
General capabilities	
	Critical and creative thinking
	Ethical understanding
	Information and communication technology capability
	Intercultural understanding
	Literacy
	Numeracy
	Personal and social capability
Other learning across the curriculum areas	
	Civics and citizenship
	Difference and diversity
	Work and enterprise

RATIONALE

 for your information

The rationale describes the distinctive nature of the subject and outlines its relationship to the contemporary world and current practice. It explains the place and purpose of the subject in the curriculum, including:

- why the subject exists
- the theoretical underpinnings
- what makes the subject distinctive
- why students would study the subject
- how it contributes to the purpose of the Stage 6 curriculum
- how it prepares students for post-school pathways.

 consult

The Biology Stage 6 course explores the diversity of life from a molecular to a biological systems level. It examines the interactions between living things and the environments in which they live. The application of Biology is significant in finding solutions for health and sustainability in a changing world.

Biology incorporates Working Scientifically processes to develop skills and also focuses on problem-solving and critical thinking in order to understand and support the natural environment. By Working Scientifically, students design and conduct biological investigations both individually and collaboratively.

The study of Biology, often undertaken in interdisciplinary teams, focuses on solving biological problems and complements the study of the other science disciplines and STEM (Science, Technology, Engineering and Mathematics) related courses. Students are encouraged to solve problems by applying a knowledge of biological interactions and through the analysis of qualitative and quantitative data.

Biology builds upon the knowledge and skills of the study of living things found in the Science Stage 5 course. The course maintains a practical emphasis for the delivery of course content and engages with the technologies that assist in investigating biological applications.

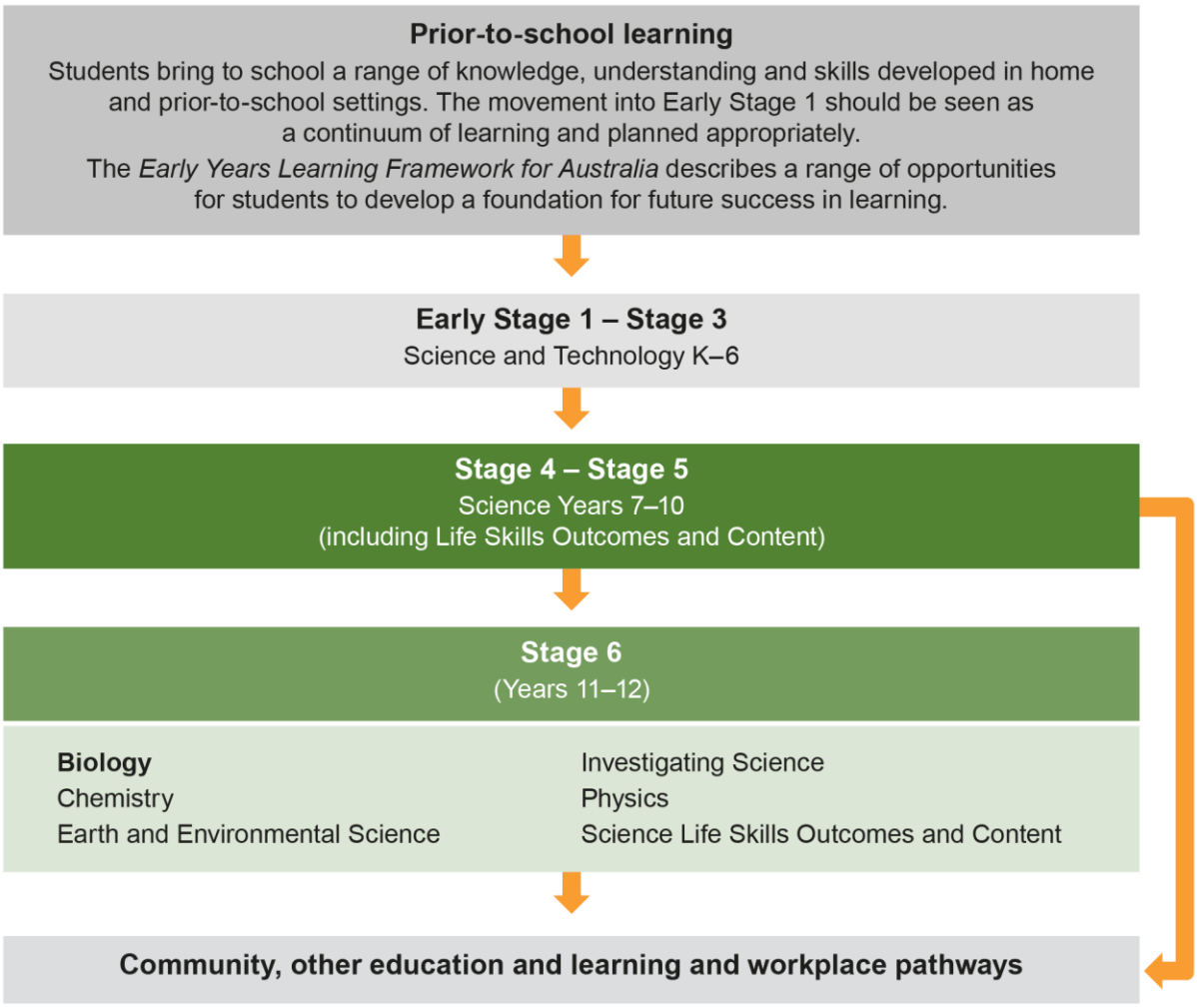
The study of Biology provides the foundation knowledge and skills required to study Biology post-school and supports participation in a range of careers in Biology and related interdisciplinary industries. It is an essential discipline that focuses on personal and public health and sustainability issues and promotes an appreciation for the diversity of life on Earth.

THE PLACE OF THE BIOLOGY STAGE 6 DRAFT SYLLABUS IN THE K–12 CURRICULUM

for your information

NSW syllabuses include a diagram that illustrates how the syllabus relates to the learning pathways in K–12. This section places the Biology Stage 6 syllabus in the K–12 curriculum as a whole.

consult



AIM

 for your information

In NSW syllabuses, the aim provides a succinct statement of the overall purpose of the syllabus. It indicates the general educational benefits for students from programs based on the syllabus.

The aim, objectives, outcomes and content of a syllabus are clearly linked and sequentially amplify details of the intention of the syllabus.

 consult

The study of Biology in Stage 6 enables students to develop an appreciation and understanding of biological concepts that can be used to explore the diversity of life, from a molecular to a biological systems level, and the interactions between living things and the environments in which they live. Through applying Working Scientifically processes and the use of biological technologies, the course aims to examine how biological models and practices are used and developed.

OBJECTIVES

 for your information

In NSW syllabuses, objectives provide specific statements of the intention of a syllabus. They amplify the aim and provide direction to teachers on the teaching and learning process emerging from the syllabus. They define, in broad terms, the knowledge, understanding, skills, values and attitudes to be developed through study in the subject. They act as organisers for the intended outcomes.

 consult

VALUES AND ATTITUDES

Students:

- develop positive, informed values and attitudes towards Biology
- recognise the importance and relevance of biology in their lives
- recognise the influence of economic, political and societal impacts on the development of scientific knowledge
- develop an appreciation of the influence of imagination and creativity in scientific research

SKILLS

Students:

- develop skills in applying the processes of Working Scientifically

KNOWLEDGE AND UNDERSTANDING

Students:

- develop knowledge and understanding of the structure and function of organisms
- develop knowledge and understanding of the Earth's biodiversity and the effect of evolution
- develop knowledge and understanding of heredity and genetic technologies
- develop knowledge and understanding of the effects of disease and disorders

OUTCOMES

 for your information

In NSW syllabuses, outcomes provide detail about what students are expected to achieve at the end of each Years in relation to the objectives. They indicate the knowledge, understanding and skills expected to be gained by most students as a result of effective teaching and learning. They are derived from the objectives of the syllabus.

 consult

TABLE OF OBJECTIVES AND OUTCOMES – CONTINUUM OF LEARNING

SKILLS

Objective Students • develop skills in applying the processes of Working Scientifically	
Year 11 course outcomes A student:	**Year 12 course outcomes** A student:
Questioning **BIO11-1** poses questions and hypotheses for scientific investigation	**Questioning** **BIO12-1** develops and evaluates questions and hypotheses for scientific investigation
Designing investigations **BIO11-2** designs and plans appropriate scientific investigations	**Designing investigations** **BIO12-2** designs, plans and evaluates primary and secondary-sourced investigations
Conducting investigations **BIO11-3** conducts primary or secondary-sourced investigations individually or in a team	**Conducting investigations** **BIO12-3** conducts primary and secondary-sourced investigations individually or in a team
Representing data **BIO11-4** represents qualitative and quantitative data and information using a range of appropriate media	**Representing data** **BIO12-4** selects and represents key qualitative and quantitative data and information using a range of appropriate media
Analysing **BIO11-5** analyses primary and secondary information sources	**Analysing** **BIO12-5** analyses primary and secondary information sources

Solving problems **BIO11-6** solves scientific problems	**Solving problems** **BIO12-6** solves scientific problems using primary and secondary data
Communicating **BIO11-7** communicates scientific understanding	**Communicating** **BIO12-7** communicates scientific understanding using suitable language and terminology

The Skills outcomes found at the beginning of each module are targeted for emphasis. It is recognised that the other Skills outcomes will also be addressed in each module.

KNOWLEDGE AND UNDERSTANDING

Year 11 course Unit 1	**Year 12 course Unit 3**
Objective Students: ● develop knowledge and understanding of the structure and function of organisms	**Objective** Students: ● develop knowledge and understanding of heredity and genetic technologies
Year 11 course outcomes A student:	**Year 12 course outcomes** A student:
BIO11-8 describes single cells as the basis for all life by analysing and explaining cells' ultrastructure and biochemical processes	**BIO12-8** explains the structures of DNA and analyses the mechanisms of inheritance and how processes or reproduction ensure continuity of species
BIO11-9 explains the structure and function of multicellular organisms and describes how the coordinated activities of cells, tissues and organs contribute to macroscopic processes in organisms	**BIO12-9** explains natural genetic change and the use of genetic technologies to induce genetic change
Year 11 course Unit 2	**Year 12 course Unit 4**
Objective Students: ● develop knowledge and understanding of the Earth's biodiversity and the effect of evolution	**Objective** Students: ● develop knowledge and understanding of living things and their ability to maintain a balance
Year 11 course outcomes A student:	**Year 12 course outcomes** A student:
BIO11-10 describes biological diversity by explaining the relationships between a range of organisms in terms of specialisation for selected habitats and evolution of species	**BIO12-10** analyses infectious disease in terms of disruption to homeostatic mechanisms and the organism's response including the human immune system
BIO11-11 analyses ecosystem dynamics and the interrelationships of organisms within the ecosystem	**BIO12-11** explains non-infectious disease and disorders and a range of technologies used to assist, control, prevent and treat non-infectious disease

WORKING SCIENTIFICALLY

Working Scientifically skills are at the core of conducting primary and secondary-sourced investigations in science.

Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In each module, particular outcomes have been identified as those that are most relevant to the intended learning.

In Stage 6 students are challenged to further develop their understanding of Working Scientifically as a group of dynamic and interdependent processes that are applied in each scientific investigation in a way that is appropriate for the task. This dynamism and interrelatedness adds a level of sophistication to students' understanding of the true nature and practice of Science. Through regular involvement in these processes, applying them as they arise, in a range of varied primary investigations, students will broaden their interpretation of Working Scientifically beyond the common linear model that suggests science is a process that simply confirms the way things are.

Students, through a variety of activities, are encouraged to select the most appropriate gateway to the Working Scientifically processes. These gateways become self-evident through the nature of the investigation. An inquiry may be instigated, for example, by direct observation of a phenomenon, or emerge from inconsistencies in results, from quantitative and/or qualitative analysis of data or from secondary research previously conducted by others. Students are challenged to be open to refining or redeveloping their chosen procedures, redefining their questions and/or hypotheses, modifying their methodologies or designs, conducting further secondary research and encouraged to communicate evidence-based conclusions and novel ideas for future research. The processes are informed by the unexpected. Unexpected results are to be used to further inform the pathway towards scientific truth. Knowledge and understanding of Science is essential to these processes being performed and, in turn, a deeper knowledge and understanding of scientific concepts emerges from students' learning through the practice of Science.

Each of the seven Working Scientifically outcomes represents a part of the interdependent dynamic process and its centrality to the study of science and the acquisition of scientific knowledge and skills. This course is structured to provide ongoing opportunities for students to implement these processes, particularly through the depth study provision. The following descriptions of these outcomes provide further information about the skills students are expected to develop throughout the course.

Questioning
Developing, proposing and evaluating inquiry questions and hypotheses challenges students to identify an area that can be investigated scientifically, involving primary and/or secondary-sourced data. Students demonstrate the development of inquiry question(s) that require observations, experimentation and/or research to aid in constructing a reasonable and informed hypothesis. The consideration of variables is to be included in the questioning process.

Designing investigations
In designing investigations, students ensure that all risks are assessed, appropriate materials and technologies are sourced and that all ethical concerns are considered. Variables are to be identified as independent, dependent and controlled to ensure a valid procedure is developed that will allow for the reliable collection of data. Investigations are to include strategies that ensure that controlled variables are kept constant. Students justify and evaluate the design of investigations.

Conducting investigations
Students are to select appropriate equipment, employ safe work practices and ensure that risk assessments are conducted and followed. Appropriate technologies are to be used and procedures followed when disposing of waste. The selection and criteria for collecting valid and reliable data is to be methodical and, where appropriate, secondary-sourced information is referenced correctly. Reliability is ensured by making modifications to procedure and repeating the investigation or referring to other reliable secondary sources. Accuracy is ensured by using appropriate technologies in a consistent manner.

Representing
In representing data and information, students use the most appropriate and meaningful methods and media to organise and analyse data and information sources, including digital technologies and the use of a variety of visual representations. From these representations students identify trends, patterns and relationships in data and information and recognise error, uncertainty and limitations. Representations are to communicate data and information in order to help solve problems. They make predictions and assist in synthesising data and information to develop evidence-based conclusions and arguments.

Analysing
Students identify trends, patterns and relationships; recognise error, uncertainty and limitations in data; and interpret scientific and media texts. Students evaluate the relevance, accuracy, validity and reliability of the primary or secondary-sourced data in relation to investigations. They evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments. Where appropriate, mathematical models should be constructed and calculations applied to best demonstrate the trends and relationships that occur in data.

Solving problems
Students use critical thinking skills and creativity to demonstrate an understanding of scientific principles underlying the solutions to inquiry questions and problems posed in investigations. Appropriate and varied strategies are employed including using models to quantitatively and qualitatively explain and predict cause and effect relationships. In Working Scientifically, students synthesise and use evidence to construct and justify conclusions. Students interpret scientific and media texts and evaluate processes, claims and conclusions and consider the quality of available evidence to solve problems.

Communicating

Communicating all components of the Working Scientifically processes with clarity and accuracy is essential. Students use qualitative and quantitative information gained from investigations using primary and secondary sources including digital, visual, written and verbal forms of communication as appropriate. Students apply appropriate scientific notations, nomenclature and scientific language where appropriate and use scientific language suitable for specific audiences and contexts.

INVESTIGATIONS

Primary and secondary-sourced investigations emphasise a range of types of practical activities and may include:

- undertaking laboratory investigations, including fair tests and controlled experiments
- undertaking fieldwork and surveys
- researching by using a variety of print and multimedia, as well as internet and electronic sources of data and information
- using a range of strategies and technologies to collect and record data, including appropriate use of digital technologies
- using and constructing models
- using or reorganising second-hand data, including those in spreadsheets and databases
- extracting and reorganising information in the form of flow charts, tables, graphs, diagrams, prose, keys, spreadsheets and databases
- using digital technologies, eg computer animations and simulations, to capture and analyse data and information
- presenting data and information in multimodal texts.

COURSE STRUCTURE AND REQUIREMENTS

for your information

The following provides an outline of the Year 11 and Year 12 course structure and requirements for the *Biology Stage 6 Draft Syllabus* with indicative hours, arrangement of content, and an overview of course content.

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<table>
<tr><td rowspan="8">Year 11 course (120 hours)</td><td rowspan="16">Working Scientifically Skills</td><td>Unit</td><td colspan="2">Module</td><td>Indicative hours</td></tr>
<tr><td rowspan="2">Unit 1
The Structure and Function of Organisms</td><td>Module 1
Cells as the basis of life</td><td rowspan="2">45–60</td></tr>
<tr><td>Module 2
Organisation of living things</td></tr>
<tr><td colspan="2">Depth Study
Drawn from knowledge outcome(s) in Unit 1 and/or Unit 2</td><td>15</td></tr>
<tr><td rowspan="2">Unit 2
The Earth’s Biodiversity</td><td>Module 3
Biological diversity</td><td rowspan="2">45–60</td></tr>
<tr><td>Module 4
Ecosystem dynamics</td></tr>
<tr><td rowspan="2">Unit 3
Continuity of Life on Earth</td><td>Module 5
Heredity</td><td rowspan="2">45–60</td></tr>
<tr><td>Module 6
Genetic change</td></tr>
<tr><td rowspan="8">Year 12 course (120 hours)</td><td colspan="2">Depth Study
Drawn from knowledge outcome(s) in Units 3 and/or 4</td><td>15</td></tr>
<tr><td rowspan="2">Unit 4
Disease and Disorders</td><td>Module 7
Infectious disease</td><td rowspan="2">45–60</td></tr>
<tr><td>Module 8
Non-infectious disease and disorders</td></tr>
</table>

DEPTH STUDY: YEARS 11 AND 12

What are depth studies?

A depth study is any type of investigation/activity that a student completes individually or collaboratively that allows extension of one or more concepts found within or inspired by the syllabus. It may be one investigation/activity or a series of investigations/activities. Depth studies must address at least one knowledge outcome, the Questioning and Communicating skills outcomes and at least two other skills outcomes.

Depth studies allow students the avenue to pursue interests, to acquire a depth of understanding and to take responsibility for their own learning. They promote differentiation, engagement, ongoing feedback and support all forms of assessment.

A depth study may be, but is not limited to:

- a primary investigation or a series of primary investigations
- a secondary-sourced investigation or series of secondary-sourced investigations
- presentations, research assignments or fieldwork reports
- extension of concepts found within the course, either qualitatively and/or quantitatively.

A minimum of 15 hours per year of in-class course time is to be allocated to depth studies. The length of time for any individual study and pedagogies employed are not prescribed. The time for the depth study may be allocated to a single study or spread over the year and incorporate several studies depending on individual school and/or class requirements.

Requirements for depth studies

- A minimum of 15 hours of in-class time is allocated in each of Years 11 and 12
- At least one depth study must be included in both Year 11 and Year 12
- Depth studies are to form part of the school-based assessment in each of Years 11 and 12
- Depth studies must contribute a minimum of 20% to a maximum of 40% towards a student's school-based assessment in each of Years 11 and 12
- The Working Scientifically outcomes of Questioning and Communicating must be addressed in the school-based assessment component in each of Years 11 and 12
- A minimum of two additional Working Scientifically skills outcomes, and at least one knowledge outcome, are to be addressed in depth studies.

The following outcomes must be addressed in depth studies:

- Questioning and Communicating skills
- A minimum of two additional skills
- At least one Knowledge outcome

POSSIBLE DEPTH STUDIES

Primary investigations

- Design and conduct experiments
- Test a claim
- Test a device.

Secondary-sourced investigations

- Make a documentary or media report
- Conduct a literature review
- Develop an evidence-based argument
- Write a journal article
- Write an essay–historical or theoretical
- Develop an environmental management plan
- Analyse a work of fiction or film for scientific relevance
- Create a visual presentation
- Investigate emerging technologies.

Create

- Design and invent
- Create a working model
- Create a portfolio.

Fieldwork

Fieldwork may be a starting point for a primary investigation or secondary-sourced study and could be initiated by the following stimuli:

- an excursion
- engagement with community experts.

Data analysis

This could be incorporated into a primary investigation or secondary-sourced investigation, for example:

- constructing and analysing graphs/tables
- data analysis from a variety of sources
- analysing research, eg longitudinal data, resource management data.

ASSESSMENT

 for your information

The key purpose of assessment is to gather valid and useful information about student learning and achievement. It is an essential component of the teaching and learning cycle. School-based assessment provides opportunities to measure student achievement of outcomes in a more diverse way than the HSC examination.

BOSTES continues to promote a standards-referenced approach to assessing and reporting student achievement. Assessment for, as and of learning are important to guide future teaching and learning opportunities and to give students ongoing feedback. These approaches are used individually or together, formally or informally, to gather evidence of student achievement against standards. Assessment provides teachers with the information needed to make judgements about students' achievement of outcomes.

Ongoing stakeholder feedback, analysis of BOSTES examination data and information gathered about assessment practices in schools has indicated that school-based and external assessment requirements require review and clarification. The HSC Reforms outline changes to school-based and HSC assessment practices to:

- make assessment more manageable for students, teachers and schools
- maintain rigorous standards
- strengthen opportunities for deeper learning
- provide opportunities for students to respond to unseen questions, and apply knowledge, understanding and skills to encourage in-depth analysis
- support teachers to make consistent judgements about student achievement.

Students with special education needs

Some students with special education needs will require adjustments to assessment practices in order to demonstrate what they know and can do in relation to syllabus outcomes and content. The type of adjustments and support will vary according to the particular needs of the student and the requirements of the assessment activity. Schools can make decisions to offer adjustments to coursework and school-based assessment.

Life Skills

Students undertaking Years 11–12 Life Skills courses will study selected outcomes and content. Assessment activities should provide opportunities for students to demonstrate achievement in relation to the outcomes, and to apply their knowledge, understanding and skills to a range of situations or environments.

The following general descriptions have been provided for consistency. Further advice about assessment, including in support materials, will provide greater detail.

Assessment for Learning	• enables teachers to use formal and informal assessment activities to gather evidence of how well students are learning • teachers provide feedback to students to improve their learning • evidence gathered can inform the directions for teaching and learning programs.
Assessment as Learning	• occurs when students use self-assessment, peer-assessment and formal and informal teacher feedback to monitor and reflect on their own learning, consolidate their understanding and work towards learning goals.
Assessment of Learning	• assists teachers to use evidence of student learning to assess student achievement against syllabus outcomes and standards at defined key points within a Year or Stage of learning.
Formal assessment	• tasks which students undertake as part of the internal assessment program, for example a written examination, research task, oral presentation, performance or other practical task • tasks appear in an assessment schedule and students are provided with sufficient written notification • evidence is gathered by teachers to report on student achievement in relation to syllabus outcomes and standards, and may also be used for grading or ranking purposes.
Informal assessment	• activities undertaken and anecdotal evidence gathered by the teacher throughout the learning process in a less prescribed manner, for example class discussion, questioning and observation • used as part of the ongoing teaching and learning process to gather evidence and provide feedback to students • can identify student strengths and areas for improvement.
Written examination	• a task undertaken individually, under formal supervised conditions to gather evidence about student achievement in relation to knowledge, understanding and skills at a point in time, for example a half-yearly, yearly or trial HSC examination • a task which may include one or more unseen questions or items, assessing a range of outcomes and content.

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Biology Draft Assessment Requirements

The draft guidelines for school-based assessment provide specific advice about the number of formal assessment tasks, course components and weightings, and the nature of task types to be administered in Year 11 and Year 12.

The components and weightings for Year 11 and Year 12 are mandatory.

Year 11

- There will be 3 formal assessment tasks
- The maximum weighting for each formal assessment task is 40%
- One task may be a formal written examination
- One task must include an assessment of the depth study and its related knowledge, understanding and skills outcomes with a weighting of 20–40%
- A minimum of 25% weighting must be allocated to practical investigations.

Component	**Weighting %**
Skills in working scientifically	60
Knowledge and understanding of course content	40
	100

Year 12

- There will be no more than 4 formal assessment tasks
- The maximum weighting for each formal assessment task is 40%
- One task may be a formal written examination, eg a trial HSC, with a maximum weighting of 25%
- One task must include an assessment of the depth study and its related knowledge, understanding and skills outcomes with a weighting of 20–40%
- A minimum of 25% weighting must be allocated to practical investigations.

Component	**Weighting %**
Skills in working scientifically	60
Knowledge and understanding of course content	40
	100

Biology Draft Examination Specifications

Sections
Section I Objective response questions *Questions may include stimulus material*
Section II Short response questions which may include multiple sections *Questions may include stimulus material*

HSC examination specifications will be reviewed following finalisation of the syllabuses.

Updated assessment and reporting advice will be provided when syllabuses are released.

The Assessment Certification Examination website will be updated to align with the syllabus implementation timeline.

CONTENT

For Kindergarten to Year 12 courses of study and educational programs are based on the outcomes and content of syllabuses. The content describes in more detail how the outcomes are to be interpreted and used, and the intended learning appropriate for each Year. In considering the intended learning, teachers will make decisions about the emphasis to be given to particular areas of content, and any adjustments required based on the needs, interests and abilities of their students.

The knowledge, understanding and skills described in the outcomes and content provide a sound basis for students to successfully transition to their selected post-school pathway.

LEARNING ACROSS THE CURRICULUM

for your information

NSW syllabuses provide a context within which to develop core skills, knowledge and understanding considered essential for the acquisition of effective, higher-order thinking skills that underpin successful participation in further education, work and everyday life including problem-solving, collaboration, self-management, communication and information technology skills.

BOSTES has described learning across the curriculum areas that are to be included in syllabuses. In the Stage 6 syllabuses, the identified areas will be embedded in the descriptions of content and identified by icons. Learning across the curriculum content, including the cross-curriculum priorities and general capabilities, assists students to achieve the broad learning outcomes defined in the BOSTES *Statement of Equity Principles*, the *Melbourne Declaration on Educational Goals for Young Australians* (December 2008) and in the Australian Government's *Core Skills for Work Developmental Framework* (2013).

Knowledge, understanding, skills, values and attitudes derived from the learning across the curriculum areas will be included in BOSTES syllabuses, while ensuring that subject integrity is maintained.

Cross-curriculum priorities enable students to develop understanding about and address the contemporary issues they face.

The cross-curriculum priorities are:
- Aboriginal and Torres Strait Islander histories and cultures
- Asia and Australia's engagement with Asia
- Sustainability

General capabilities encompass the knowledge, skills, attitudes and behaviours to assist students to live and work successfully in the 21st century.

The general capabilities are:
- Critical and creative thinking
- Ethical understanding
- Information and communication technology capability
- Intercultural understanding
- Literacy
- Numeracy
- Personal and social capability

BOSTES syllabuses include other areas identified as important learning for all students:

- Civics and citizenship
- Difference and diversity
- Work and enterprise

 consult

Aboriginal and Torres Strait Islander histories and cultures

Aboriginal and Torres Strait Islander communities have diverse cultures, social structures and a history of unique, complex knowledge systems. Students are provided with opportunities to learn about how Aboriginal and Torres Strait Islander peoples have developed and refined knowledge about the world through observation, making predictions, testing (trial and error) and responding to environmental factors within specific contexts. Students will investigate examples of Aboriginal and Torres Strait Islander peoples' understanding of the environment and the ways that traditional knowledge and western scientific knowledge can be complementary.

When planning and programming content relating to Aboriginal and Torres Strait Islander histories and cultures, teachers are encouraged to consider involving local Aboriginal communities and/or appropriate knowledge holders in determining suitable resources or to use Aboriginal or Torres Strait Islander authored or endorsed publications.

Asia and Australia's engagement with Asia

Asia and Australia's engagement with Asia provides rich and engaging contexts for developing students' science and technology skills, knowledge and understanding. Students are provided with opportunities to recognise that the Asia region includes diverse environments. Students appreciate how interactions within and between these environments and the impacts of human activity influence the region, including Australia, and have significance for the rest of the world.

The Asia region plays an important role in scientific and technological research and development in areas such as medicine, natural resource management and natural disaster prediction and management.

Sustainability

Sustainability is concerned with the ongoing capacity of the Earth to maintain all life. It provides authentic contexts for exploring, investigating and understanding systems in the natural and made environments. Students are provided with opportunities to investigate relationships between systems and system components, and consider the sustainability of food sources and the natural and human environments. Students will engage with ethical debate and learn to engage with different perspectives in solving ethical problems.

Critical and creative thinking

Critical and creative thinking are integral to activities where students learn to generate and evaluate knowledge, clarify concepts and ideas, seek possibilities, consider alternatives and solve problems. Critical and creative thinking are embedded in the skills and processes of Working Scientifically and Working Technologically. Students are provided with opportunities to develop critical and creative thinking skills through asking and posing questions, making predictions, engaging in primary and secondary-sourced investigations and analysing and evaluating evidence in order to making evidence-based decisions.

Ethical understanding

Students develop the capability to assess ethical values and principles, and understand how reasoning can assist ethical judgement. Students are provided with opportunities to form and make ethical judgements in relation to scientific investigations, design, codes of practice, and the use of scientific information and applications. Students explore the importance of reporting honestly, based on evidence. They apply ethical guidelines in their investigations, particularly in their implications for others and the environment.

Information and communication technology capability

Information and communication technology (ICT) can be used effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively. Students are provided with opportunities to develop ICT capability when they develop design ideas and solutions, research science concepts and applications, investigate scientific phenomena, and communicate their scientific and technological understandings. In particular they learn to access information, collect, analyse and represent data, model and interpret concepts and relationships, and communicate scientific and technological ideas, processes and information.

Intercultural understanding

Students develop intercultural understanding as they learn to understand themselves in relation to others. This involves students valuing their own cultures and those of others, and engaging with people of diverse cultures in ways that recognise commonalities and differences, create connections and cultivate respect. Students are provided with opportunities to appreciate how diverse cultural perspectives have impacted on the development, breadth and diversity of scientific knowledge and applications. Students learn about and engage with issues requiring cultural sensitivity, and that scientists work in culturally diverse teams to address issues and solve problems of national and international importance.

Literacy

Literacy is the ability to use a repertoire of knowledge and skills to communicate and comprehend effectively, using a variety of modes and media. Being ‘literate’ is more than the acquisition of technical skills – it includes the ability to identify, understand, interpret, create and communicate effectively using written, visual and digital forms of expression and communication for a number of purposes. Students are provided with opportunities to understand that language varies according to the context and engage with different forms of written and spoken language to communicate scientific concepts. Students learn that scientific information can also be presented in the form of diagrams, flowcharts, tables, graphs and models.

Numeracy

Numeracy involves students in recognising and understanding the role of mathematics in the world. Students become numerate as they develop the confidence, willingness and ability to apply mathematics in their lives in constructive and meaningful ways. Students are provided with opportunities to develop numeracy skills through practical measurement and the collection, representation and interpretation of data from first-hand investigations and secondary sources. Students consider issues of uncertainty and reliability in measurement and learn data-analysis skills, identifying trends and patterns from numerical data and graphs.Students will apply mathematical equations and concepts in order to solve problems.

Personal and social capability

Students develop personal and social capability as they learn to understand and manage themselves, their relationships and their lives more effectively. This includes establishing positive relationships, making responsible decisions, working effectively individually and in teams and constructively handling challenging situations. Through applying the processes of Working Scientifically students develop skills in collaboration, peer assessment and review. Students learn to plan and conduct a depth study either individually or in a team.

Civics and citizenship

Civics and citizenship content involves knowledge and understanding of how our Australian society operates. Students are provided with opportunities to broaden their understanding of aspects of civics and citizenship in relation to the application of scientific ideas and technological advances, including ecological sustainability and the development of environmental and sustainable practices at a local, regional and national level.

Difference and diversity

Difference and diversity comprise gender, race and socio-economic circumstances. Students are provided with opportunities for students to understand and appreciate the difference and diversity they experience in their everyday lives. Working Scientifically and Working Technologically provide opportunities for students to work collaboratively, where they can develop an appreciation of the values and ideas of all group members. This also enables them to identify individual rights, challenge stereotypes and engage with opinions different to their own.

Work and enterprise

Students develop work-related skills and an appreciation of the value of working individually and collaboratively when conducting investigations. Students are provided with opportunities to prioritise safe practices and understand the potential risks and hazards present when conducting investigations. They engage with risk assessment while working safely in the laboratory or in the field.

ORGANISATION OF CONTENT

for your information

The following provides a diagrammatic representation of the relationships between syllabus content.

consult

The Working Scientifically outcomes and content are to be integrated into each module wherever students undertake an investigation.

BIOLOGY YEAR 11 COURSE CONTENT

 consult

WORKING SCIENTIFICALLY SKILLS

The following Working Scientifically outcomes and content are to be integrated into each module wherever students undertake an investigation.

1. QUESTIONING

OUTCOMES

A student:

> poses questions and hypotheses for scientific investigation BIO11-1

CONTENT

Students:

- develop and propose inquiry questions and hypotheses to identify an area that can be investigated scientifically, involving primary and/or secondary source data (ACSBL001)

2. DESIGNING INVESTIGATIONS

OUTCOMES

A student:

> designs and plans appropriate scientific investigations BIO11-2

CONTENT

Students:

- assess risks, consider ethical issues and select appropriate materials and technologies when designing and planning investigations (ACSBL031)
- include the use of variables and experimental controls to ensure that a valid procedure is developed that allows for the reliable collection of data (ACSBL002)

3. CONDUCTING INVESTIGATIONS

OUTCOMES

A student:

> conducts primary or secondary-sourced investigations individually or in a team BIO11-3

CONTENT

Students:

- employ safe work practices and manage risks (ACSBL031)
- use appropriate technologies to ensure accuracy
- select and extract information from reliable secondary sources, acknowledge them using an accepted referencing style

4. REPRESENTING

OUTCOMES

A student:

> represents qualitative and quantitative data and information using a range of appropriate media BIO11-4

CONTENT

Students:

- represent qualitative and quantitative data and information using a range of formats, digital technologies and appropriate media (ACSBL004, ACSBL007)

5. ANALYSING

OUTCOMES

A student:

> analyses primary and secondary information sources BIO11-5

CONTENT

Students:

- determine trends, patterns and relationships; identify error, uncertainty and limitations in data, including primary data and secondary-sourced information (ACSBL004, ACSBL005, ACSBL033)
- evaluate the relevance, accuracy, validity and reliability of primary and secondary-sourced data (ACSBL005)

6. SOLVING PROBLEMS

OUTCOMES

A student:

> solves scientific problems BIO11-6

CONTENT

Students:

- use modelling (including mathematical examples) to explain phenomena, make predictions and/or solve problems using evidence from primary and/or secondary sources (ACSBL006, ACSBL010)

7. COMMUNICATION

OUTCOMES

A student:

> communicates scientific understanding BIO11-7

CONTENT

Students:

- use suitable forms of digital, visual, written and verbal forms of communication
- apply appropriate scientific notations, nomenclature and scientific language to communicate in a variety of contexts (ACSBL008, ACSBL036)
- construct evidence-based arguments (ACSBL034, ACSBL036)

UNIT 1 THE STRUCTURE AND FUNCTION OF ORGANISMS

MODULE 1 CELLS AS THE BASIS OF LIFE

OUTCOMES

A student:

> conducts primary or secondary-sourced investigations individually or in a team BIO11-3
> represents qualitative and quantitative data and information using a range of appropriate media BIO11-4
> describes single cells as the basis for all life by analysing and explaining cells' ultrastructure and biochemical processes BIO11-8

CONTENT FOCUS

Cells are the basis of life and coordinate activities to form colonial and multicellular organisms. Students examine the structure and function of organisms at the cellular and tissue levels in order to describe how they facilitate the efficient provision and removal of materials to and from all cells of organisms. Biochemical processes are introduced and are investigated through the application of the processes of working scientifically.

The study of microbiology and the tools that scientists use in this field are introduced. These tools will be used throughout the course to assist in making predictions and solving problems of a multidisciplinary nature.

Working Scientifically

Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on conducting investigations to collect, represent and analyse data to identify trends, patterns and relationships about cell structure and function.

CONTENT

Cell structure

Inquiry question: What distinguishes one cell from another?

Students:

- investigate different cellular structures, including but not limited to:
  - examination of a variety of prokaryotic and eukaryotic cells (ACSBL032, ACSBL048)
  - examination of a range of technologies that are used to determine a cell's structure and function
- investigate a variety of cell structures, including but not limited to:
  - drawing scaled diagrams of a variety of cells (ACSBL035)
  - comparing and contrasting different cell organelles and arrangements
  - modelling the fluid mosaic model of the cell membrane (ACSBL045)

Cell function

Inquiry question: How do cells coordinate function within their internal and the external environments?

Students:

- examine the way in which materials can move into and out of cells, including but not limited to:
  - modelling diffusion and osmosis (ACSBL046)
  - active transport, endocytosis and exocytosis (ACSBL046)
  - relating the exchange of materials across membranes to the surface area to volume ratio, concentration gradients and the characteristics of the materials being exchanged (ACSBL047)
- investigate cell requirements', including but not limited to:
  - suitable forms of energy including light energy and chemical energy in complex molecules (ACSBL044)
  - matter, including gases, simple nutrients and ions
  - removal of wastes (ACSBL044)
- investigate the biochemical processes of photosynthesis, cell respiration and the removal of cellular products and wastes in eukaryotic cells (ACSBL049, ACSBL052, ACSBL050, ACSBL053)
- conduct a primary investigation to model the action of enzymes in a cell (ACSBL050)
- investigate the effects of the environment on enzyme activity (ACSBL050, ACSBL051)

Organisation of cells

Inquiry question: How are cells arranged in a multicellular organism?

Students:

- compare the differences between unicellular, colonial and multicellular organisms, by:
  - examining whole structures and microscopic structures
  - relating structure of cells and cell specialisation to function
- derive the hierarchical structural organisation of organelles, cells, tissues, organs, systems and organisms (ACSBL054)
- examine the structure of and function of tissues, organs and systems and relate function to cell differentiation and specialisation (ACSBL055)

UNIT 1 THE STRUCTURE AND FUNCTION OF ORGANISMS

MODULE 2 ORGANISATION OF LIVING THINGS

OUTCOMES

A student:

> represents qualitative and quantitative data and information using a range of appropriate media BIO11-4
> solves scientific problems BIO11-6
> communicates scientific understanding BIO11-7
> explains the structure and function of multicellular organisms and describes how the coordinated activities of cells, tissues and organs contribute to macroscopic processes in organisms BIO11-9

CONTENT FOCUS

Multicellular organisms typically consist of a number of interdependent transport systems that range in complexity allowing the organism to exchange nutrients, gases and wastes between the internal and external environment. Students examine the relationship between transport systems, compare nutrient requirements and compare excretory mechanisms. Students will also explore how the nervous system operates in mammals allowing them to interact with their environment.

Models of these systems and structures have been developed over time, based on evidence from multiple disciplines. The interrelatedness of systems in living things is critical in maintaining their health and in solving problems relating to sustainability in agriculture and ecology.

Working Scientifically
Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on collecting, representing and analysing data and information to identify trends, patterns and relationships, solve problems and communicate ideas about the organisation of living things.

CONTENT

Nutrient and gas requirements

Inquiry question: What is the difference in nutrient and gas requirements between heterotrophs and autotrophs?

Students:

- investigate the structure of plants through the examination of a variety of materials, for example:
  - the examination of microscopic structures
  - dissected plant materials (ACSBL032)
  - using a range of technologies that are used to determine plant structure and function (ACSBL035) 
- investigate the function of structures in a plant, including but not limited to:
  - tracing the development and movement of the products of photosynthesis (ACSBL059) (ACSBL060)

  - interpreting a range of secondary source information to evaluate processes, claims and conclusions that have lead scientists to develop theories about the structure and function of plants (ACSBL034)
- investigate the gas exchange structures in animals (ACSBL056) through primary and secondary-sourced investigation, including but not limited to:
  - microscopic structures: alveoli
  - macroscopic structures: respiratory system
- trace the changes in gas exchange and concentration as it moves around the mammalian body (ACSBL056)
- investigate the structure of a mammalian digestive system through examination of digestive structures, for example: (ACSBL057)
  - microscopic samples of digestive surfaces
  - virtual dissections and models of digestive systems
- trace the digestion of foods in a mammalian digestive system, including:
  - physical digestion
  - chemical digestion
  - absorption of nutrients, minerals and water
  - excretion of solid waste
- compare the nutrient and gas requirements of autotrophs and heterotrophs

Transport

Inquiry question: How does the composition of the transport medium change as it moves around an organism?

Students:

- investigate transport systems in animals and plants, through comparing structures and components through physical and digital models, for example: (ACSBL032, ACSBL058, ACSBL059, ACSBL060)
  - microscopic samples of blood, the cardiovascular system, and plant vascular systems
  - examination of macroscopic structures in plants and animals
- investigate and evaluate, using a range of secondary sources, the future directions of blood substitutes, including but not limited to:
  - social and economic impacts (ACSBL034)
  - future development of blood substitutes
- design and conduct procedures to collect primary and/or secondary data in order to analyse the exchange of gases between internal and external environments, for example:
  - using real and virtual microscopy techniques of gas exchange structures in plants and animals
  - real or virtual dissections of gas exchange structures in plants and animals (ACSBL031, ACSBL056, ACSBL032)
- compare the structures and function of transport systems in animals and plants, including but not limited to: (ACSBL033)
  - vascular systems in plants and animals
  - open and closed transport systems in animals

Elimination of waste

Inquiry question: Why don't autotrophs require a specialised excretory system?

Students:

- model the change in transport medium composition as wastes are exchanged in animals, for example:
  - nitrogenous wastes in the nephron
  - respiratory gases in the alveoli (ACSBL035, ACSBL057)
- compare the elimination of waste products in autotrophs to heterotrophs, including:
  - waste products
  - excretory structures
  - process of waste elimination

Sensing

Inquiry question: How do mammals sense and interpret their environment?

Students:

- investigate and model the structure and function of neurons, including but not limited to:
  - action potential
  - transmission across the synapse and the role of neurotransmitters
- investigate the functions of the peripheral and central nervous systems in coordinating electrochemical messages around the body, including but not limited to:
  - sensory neurons
  - motor neurons
  - interneurons
- investigate mammalian brain structure and the role that each region of the brain has in interpreting and responding to information, including but not limited to:
  - cerebrum
  - cerebellum
  - midbrain

UNIT 2 THE EARTH'S BIODIVERSITY

MODULE 3 BIOLOGICAL DIVERSITY

OUTCOMES

A student:

> poses questions and hypotheses for scientific investigation BIO11-1
> designs and plans appropriate scientific investigations BIO11-2
> communicates scientific understanding BIO11-7
> describes biological diversity by explaining the relationships between a range of organisms in terms of specialisation for selected habitats and evolution of species BIO11-10

CONTENT FOCUS

Biodiversity is important to balance ecosystems on the Earth. Biodiversity can be affected slowly or quickly over time by natural selective pressures. Human impact can also affect biodiversity over a shorter time period. In this module students learn about the theory of evolution and the effect of various selective pressures.

Monitoring biodiversity is key to being able to predict future change. Monitoring, including the monitoring of abiotic features in the environment enables ecologists to design strategies to reduce the effects of adverse biological change. Students will investigate methods of classification and assess abundance using mathematical relationships to monitor diversity in the natural environment.

Working Scientifically
Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on designing appropriate investigations, collecting and representing data to develop questions and test hypotheses and communicate using appropriate media about biological diversity.

CONTENT

Effects of the environment on organisms

Inquiry question: How do environmental pressures promote a change in species diversity and abundance?

Students:

- predict the effects of selection pressures on organisms in ecosystems (ACSBL026, ACSBL090), including:
  - biotic factors
  - abiotic factors
- investigate secondary sources in order to examine changes in a population of organisms due to selection pressures over time, and present associated data and information using appropriate media, for example: (ACSBL002, ACSBL094)
  - rabbit populations in Australia
  - Prickley Pear distribution in Australia

Adaptations

Inquiry question: How do adaptations increase the organism's ability to survive?

Students:

- conduct primary investigations, individually or in teams, or use secondary sources to examine the adaptations of organisms that increase their ability to survive in their environment, including:
  - structural adaptations
  - physiological adaptations
  - behavioural adaptations
- investigate, through secondary sources, the observations and collection of data that were obtained by Charles Darwin to support his Theory of Evolution by Natural Selection, for example:
  - finches of the Galapagos Islands

Classification

Inquiry question: How can living things be classified?

Students:

- investigate the hierarchical nature of classification systems based on morphology and apply this information to the classification of living things, for example: (ACSBL017, ACSBL016, ACSBL015, ACSBL018)
  - classification of Australian plants
  - mammal classification

The Theory of Evolution

Inquiry question: What is the relationship between evolution and biodiversity?

Students:

- explain biological diversity in terms of the Theory of Evolution by examining the changes and diversification of life since life appeared on Earth (ACSBL088)
- analyse how an accumulation of micro-evolutionary changes can drive macro-evolutionary changes and speciation over time (ACSBL093, ACSBL034), for example:
  - evolution of the horse
  - evolution of the platypus
- explain, using examples, the Theory of Evolution by Natural Selection, including:
  - gradualism
  - isolation
  - convergent evolution
  - punctuated equilibrium

Evolution – the evidence

Inquiry question: What is the evidence that supports the theory of evolution?

Students:

- investigate, using secondary sources, evidence in support of the theory of evolution, including but not limited to:
  - demonstrating how biochemical evidence, comparative anatomy, comparative embryology, biogeography, artificial selection and molecular homology supports Darwin's Theory of Evolution by Natural Selection (ACSBL089)
  - examining the techniques used to date fossils and artefacts and the evidence produced
- explain modern day examples that demonstrate evolutionary change, for example:
  - the peppered moth
  - antibiotic resistant strains of bacteria

UNIT 2 THE EARTH'S BIODIVERSITY

MODULE 4 ECOSYSTEM DYNAMICS

OUTCOMES

A student:

> develops and proposes questions and/or hypotheses BIO11-1
> designs ethical investigations, considers risks, identifies appropriate materials and suggests primary data and/or secondary information to be collected BIO11-2
> conducts investigations individually or in teams and methodically collects valid and reliable primary data and secondary information using appropriate equipment and/or sources BIO11-3
> processes, analyses and evaluates primary data and secondary information to identify trends, patterns and relationships including quantitative analysis where appropriate BIO11 - 5
> analyses ecosystem dynamics and the interrelationships of organisms within the ecosystem BIO11 - 11

CONTENT FOCUS

The Earth's biodiversity has increased since life first appeared. The Theory of Evolution by Natural Selection can be used to explain periodic increases and decreases in populations and in biodiversity. Scientific knowledge derived from the fossil record and geological evidence has enabled scientists to offer valid explanations for this progression in terms of biotic and abiotic relationships. The study of past ecosystems allows us to create models of possible future ecosystems so that human impact on biodiversity is minimised.

The study of ecosystem dynamics integrates a range of data that can be used to predict environmental change into the future.

Working Scientifically
Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on developing questions and hypotheses when designing and conducting investigations to analyse trends, patterns and relationships in data to analyse interrelationships and dynamics within an ecosystem.

CONTENT

Population dynamics

Inquiry question: How much effect does one species have on the others in a community?

Students:

- model relationships between biotic and abiotic factors in ecosystems and interactions, including: (ACSBL019)
  - examining abiotic factors (ACSBL025, ACSBL021, ACSBL022)
  - examining biotic factors including predation, competition and symbiotic relationships (ACSBL024)
  - examine the specific niches occupied by species (ACSBL023)
  - predict consequences on populations in ecosystems due to predation, competition, symbiosis and disease (ACSBL019, ACSBL020)
  - measure populations of organisms using sampling techniques (ACSBL015, ACSBL003)
  - explain a recent extinction event (ACSBL024)

Past ecosystems

Inquiry question: What evidence is available to indicate that the selection pressures from the abiotic and biotic features of an ecosystem have led to the evolution of that ecosystem?

Students:

- analyse possible paleontological and geological evidence that can be used to provide evidence for past changes in ecosystems, for example:
  - paleontological evidence including Aboriginal rock painting
  - geological evidence
  - ice core drilling
- investigate and analyse past and present technologies that have been used to determine evidence for past changes, for example: (ACSBL005)
  - radiometric dating
  - gas analysis
- analyse secondary information to identify trends in evidence (ACSBL004)
- analyse evidence that present-day organisms have evolved from organisms in the past by examining and interpreting a range of secondary sources to evaluate processes, claims and conclusions relating to the evolution of organisms, for example: (ACSBL027, ACSBL005)
  - small mammals
  - sclerophyll plants
- investigate the reasons for changes in past ecosystems, including:
  - interpreting a range of secondary sources to develop an understanding of the changes in abiotic and biotic features over short and long periods of time (ACSBL025, ACSBL026)
  - development of questions and hypotheses to account for the identified trends (ACSBL001)

Future ecosystems

Inquiry question: How can human activity impact an ecosystem?

Students:

- examine changes in past ecosystems that may inform our approach to the management of future ecosystems, including:
  - investigating the role of human induced selection pressures on the extinction of species (ACSBL028, ACSBL095, ACSBL005)
  - investigating models that humans can use to predict future impacts on biodiversity (ACSBL029, ACSBL071)
  - investigate practices used to restore damaged ecosystems

DEPTH STUDY: YEAR 11 BIOLOGY

OUTCOMES

A student:

> poses questions and hypotheses for scientific investigation BIO11-1
> designs and plans appropriate scientific investigations BIO11-2
> conducts primary or secondary-sourced investigations individually or in a team BIO11-3
> represents qualitative and quantitative data and information using a range of appropriate media BIO11-4
> analyses primary and secondary information sources BIO11-5
> solves scientific problems BIO11-6
> communicates scientific understanding BIO11-7

Knowledge and understanding

A student:

> describes single cells as the basis of all life by analysing and explaining a cells ultrastructure and biochemical processes BIO11-8
> explains the structure and function of multicellular organisms and describes how the coordinated activities of cells, tissues and organs contribute to macroscopic processes in organisms BIO11-9
> describes biological diversity by explaining the relationships between a range of organisms in terms of specialisation for selected habitats and evolution of species BIO11-10
> analyses ecosystem dynamics and the interrelationships of organisms within the ecosystem BIO11-11

CONTENT

Possible depth studies:

Unit 1. The Structure and Function of Organisms

- Investigate the way prokaryotic cells, eukaryotic unicellular, colonial and multicellular organisms respond to and interact with their environment.
- Investigate the impact of environmental factors on photosynthesis.
- Investigate the use of scale in microscopy.
- Investigate the activity of enzymes in living things.
- Research the historical development of the cell theory.

Unit 2. The Earth's Biodiversity

- Investigate a local ecosystem and trace abiotic and biotic changes over the last 50 years using data from public sources.
- Investigate a human impact or a series of human impacts on a local ecosystem.
- Global biodiversity issues associated with bee extinction.
- The effect of a man-made disaster such as an oil spill on biodiversity.
- Analysis of population size, age and reproductive status of fish on sustainable fishing practices.

BIOLOGY YEAR 12 COURSE CONTENT

WORKING SCIENTIFICALLY SKILLS

The following Working Scientifically outcomes and content are to be integrated into each module wherever students undertake an investigation.

1. QUESTIONING

OUTCOMES

A student:

> develops and evaluates questions and hypotheses for scientific investigation BIO12-1

CONTENT

Students:

- develop and evaluate inquiry questions and hypotheses to identify an area that can be investigated scientifically, involving primary and/or secondary-sourced data (ACSBL001)

2. DESIGNING INVESTIGATIONS

OUTCOMES

A student:

> designs, plans and evaluates primary and secondary-sourced investigations BIO12-2

CONTENT

Students:

- assess risks, consider ethical issues and select appropriate materials and technologies when designing and planning an investigation (ACSBL031)
- justify and evaluate the use of variables and experimental controls to ensure that a valid procedure is developed that allows for the reliable collection of data (ACSBL002)

3. CONDUCTING INVESTIGATIONS

OUTCOMES

A student:

> conducts primary and secondary-sourced investigations individually or in a team BIO12-3

CONTENT

Students:

- employ and evaluate safe work practices and manage risks (ACSBL031)
- use appropriate technologies, evaluate accuracy and identify sources of error
- select and extract information from a wide range of reliable secondary sources and acknowledging them using an accepted referencing style

4. REPRESENTING

OUTCOMES

A student:

> selects and represents key qualitative and quantitative data and information using a range of appropriate media BIO12-4

CONTENT

Students:

- select and represent qualitative and quantitative data and information and represent them using a range of formats, digital technologies and appropriate media (ACSBL004, ACSBL007)

5. ANALYSING

OUTCOMES

A student:

> analyses primary and secondary information sources BIO12-5

CONTENT

Students:

- derive trends, patterns and relationships; consider error, uncertainty and limitations in data; and interpret scientific and media texts (ACSBL004, ACSBL005, ACSBL033)
- evaluate the relevance, accuracy, validity and reliability of primary and secondary-sourced data and suggest improvements to investigations (ACSBL005)

6. SOLVING PROBLEMS

OUTCOMES

A student:

> solves scientific problems using primary and secondary data BIO12-6

CONTENT

Students:

- use modelling (including mathematical examples) to explain phenomena, make predictions and solve problems using evidence from primary and secondary sources (ACSBL006, ACSBL010)

7. COMMUNICATION

OUTCOMES

A student:

> communicates scientific understanding using suitable language and terminology BIO12-7

CONTENT

Students:

- select and use suitable forms of digital, visual, written and verbal forms of communication
- select and apply appropriate scientific notations, nomenclature and scientific language to communicate in a variety of contexts (ACSBL008, ACSBL036)
- construct evidence based arguments and engage in peer feedback to evaluate an argument and assess its validity (ACSBL034, ACSBL036)

UNIT 3 CONTINUITY OF LIFE ON EARTH

MODULE 5 HEREDITY

OUTCOMES

A student:

> selects and represents key qualitative and quantitative data and information using a range of appropriate media BIO12-4
> analyses primary and secondary information sources BIO12-5
> solves scientific problems using primary and secondary data BIO12-6
> explains the structures of DNA and analyses the mechanisms of inheritance and how the process of reproduction ensures continuity of species BIO12-8

CONTENT FOCUS

Life continues through the processes of reproduction and heredity. Students will expand their knowledge of evolution by understanding cellular processes that are involved in increasing variability and therefore genetic diversity. Reproduction and inheritance patterns are investigated in both plants and animals along with the role of DNA in polypeptide synthesis and uses of technologies in the study of inheritance patterns.

Students will learn about contemporary research and the work of geneticists across a variety of industries including medical applications and agriculture. The effects on society and the environment are explored through the application of genetic research.

Working Scientifically
Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on processing and representing data in appropriate formats to analyse and evaluate trends, relationships and patterns to derive and justify valid conclusions about the processes involved in heredity.

CONTENT

Reproduction

Inquiry question: How does reproduction ensure the continuity of the species?

Students:

- explain the mechanisms of reproduction that ensure the continuity of the species, by analysing sexual and asexual methods of reproduction in a variety of organisms, including but not limited to:
  - animals: advantages of external and internal reproduction
  - plants: asexual and sexual reproduction
  - fungi: budding, spores
  - bacteria (ACSBL075): binary fission
  - protists: binary fission, budding
- analyse the features of fertilisation, implantation and hormonal control of pregnancy and birth in mammals (ACSBL075)
- assess the role that pollination, fertilisation and seed dispersal plays in the success of plant reproduction

- evaluate the impact of scientific knowledge on the manipulation of plant, animal, fungal and bacterial reproduction in agriculture (ACSBL074)

Cell replication

Inquiry question: How important is it for genetic material to be replicated exactly?

Students:

- model the processes in cell replication including, but not limited to:
  - mitosis and meiosis (ACSBL075)
  - DNA replication using the Watson and Crick DNA model including nucleotide composition, pairing and bonding (ACSBL076, ACSBL077)
- assess the effect on the continuity of the species of the cell replication processes (ACSBL084)

DNA and protein synthesis

Inquiry question: Why is protein synthesis important?

Students:

- construct appropriate representations to communicate a conceptual understanding, by comparing the forms in which DNA exists in eukaryotes and prokaryotes (ACSBL076)
- model the process of protein synthesis, including transcription and translation, (ACSBL079) including:
  - assess the importance of mRNA and tRNA in transcription and translation (ACSBL079)
  - analyse the function and importance of polypeptide synthesis (ACSBL080)
  - assess how genes and environment affect phenotypic expression (ACSBL081, ACSBL081)

Genetic variation

Inquiry question: How can we compare the genetic similarities and differences between species and within a species?

Students:

- conduct investigations to predict variations in the genotype of offspring by modelling meiosis including the crossing over of homologous chromosomes, fertilisation and mutations, (ACSBL084), including but not limited to:
  - constructing and interpreting Punnett squares of autosomal, sex-linked and multiple alleles (ACSBL085)
  - constructing and interpreting pedigrees
  - investigating physical or digital models
- collect, record and present data to represent frequencies of characteristics in a population, in meaningful and useful ways to identify trends, patterns and relationships as well as limitations in data, for example:
  - Punnett squares and frequency data
  - pedigrees
  - DNA sequencing (ACSBL085)
- investigate the use of technology used to identify individuals in forensic investigations and paternity cases

Inheritance patterns in a population

Inquiry question: Can population genetic patterns be predicted with any accuracy?

Students:

- investigate the use of technologies to determine inheritance patterns in a population (ACSBL064), for example:
  - DNA sequencing and DNA profiling (ACSBL086)
  - analysing data from large scale collaborative projects to identify trends, patterns and relationships (ACSBL064, ACSBL073)

UNIT 3 CONTINUITY OF LIFE ON EARTH

MODULE 6 GENETIC CHANGE

OUTCOMES

A student:

> applies scientific thinking, quantitative analysis and problem-solving techniques to assess the validity of conclusions drawn from gathered information BIO12-6

> communicates using appropriate scientific terminology, understandings and conclusions; acknowledges sources and responds to peer reviews and presents associated data and information using a variety of media BIO12-7

> explains natural genetic change and the use of genetic technologies to induce genetic change BIO12-9

CONTENT FOCUS

Genetic change can be natural or induced. Students learn about natural and human induced causes and effects of genetic change including mutations, environmental pressure and uses of biotechnology. This module builds on the previous module by investigating the application of the processes of inheritance and evolution.

The work of scientists in various fields of work including agriculture, industry and medicine are explored within the context of biotechnology. New and emerging technologies may be investigated as either part of the module or as a depth study. The impact of biotechnology on biological diversity is also explored.

Working Scientifically

Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on analysing trends, patterns and solving problems with data while communicating ideas about genetic change.

CONTENT

Mutation

Inquiry question: How does mutation (ACSBL092) result in micro-evolutionary change?

Students:

- explain a range of mutagens, including, but not limited to:
  - electromagnetic radiation sources
  - chemicals
  - naturally occurring mutagens
- compare the cause, process and effects of different types of mutation, including, but not limited to:
  - point mutation
  - chromosomal mutation
- distinguish between somatic mutations and germ-line mutations and their effect on an organism (ACSBL082, ACSBL083)
- assess the significance of ‘coding’ and ‘non-coding’ DNA segments in the process of mutation (ACSBL078)

- investigate the causes of genetic variation relating to the processes of fertilisation, meiosis and mutation (ACSBL078)
- evaluate the effect of mutation, gene flow and genetic drift on the gene pool of populations (ACSBL091)

Biotechnology

Inquiry question: How will genetic techniques affect Earth's biodiversity?

Students:

- using secondary sources, explore the uses and applications of biotechnology (ACSBL087) (past, present and future), including:
  - analysing social implications and ethical uses of biotechnology including plant and animal examples
  - researching future directions of the use of biotechnology
  - evaluating the potential benefits of researching genetic techniques on society
  - evaluating the changes to Earth's biodiversity due to genetic techniques

Genetic technologies

Inquiry question: Does artificial manipulation of DNA have the potential to change populations forever?

Students:

- investigate the uses and advantages of current genetic technologies that induce genetic change.
- compare the process and outcomes of reproductive technologies, including but not limited to:
  - artificial insemination
  - artificial pollination
- investigate and assess, through secondary source research, the effectiveness of cloning, including, but not limited to:
  - whole organism cloning
  - gene cloning
- examine techniques and applications used in recombinant DNA technology, including but not limited to:
  - transgenic organisms used in agricultural and medical applications (ACSBL087)
- evaluate the benefits of using genetic technologies in agricultural, medical and industrial applications (ACSBL086)
- evaluate the effect of the use of biotechnology in agriculture on biodiversity
- interpret a range of secondary sources to assess the influence of social, economic and cultural contexts on a range of biotechnologies

UNIT 4 DISEASE AND DISORDERS

MODULE 7 INFECTIOUS DISEASE

OUTCOMES

A student:

> develops and evaluates questions and hypotheses for scientific investigation BIO12-1
> designs, plans and evaluates primary and secondary-sourced investigation BIO12-2
> conducts primary and secondary-sourced investigations individually or in a team BI12 - 3
> selects and represents key qualitative and quantitative data and information using a range of appropriate media BIO12-4
> analyses infectious disease in terms of disruption to homeostatic mechanisms and the organism's response including the human immune system BIO12-10

CONTENT FOCUS

Students investigate the homeostatic responses of organisms to an invasion by pathogens. The treatment, prevention and control of infectious disease is examined both locally and globally along with a study of the human immune system and its response to an infectious disease.

The value of studying infectious disease and its causes and effects is highlighted by the cost to humans in terms of productivity and production loss and overall health and sustainability of the biosphere. This module also considers medical and agricultural applications that draw on the work of a variety of scientists.

Working Scientifically
Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on developing and evaluating questions and hypotheses when designing and conducting investigations to analyse trends, patterns and relationships in data about infectious diseases.

CONTENT

Homeostasis

Inquiry question: How is an organism's internal environment maintained in response to a changing external environment?

Students:

- construct and interpret negative feedback loops by using a range of sources, including but not limited to: (ACSBL101, ACSBL110, ACSBL111)
  - temperature (ACSBL098)
  - glucose
- investigate the various mechanisms used by organisms to maintain their internal environment within tolerance limits, including:
  - collecting, processing, analysing and evaluating primary data and secondary information to identify trends and patterns in behavioural, structural and physiological adaptations in endotherms (ACSBL099, ACSBL114)
  - explaining internal communication systems that allow homeostasis to be maintained, including hormones and neural pathways (ACSBL112, ACSBL113, ACSBL114)

  - investigating mechanisms in animals and plants that allow for the maintenance of water balance through primary and secondary sources (ACSBL115)

Causes of infectious disease

Inquiry question: How are diseases transmitted?

Students:

- describe a variety of infectious diseases caused by microorganisms, macroorganisms and non-cellular pathogens and design and conduct primary and secondary investigations relating to disease transmission, including: (ACSBL117, ACSBL098, ACSBL097, ACSBL116)
  - describing and comparing the structure, function and action of different pathogens that cause disease in plants and animals (ACSBL117)
  - investigating the transmission of a disease during an epidemic
  - designing and conducting a primary investigation relating to the microbial testing of water or food samples
  - investigating modes of transmission including direct contact, indirect contact and vector transmission
- investigate of the work of Robert Koch and Louis Pasteur, in explaining the cause and transmission of infectious disease, by conducting primary and secondary-sourced investigations, including:
  - Koch's postulates
  - Pasteur's experiments on microbial contamination
- assess the causes and effects of diseases on production in agriculture, for example:
  - plant disease
  - animal disease
- compare the adaptations of different pathogens that facilitate their entry into and transmission between hosts (ACSBL118)

Responses to pathogens

Inquiry question: How does a plant or animal respond to a change in homeostasis? (ACSBL119)

Students:

- analyse responses of plants and animals to pathogens by assessing the physical or chemical changes, both innate and adaptive, that occur in the cells and tissues of plants and animals in the presence of pathogens (ACSBL119, ACSBL120, ACSBL121, ACSBL122)
- investigate and model the first, second and third lines of defence in the human body (ACSBL096)

Immunity

Inquiry question: Can homeostatic changes be reversed?

Students:

- explain how the immune system responds after primary exposure to a pathogen, including:
  - innate and acquired immunity
  - passive and active immunity (ACSBL100, ACSBL123)

Prevention, treatment and control

Inquiry question: How can the spread of infectious diseases be controlled?

Students:

- investigate and analyse the wide range of interrelated factors involved in limiting local, regional and global spread of disease
- investigate procedures that can be employed to prevent the spread of disease, for example: (ACSBL124)
  - hygiene practices
  - quarantine
  - vaccination
  - public health campaigns
  - use of pesticides
  - genetic engineering
- investigate and assess the effectiveness of pharmaceuticals, including antibiotics, as effective treatment strategies for the control of infectious disease
- investigate and evaluate environmental management and quarantine methods used to control an epidemic or pandemic
- interpret data relating to the incidence and prevalence of infectious disease in populations, for example:
  - mobility of individuals and the proportion that are immune or immunised (ACSBL124, ACSBL125)
- evaluate historical, culturally diverse and current strategies to predict and control the spread of disease (ACSBL125)
- investigate the contemporary application of Aboriginal protocols in the development of particular medicines and biological materials in Australia and how recognition and protection of Indigenous Cultural and Intellectual Property (ICIP) is important

UNIT 4 DISEASE AND DISORDERS

MODULE 8 NON-INFECTIOUS DISEASE AND DISORDERS

OUTCOMES

A student:

> analyses primary and secondary information sources BIO12-5
> solves scientific problems using primary and secondary data BIO12-6
> communicates scientific understanding using suitable language and terminology BIO12-7
> explains non-infectious disease and disorders and a range of technologies used to assist, control, prevent and treat non-infectious disease BIO12-11

CONTENT FOCUS

In this module students engage with the study of non-infectious diseases and disorders including their causes and effects on human health. Technologies and their uses in treating diseases and disorders and the epidemiology of non-infectious disease in populations are explored.

This module also examines the practical applications of science, technology, engineering and mathematics and the importance of understanding the multidisciplinary nature of the applications of Science. It involves examining physiology and engineered design solutions to problems relating to managing human disorders.

Working Scientifically

Opportunities are provided for students to engage with all the Working Scientifically skills for each investigation. In this module students focus on collecting and representing data to analyse trends and patterns and solve problems while communicating ideas about non-infectious diseases and disorders.

CONTENT

Cause and responses

Inquiry question: Do non-infectious diseases cause more deaths than infectious diseases?

Students:

- investigate the causes and host responses of non-infectious diseases in humans, including, but not limited to:
  - genetic diseases
  - diseases caused by environmental exposure
  - nutritional diseases
  - cancer
- collect data that shows the incidence and prevalence of non-infectious disease, for example:
  - a nutritional disease
  - a disease caused by environmental exposure

Epidemiology

Inquiry question: Why do we use epidemiological studies?

Students:

- analyse patterns of non-infectious disease in populations including their incidence, prevalence, causes and effects, for example:
  - a nutritional disease
  - a disease caused by environmental exposure
- investigate the treatment/management, and possible future directions for further research using an example from one of the non-infectious diseases categories listed above
- evaluate the method used for an example of an epidemiological study
- evaluate the benefits of engaging in an epidemiological study using examples

Prevention and treatment

Inquiry question: How can non-infectious diseases be treated and prevented?

Students:

- investigate the use of technologies used to detect non-infectious disease, including, but not limited to:
  - medical imaging
  - pathology
  - genetic screening
- use secondary sources to evaluate the effectiveness of current disease prevention methods and develop strategies for the prevention of a disease outbreak, for example:
  - educational programs and campaigns
  - use of pesticides
  - genetic engineering
- investigate and assess the effectiveness of a range of technologies used for the treatment of cancer, including, but not limited to:
  - chemotherapy
  - radiation therapy

Technologies and disorders

Inquiry question: How can technologies be used to assist people with a disorder?

Students:

- investigate a range of causes of the following disorders, including but not limited to:
  - hearing loss
  - visual disorders
  - organ failure
  - loss of kidney function
- investigate and assess the appropriateness of technologies that are used to manage and assist with the effects of a disorder, including but not limited to: (ACSBL100)
  - hearing loss: cochlear implants, bone conduction implants, hearing aids
  - visual disorders: spectacles, laser surgery
  - organ or limb replacement: prosthetics, organ transplant
  - dialysis for loss of kidney function

- investigate, using secondary information sources, the biocompatibility of artificial and transplanted organs and the development of technologies that are used to prevent rejection, for example:
  - use of inert materials
  - anti-rejection drugs

DEPTH STUDY: YEAR 12 BIOLOGY

OUTCOMES

Skills

A student:

> develops and evaluates questions and hypotheses for scientific investigation BIO12-1
> designs, plans and evaluates primary and secondary-sourced investigations BIO12-2
> conducts primary and secondary-sourced investigations individually or in a team BIO12-3
> selects and represents key qualitative and quantitative data and information using a range of appropriate media BIO12-4
> analyses primary and secondary information sources BIO12-5
> solves scientific problems using primary and secondary data BIO12-6
> communicates scientific understanding using suitable language and terminology BIO12-7

Knowledge and understanding

A student:

> explains the structures of DNA and analyses the mechanisms of inheritance and how the process of reproduction ensures continuity of species BIO12-8
> explains natural genetic change and the use of genetic technologies to induce genetic change BIO12-9
> analyses infectious disease in terms of disruption to homeostatic mechanisms and the organism's response including the human immune system BIO12-10
> explains non-infectious disease and disorders and a range of technologies used to assist, control, prevent and treat non-infectious diseases and disorders BIO12-11

CONTENT

Possible depth studies

Unit 3. Continuity of life on Earth

- Research pharmacogenomics and its dependence on genetic variation between people to determine which drugs will work most effectively as treatment for diseases.
- The use and abuse of human genetic information.
- Genetically modified food sources in relation to food sustainability.
- Modelling of polypeptides synthesised in the human body.
- Researching applications of biomedical engineering in assisting the diagnosis and treatment of disease and disorders.

Unit 4. Diseases and disorders

- Microbial techniques including gram staining and use of selective growth media.
- Researching historical chemical spills or nuclear fall-out to analyse the long-term effects on affected populations in terms of disease or disorders.
- Current examples of disease pandemics including cause, prevention, control and treatment.
- Inventing a biomechanical device to assist in a person's mobility.
- Analysis of global data on a named non-infectious disease.

GLOSSARY

 for your information

The glossary explains terms that will assist teachers in the interpretation of the subject. The glossary will be based on the NSW Science K–10 glossary and the Australian curriculum senior secondary years Biology glossary.

 consult

Glossary term	**Definition**
abiotic	The non-living components of the environment.
analyse	To consider in detail for the purpose of finding meaning or relationships, and identifying patterns, similarities and differences.
allele	A variant form of a gene.
apply	Use, utilise, employ in a particular situation.
assess	Make a judgement of value, quality, outcomes, results or size.
biota (biotic)	All of the living organisms in a specific region or area including animals, plants, and microorganisms.
calculate	Ascertain/determine from given facts, figures or information.
classify	Arrange or include in classes/categories.
compare	Show how things are similar or different.
conclusion	A judgement based on evidence.
construct	Make, build, put together items or arguments.
compare	Show similarities or differences.
controlled variable	A variable that is kept constant (or changed in constant ways) during an investigation.
Country	An area that is traditionally owned and looked after by an Aboriginal language group or community or certain people within that group. The term may indicate more than simply a geographical area; it is also a concept that can encompass the spiritual meanings and feelings of attachment associated with that area.
deduce	Draw conclusions.
demonstrate	Show by example.

Glossary term	Definition
dependent variable	A variable that changes in response to changes to the independent variable in an investigation.
design	To plan and evaluate the construction of a product or process, including an investigation.
digital technologies	Systems that handle digital data, including hardware and software, for specific purposes.
discuss	Identify issues and provide points for and against.
distinguish	Recognise or note/indicate as being distinct or different from; to note differences between.
environment	All surroundings, both living and non-living.
evaluate	To examine and judge the merit or significance of something, including processes, events, descriptions, relationships or data.
examine	Inquire into.
explain	Relate cause and effect; make the relationship between things evident/provide why and/or how.
extract	Choose relevant and/or appropriate details.
extrapolate	Infer from what is known.
gene pool	The stock of different genes in an interbreeding population.
hypothesis	A tentative idea or explanation for an observation, which can be tested and either supported or refuted by investigation.
Indigenous Cultural and Intellectual Property (ICIP)	Includes objects, sites, cultural knowledge, cultural expression and the arts, that have been transmitted or continue to be transmitted through generations as belonging to a particular Indigenous group or Indigenous people as a whole or their territory.
identify	Recognise and name.
independent variable	A variable that is changed in an investigation to see what effect it has on the dependent variable.
interpret	Draw meaning from.
investigate	Plan, inquire into and draw conclusions about.
investigation	A scientific process of answering a question, exploring an idea or solving a problem that requires activities such as planning a course of action, collecting data, interpreting data, reaching a conclusion and communicating these activities.
justify	Support an argument or conclusion.

Glossary term	Definition
model	A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.
niche	A position or function in a habitat that provides all the requirements for life of a species.
outline	Sketch in general terms; indicate the main features of.
plan	Decide on, and make arrangements for, in advance.
Place	A space mapped out by physical or intangible boundaries that individuals or groups of Torres Strait Islander peoples occupy and regard as their own. It is a space with varying degrees of spirituality.
predict	Suggest what might happen based on available information.
primary sources	Information created by a person or persons directly involved in a study or observing an event.
propose	Put forward (for example a point of view, idea, argument, suggestion) for consideration or action.
protocol	Appropriate ways of behaving, communicating and showing respect for diversity of histories and cultures. This involves appreciation of the knowledge, standing and status of people within the local Aboriginal community. Protocols inevitably vary between communities, and between people within a community. In establishing partnerships between Aboriginal communities and industries or professions, it is especially important that protocols are acknowledged and respected.
recall	Present remembered ideas, facts or experiences.
recommend	Provide reasons in favour.
recount	Retell a series of events.
relate	To identify connections or associations between ideas or relationships or between components of systems and structures.
reliability	Data that have been judged to have a high level of reliability; reliability is the degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute achieving similar results for the same population.
secondary-sourced investigation	Information that has been compiled from primary sources by a person or persons not directly involved in the original study or event.
summarise	Express, concisely, the relevant details.
synthesise	Putting together various elements to make a whole.

Glossary term	Definition
symbiosis	Any of several living arrangements between members of two different species, including mutualism, commensalism, and parasitism. Symbiosis can be positive (beneficial) or negative.
technology	Anything that can help solve a human problem or satisfy a need or want. It includes all types of human-made systems, tools, machines and processes, not just modern computational and communication devices, used to solve that problem.
theory	An explanation of a set of observations that is based on one or more proven hypotheses, which has been accepted through consensus by a group of scientists.
translation	The process by which a sequence of nucleotide triplets in a messenger RNA molecule gives rise to a specific sequence of amino acids during synthesis of a polypeptide or protein.
validity	An extent to which tests measure what was intended; an extent to which data, inferences and actions produced from tests and other processes are accurate.
variable	A factor that can be changed, kept the same or measured in an investigation, for example, time, distance, light, temperature.
vector	An insect or animal that carries a disease from one animal or plant to another.