BOARD OF STUDIES TEACHING & EDUCATIONAL STANDARDS NSW

INVESTIGATING SCIENCE 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 *Investigating Science 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 19 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 Australian Standard 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 Investigating Science 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.

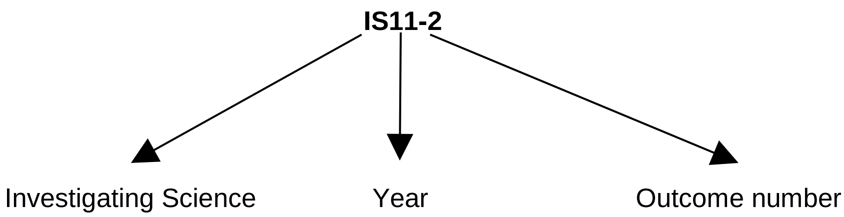
INVESTIGATING SCIENCE KEY

The following codes and icons are used in the *Investigating Science 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 *Investigating Science Stage 6 Draft Syllabus*, outcome codes indicate the subject, Year and outcome number, for example:

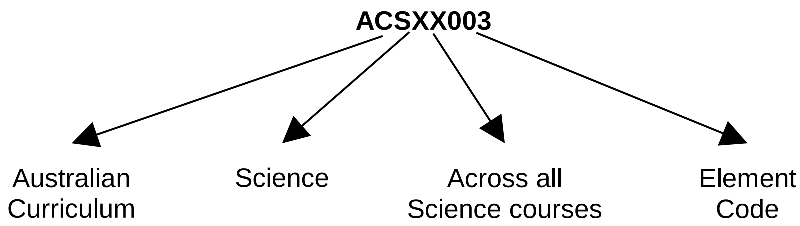


Outcome code	Interpretation
IS11-1	Investigating Science, Year 11 –Outcome number 1
IS12-4	Investigating Science, Year 12 – Outcome number 4
SC6LS-6	Science, Stage 6, Life Skills – Outcome number 6

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 map and field location techniques and rock and soil sampling and identification procedures, safely, competently and methodically for the collection of valid and reliable data (ACSXX003).



Where a number of content descriptions are jointly represented, all description codes are included, eg (ACSXX001, ACSXX002, ACSXX003).

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 *Stage 6 Investigating Science 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 Investigating Science Stage 6 course is designed to engage students of all abilities with scientific processes and to enable them to investigate relevant local and global scientific issues.

The processes of science and the specific skills of Working Scientifically have led humans to accumulate an evidence-based body of knowledge about how we have, are and intend to interact with our world and our galactic neighbourhood. The course is firmly focused on developing these skills as they provide a foundation for students to value investigation, solve problems, develop and communicate evidence-based arguments and make informed decisions.

The course promotes active inquiry and explores key concepts, models and phenomena. It draws and builds upon the values and attitudes, skills, knowledge and understanding developed in Science Stage 5. The course is designed to enhance students' understanding of the value of evidence-based investigations and the utility of science-based inquiry.

Investigating Science complements the science disciplines by developing integrated concepts and understandings found in the natural and physical sciences. The course draws upon and promotes interdisciplinary science and allows students to investigate a wide range of STEM (Science, Technology, Engineering and Mathematics) related issues in depth.

Investigating Science encourages the development of a range of capabilities that will enhance a student's ability to participate in all aspects of community life and within a fast-changing, technological landscape. The skills gained from this course will also provide important background for further studies in Science and STEM subjects at post-school level.

THE PLACE OF THE INVESTIGATING SCIENCE 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 Investigating Science Stage 6 syllabus in the K–12 curriculum as a whole.

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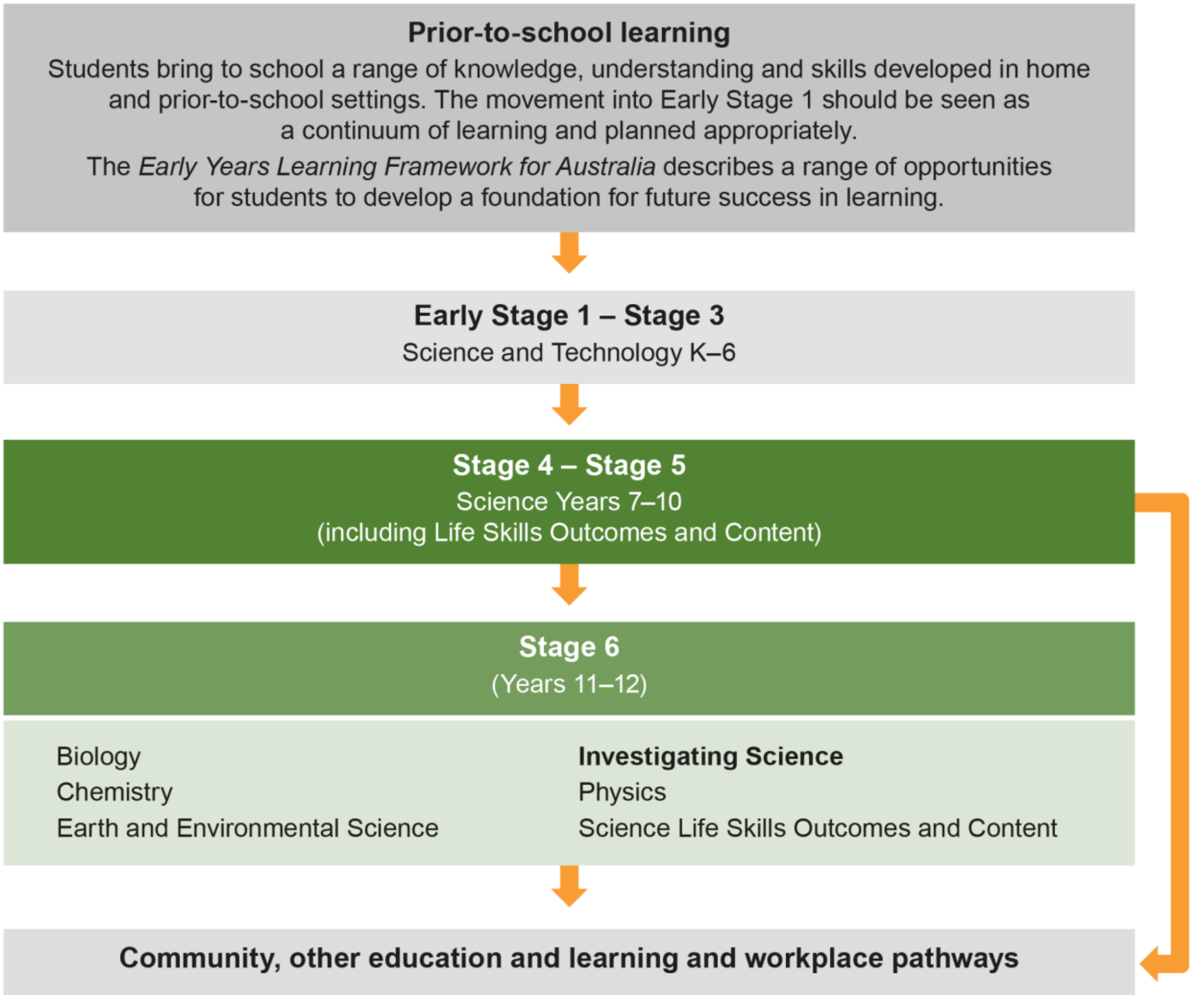

AIM

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.

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The study of Investigating Science in Stage 6 enables students to develop an appreciation and understanding of Science as a body of knowledge and a set of valuable processes that provide us with an ability to understand ourselves and the world in which we live. Through applying working scientifically processes, the course aims to enhance students' analytical and problem-solving skills to engage with and positively participate in an ever-changing, interconnected and technological world.

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.

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VALUES AND ATTITUDES

Students:

- develop positive, informed values and attitudes towards science
- recognise the importance and relevance of science 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 cause and effect
- develop knowledge and understanding of models, theories and laws
- develop knowledge and understanding of science and technology
- develop knowledge and understanding of contemporary issues involving science

OUTCOMES

for your information

In NSW syllabuses, outcomes provide detail about what students are expected to achieve at the end of each Year 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.

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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 **IS11-1** poses questions and hypotheses for scientific investigation	**Questioning** **IS12-1** develops and evaluates questions and hypotheses for scientific investigation
Designing investigations **IS11-2** designs and plans appropriate scientific investigations	**Designing investigations** **IS12-2** designs, plans and evaluates primary and secondary-sourced investigations
Conducting investigations **IS11-3** conducts primary or secondary-sourced investigations individually or in a team	**Conducting investigations** **IS12-3** conducts primary and secondary-sourced investigations individually or in a team
Representing **IS11-4** represents qualitative and quantitative data and information using a range of appropriate media	**Representing** **IS12-4** selects and represents key qualitative and quantitative data and information using a range of appropriate media
Analysing **IS11-5** analyses primary and secondary information sources	**Analysing** **IS12-5** analyses primary and secondary information sources

Solving problems **IS11-6** solves scientific problems	**Solving problems** **IS12-6** solves scientific problems using primary and secondary data
Communicating **IS11-7** communicates scientific understanding	**Communicating** **IS12-7** 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 cause and effect	**Objective** Students: • develop knowledge and understanding of science and technology
Year 11 course outcomes A student:	**Year 12 course outcomes** A student:
IS11-8 identifies that the collection of primary and secondary data initiates scientific investigations	**IS12-8** develops and evaluates the process of undertaking scientific investigations
IS11-9 examines the use of inferences and generalisations in scientific investigations	**IS12-9** describes and explains how science drives the development of technologies
Year 11 course Unit 2	**Year 12 course Unit 4**
Objective Students: • develop knowledge and understanding of models, theories and laws	**Objective** Students: • develop knowledge and understanding of contemporary issues involving science
Year 11 course outcomes A student:	**Year 12 course outcomes** A student:
IS11-10 describes and assesses how scientific explanations, laws and theories have developed	**IS12-10** uses evidence-based analysis in a scientific investigation to support or refute a hypothesis
IS11-11 develops and engages with modelling as an aid in predicting and simplifying scientific objects and processes	**IS12-11** evaluates the implications of ethical, social, economic and political influences on science

WORKING SCIENTIFICALLY

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

Opportunities are to be 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 phenomena, 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 provision of depth studies. 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 primary and secondary-sourced investigations 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 *Investigating Science Stage 6 Draft Syllabus* with indicative hours, arrangement of content, and an overview of course content.

consult

		Unit	Module	Indicative hours
Year 11 course (120 hours)	**Working Scientifically Skills**	**Unit 1** Cause and Effect	**Module 1** Observing	45
			Module 2 Inferences and generalisations	
		Depth Study Drawn from knowledge outcome(s) in Units 1 and/or 2		30
		Unit 2 Models, Theories and Laws	**Module 3** Theories and laws	45
			Module 4 Scientific models	
Year 12 course (120 hours)		**Unit 3** Science and Technology	**Module 5** Scientific investigations	45
			Module 6 Technologies	
		Depth Study Drawn from knowledge outcome(s) in Units 3 and/or 4		30
		Unit 4 Contemporary Issues Involving Science	**Module 7** Fact or fallacy?	45
			Module 8 Science and society	

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 30 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 30 hours of in-class time is allocated in each of Years 11 and 12.
- At least one depth study must be included in each of Years 11 and 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 30% 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

- Devise 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.

Field work

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.

consult

Investigating Science 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 30–40%
- A minimum of 25% weighting must be allocated to practical investigations.

Component	**Weighting %**
Skills in working scientifically	70
Knowledge and understanding of course content	30
	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 30–40%
- A minimum of 25% weighting must be allocated to practical investigations.

Component	**Weighting %**
Skills in working scientifically	70
Knowledge and understanding of course content	30
	100

Investigating Science 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

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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 make 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 for students 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 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 for students 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 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 science 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 whilst 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.

INVESTIGATING SCIENCE 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 IS11-1

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 IS11-2

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 IS11-3

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 IS11-4

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 IS11-5

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 IS11-6

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 IS11-7

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)

UNIT 1 CAUSE AND EFFECT

MODULE 1 OBSERVING

OUTCOMES

A student:

> poses questions and hypotheses for scientific investigation IS11-1
> conducts primary or secondary-sourced investigations individually or in a team IS11-3
> represents qualitative and quantitative data and information using a range of appropriate media IS11-4
> identifies that the collection of primary and secondary data initiates scientific investigations IS11-8

Related Life Skills outcomes: SC6LS-1, SC6LS-3, SC6LS-4, SC6LS-8

CONTENT FOCUS

Observation is the foundation and the trigger of scientific research. Scientific processes can only be applied to phenomena that can be observed and measured. Detailed observations motivate scientists to ask questions about the causes and the effects of phenomena they observe. In this way, science has continued to progress and enhance the lives of individuals and society by encouraging a continued search for reason and understanding.

Students explore the importance of observations and the collection of data in scientific investigations. In this module students will be expected to design and conduct an ongoing primary investigation which will be used to demonstrate the importance of making detailed and accurate observations, determining types of variables and formulating testable scientific hypotheses.

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 by collecting and representing data to answer questions and generate hypotheses arising from observations.

CONTENT

Observation

Inquiry question: What information can be gathered by observations?

Students:

- observe and record qualitative and quantitative data, from one of the following information sources, for use in a primary investigation, for example:
  - digital images or hand-drawn diagrams of cells
  - geological succession obtained from rock strata
  - observing an object falling due to gravity
  - observing a candle burning
  - measuring the pH of common household chemicals

Scientific investigation and variables

Inquiry question: What are the differences between a practical exercise and a primary scientific investigation comprising variables?

Students:

- compare characteristics of a practical exercise and a primary scientific investigation
- using data gathered for the primary investigation:
  - pose questions that may be investigated
  - discuss the role of variables
  - determine the independent and dependent variables
  - formulate a hypothesis that links the independent and dependent variables
  - describe at least three variables that should be controlled in order to increase the validity of the investigation
- using the information gained above develop a method for their primary investigation by:
  - describing how to change the independent variable
  - determining the characteristics of the measurements that will form the dependent variable
  - describing how the controlled variables will be made consistent
  - describing how risks can be minimised

The role of observations

Inquiry question: What is the role of observation in a scientific investigation?

Students:

- conduct the primary investigation, record the data and evaluate the difference between qualitative and quantitative observations and where they can be used appropriately
- evaluate where data obtained from observations is limited by the observational tools we have available to us, including but not limited to:
  - light microscope vs electron microscope
  - digital vs analogue technologies
- discuss the characteristics of looking, seeing and observing
- assess ways in which Aboriginal and Torres Strait Island peoples used observations to develop an understanding of Country and Place to develop innovative ways of managing the natural environment, for example, the observations required to develop:
  - spear throwers, eg woomeras and other hunting weapons
  - fire stick farming
  - knowledge of the seasons and plant and animal activity to predict hunting, fishing and gathering opportunities
  - knowledge about plants for medicinal purposes

Collecting and recording data

Inquiry question: What information can be collected in a primary scientific investigation?

Students:

- investigate methods used and the type of data that needs to be collected when an investigation is dependent on the subject and the context of the study, for example:
  - experimental testing in engineering applications such as mechanical or chemical testing
  - environmental fieldwork such as marine biology or soil-testing programs
  - conducting surveys such as a National Health Survey
  - using models and simulations such as the use of digital models used in organic chemistry or in medical applications
- apply conventions for collecting and recording information from the primary investigation to analyse the data, including but not limited to:
  - tables
  - graphs
  - visual representations
  - digital representations

Conclusions promote further observations

Inquiry question: How do conclusions drawn from scientific investigations promote further scientific investigation?

Students:

- draw conclusions from their analysis of the primary scientific investigation data
- assess the need to observe and gather further data about other phenomena arising from the primary scientific investigation

UNIT 1 CAUSE AND EFFECT

MODULE 2 INFERENCES AND GENERALISATIONS

OUTCOMES

A student:

> poses questions and hypotheses for scientific investigation IS11-1
> designs and plans appropriate scientific investigations IS11-2
> represents qualitative and quantitative data and information using a range of appropriate media IS11-4
> examines the use of inferences and generalisations in scientific investigations IS11-9

Related Life Skills outcomes: SC6LS-1, SC6LS-2, SC6LS-4, SC6LS-9

CONTENT FOCUS

Scientific inquiry is instigated through humans making inferences and generalisations from commonly held understandings. Such inferences and generalisations have led to a wide range of experiments being performed throughout history which have led to breakthroughs in scientific understanding. Many hypotheses, when found correct, have generated further breakthroughs and created the need to develop new technologies to enable further observation.

Students will consider that advances in knowledge and skills in one field influence other areas of science, technology and engineering. Throughout this module, students will engage in primary and secondary investigations which will assist them in conducting and reporting on investigations, understand further the central roles of scientific questioning and the need for collaboration as essential in the pursuit of scientific truth.

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, by developing understandings about drawing inferences, making generalisations and formulating and testing hypotheses through the collection and representation of data.

CONTENT

Observations and inferences

Inquiry question: What inferences can be drawn from observations?

Students:

- conduct a collaborative primary investigation and collect a range of qualitative and quantitative data from one, or more, of the following areas, for example:
  - microscopy–structure and measurement of cells
  - the reactions of calcium carbonate
  - the 'life' of different batteries under different circumstances
  - observations made and data collected in the local environment
- make inferences from observations made in this primary investigation
- compare the meaning of inference and observation

- investigate practices of Aboriginal and Torres Strait Islander peoples that relate to observations and inferences, for example:
  - leaching of toxins in bush tucker
  - locating sources of freshwater within bodies of salt water

Using secondary sources

Inquiry question: How are secondary sources useful in conducting a primary investigation?

Students:

- conduct an initial secondary-sourced investigation relating to the collaborative primary investigation above, including:
  - use of appropriate language and structure for a report
  - appropriate referencing
- investigate qualitative and quantitative data found in secondary sources used to inform the collaborative primary investigation, for example:
  - the development of measurement in microscopy
  - chemical reactions in cave formation
  - energy storage
  - methods of environmental measurement
- evaluate the usefulness of secondary-sourced research prior to undertaking a primary investigation in order to:
  - make inferences
  - develop inquiry questions
  - construct suitable hypotheses
  - avoid unnecessary investigation

Developing hypotheses and inquiry questions

Inquiry question: What is the relationship between inquiry questions and a hypothesis?

Students:

- develop inquiry questions for further investigation generated from the collaborative primary investigation
- using a selected inquiry question, develop a hypothesis based on initial primary and secondary-sourced research
- devise a primary investigation that tests the hypothesis developed (ACSXX002, ACSXX003)

Generalisations in Science

Inquiry question: What generalisations and assumptions are made from observed data?

Students:

- conduct the primary investigation, using the hypothesis developed above
- record data
- use appropriate representations to analyse the data
- make generalisations to describe any trends found in the data
- draw conclusion based on generalisations

Peer review

Inquiry question: What role do peers play in scientific investigation?

Students:

- assess the experimental design of the primary investigation by engaging in peer feedback concerning the hypothesis, research questions, data collection and analysis
- assess the input that collaborative teams and alternative perspectives can have on the development of hypotheses and research questions, for example: (ACSXX009, ACSXX010, ACSXX013)
  - the development of the Watson and Crick Model of DNA
  - the development of the Periodic Table
  - the development of the heliocentric model of the solar system
  - the development of rates of sedimentation
- assess the scientific community's current understanding of scientific mysteries and outline why such scientific understanding remains unknown or incomplete, for example: (ACSXX005)
  - the origin of life on Earth
  - is Feynmanium the last chemical on the Periodic Table that could exist?
  - the expanding universe and the Hubble constant
- evaluate biases that may have affected the scientific thinking of European settlers regarding the ecological understanding and knowledge Aboriginal and Torres Strait Islander peoples have of Country and Place in relation to agricultural practices and biological and natural resources of Australia (ACSXX005)

Continuing the search

Inquiry question: How do scientific investigations lead to further research?

Students:

- propose a series of questions for further research about the investigation based on observations
- Investigate, using secondary sources, historical instances where assumptions have been made, tested and then revised, for example:(ACSXX010)
  - spontaneous generation and the investigations that led to the proposal of the 'Germ Theory'
  - radioactivity, including the work of Henri Becquerel and Marie Curie
  - Phlogiston theory
  - human influences on climate change

UNIT 2 MODELS, THEORIES AND LAWS

MODULE 3 THEORIES AND LAWS

OUTCOMES

A student:

> analyses primary and secondary information sources IS11-5
> solves scientific problems IS11-6
> communicates scientific understanding IS11-7
> describes and assesses how scientific explanations, laws and theories are developed IS11-10

Related Life Skills outcomes: SC6LS-5, SC6LS-6, SC6LS-7, SC6LS-11

CONTENT FOCUS

The term ‘Science’ comes from the Latin *scientia* which means a knowledge based on demonstrable and reproducible data. Such reproducible data is used by scientists to develop theories and laws to explain and describe phenomena. Theories provide a coherent understanding of a wide range of phenomena. Laws are usually statements that can be expressed as a mathematical relationship that describes phenomena in nature, with no exceptions, at the time it was made. Testing these theories and laws constantly drives science forward to achieve breakthroughs in interpreting our observations of nature.

Students examine that complex models and or theories often require a wide range of evidence which can have an impact on society and the environment. In this module, students engage in primary and secondary investigations that are related to major theories or laws and their application.

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 analysing data and information to identify trends, patterns and relationships, solve problems and communicate ideas about the development of theories and laws.

CONTENT

Introduction to scientific laws and theories

Inquiry question: What differences and similarities are there between scientific theories and laws?

Students:

- investigate the Law of Conservation of Mass through a primary investigation
- investigate the Theory of Plate Tectonics through a secondary-sourced investigation
- propose the differences between a theory and a law

The development of a theory

Inquiry question: What leads to a theory being developed?

Students:
- investigate the supporting evidence and the development of theories, including:
  - The Big Bang Theory
  - Plate Tectonic Theory
- investigate how aspects of a theory can be disproved through the collection of evidence, including:
  - the Geocentric Theory of the solar system
  - the theory of inherited acquired characteristics and the subsequent development of the Theory of Evolution
  - J.J. Thomson's plum pudding model of the atom
  - the Steady State Theory of the Universe in cosmology

The development of laws

Inquiry question: What leads to the acceptance of a scientific law?

Students:
- investigate and assess the evidence that supports scientific laws, for example:
  - Newton's Second Law of Motion
  - Avogadro's Law
  - Law of Superposition
  - Mendel's Laws
- design and conduct a primary investigation where the results can be predicted through a law, for example:
  - Ohm's Law
  - the Law of Conservation of Energy

Application of laws and theories in Science

Inquiry question: How are theories and laws used in science?

Students:
- investigate applications of the Law of Conservation of Energy in different science disciplines through primary and secondary-sourced research, including, but not limited to:
  - Chemistry
  - Physics
  - Human Biology
  - Climate Science
- demonstrate, using evidence and examples, how diverse phenomena have been unified into specific theories, for example:
  - the Atomic Theory
  - the Theory of Evolution
  - the Big Bang Theory
  - Plate Tectonic Theory
- investigate how scientific investigations of nuclear reactions changed the way the Law of Conservation of Mass and the Law of Conservation of Energy are interpreted

UNIT 2 MODELS, THEORIES AND LAWS

MODULE 4 SCIENTIFIC MODELS

OUTCOMES

A student:

> designs and plans appropriate scientific investigations IS11-2
> conducts primary or secondary-sourced investigations individually or in a team IS11-3
> represents qualitative and quantitative data and information using a range of appropriate media IS11-4
> develops and engages with modelling as an aid in predicting and simplifying scientific objects and processes IS11-11

Related Life Skills outcomes: SC6LS-2, SC6LS-3, SC6LS-4, SC6LS-11

CONTENT FOCUS

Scientific models are developed as a means of understanding structure and function and representing scientific concepts, in a visual medium, often too complex to understand in the abstract. Models are used to make predictions and may include physical and digital models which can be refined over time by the inclusion of emerging scientific knowledge.

In this module, students are led to recognise that many models have limitations and are modified as further evidence comes to light, for this reason, scientific models are continually evaluated for accuracy and applicability by the global scientific community through the process of peer review. Students construct and evaluate their own models generated through a primary investigation.

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 and conducting investigations to obtain and represent data and apply the function of scientific modelling.

CONTENT

Models to inform understanding

Inquiry question: What makes scientific models useful?

Students:

- examine the use of models, including, but not limited to:
  - Watson and Crick's DNA model
  - models of the solar system
  - atomic models
  - climate models
- outline how these models have been used to illustrate, simplify and represent scientific concepts and processes
- explain how these models are used to make predictions that are difficult to analyse in the real world due to time frames, size and cost
- assess the effectiveness of these models at facilitating the understanding of scientific processes, structures and mathematical relationships through the use of diagrams, physical replicas, mathematical representations, analogies and computer simulations (ACSXX013)

- evaluate how these models utilise a growing body of data from a wide range of disciplines and technologies to refine predictions and test new hypotheses (ACSXX009, ACSXX013)

Types of models

Inquiry question: When should we use a particular model?

Students:

- explain why new evidence can challenge the use of older scientific models and may result in such models being contested and refined or replaced, including, but not limited to the development of: (ACSXX005, ACSXX009)
  - identification of the causes of infectious disease
  - models of the solar system
  - atomic models
  - climate models
- compare the differences and discuss the limitations of these simple and complex models (ACSXX005, ACSXX009)

Constructing a model

Inquiry question: How can a model be constructed to simplify our understanding of a scientific concept?

Students:

- investigate a scientific concept or process that can be represented using a model, including:
  - planning a model with reference to the scientific literature (ACSXX009)
  - constructing a model using appropriate resources to represent the scientific concept (ACSXX006)
  - demonstrating how the model could be used to make a prediction
  - present and evaluate the model through peer feedback (ACSXX005, ACSXX007)

YEAR 11 DEPTH STUDIES

OUTCOMES

Skills
A student:

- > poses questions and hypotheses for scientific investigation IS11-1
- > designs and plans appropriate scientific investigations IS11-2
- > conducts primary or secondary-sourced investigations individually or in a team IS11-3
- > represents qualitative and quantitative data and information using a range of appropriate media IS11-4
- > analyses primary and secondary information sources IS11-5
- > solves scientific problems IS11-6
- > communicates scientific understanding IS11-7

Knowledge and understanding
A student:

- Identifies that the collection of primary and secondary data initiates scientific investigations IS11-8
- explores the use of inferences and generalisations in order to form hypotheses IS11-9
- describes and assesses how scientific explanations, laws and theories have developed IS11-10
- develops and engages with modelling as an aid in predicting and simplifying scientific objects and processes IS11-11

Related Life Skills outcomes: SC6LS-1, SC6LS-2, SC6LS-3, SC6LS-4, SC6LS-5, SC6LS-6, SC6LS-7, SC6LS-8, SC6LS-9, SC6LS-10

CONTENT

Possible depth studies

Unit 1. Cause and Effect

- Case study of a 20th century scientist investigating observations, inferences and models/theories/laws that came out of or built upon research
- Examine 'Clock' reactions in chemistry
- Examine the variables involved in pendulum motion
- The effect of environmental conditions on the rate of photosynthesis
- Observe the properties of different soils

Unit 2. Models, Theories and Laws

- Evaluate a scientific model
- Construct a visual presentation showing the development of the Atomic Theory
- Create a model to demonstrate the Theory of Plate Tectonics
- Examine paleontological climate models–what observational data is required to build them? What assumptions have to be made to 'fill the gaps' and how are the models built?
- Explore microscopy technology advances and their impacts on human society
- Investigate the ways in which traditional knowledge can be used to inform models and theories around sustainable practices in Australia

INVESTIGATING SCIENCE YEAR 12 COURSE

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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 IS12-1

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 IS12-2

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 IS12-3

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 IS12-4

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 IS12-5

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 IS12-6

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 IS12-7

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 SCIENCE AND TECHNOLOGY

MODULE 5 SCIENTIFIC INVESTIGATIONS

OUTCOMES

A student:
> develops and evaluates questions and hypotheses for scientific investigation IS12-1
> designs, plans and evaluates primary and secondary-sourced investigations IS12-2
> conducts primary and secondary-sourced investigations individually or in a team IS12-3
> develops and evaluates the process of undertaking scientific investigations IS12-8

Related Life Skills outcomes: SC6LS-1, SC6LS-2, SC6LS-3, SC6LS-11

CONTENT FOCUS

Students learn that the experimental method is a dynamic process influenced by initial observations, new evidences, unexpected results or phenomena arising from the investigation. In this module, the interrelated roles of primary and secondary-sourced investigations are examined. By conducting a primary and a secondary-sourced investigation students use peer feedback in order to refine their investigative designs and report on their findings.

The importance of accuracy, validity and reliability are explored in relation to the investigative work of a scientist. Students examine the differences between a scientific investigation and a scientific report, recognising that while the report format is sequential, the investigation need not be.

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 hypotheses and focus questions, justify a particular design for an investigation and conduct valid scientific investigations accurately and reliably.

CONTENT

Primary investigations

Inquiry question: What initiates an investigation?

Students:
- research how scientists were brought to investigate the following, including, but not limited to:
  - Marshall and Warren and their work on peptic ulcers
  - Von Helmont's investigations on plant growth
  - Percy Spencer and his work on microwaves
- plan and conduct a primary investigation that involves the production or consumption of oxygen and assess the reliability and validity of the investigation
- assess the need to conduct a secondary-sourced investigation prior to and during a primary investigation

The process of conducting a primary investigation

Inquiry question: Does an investigation always start with an aim?

Students:
- conduct an initial investigation through observation and propose scientific inquiry questions in the following areas, for example:
  - observing the interactions that occur in an outdoor area such as a garden
  - testing the pH of foods or water
- from the initial investigation, choose an inquiry question, conduct secondary-sourced research and propose a hypothesis for the example chosen
- plan and conduct the investigation
- make amendments to the proposed plan where necessary
- analyse where deviations from the traditional and linear model of scientific methodology would be necessary in order to test the hypothesis
- discuss the differences between the process of investigation and the requirements of an experimental report

Secondary-sourced investigations

Inquiry question: How is a secondary-sourced investigation conducted?

Students:
- conduct a secondary-sourced investigation focusing on the pathway and/or methodologies followed by an individual or team of scientists, for example:
  - Eratosthenes and the Earth's circumference
  - Newton and gravity
  - Graham Clark and the cochlear implant team
- synthesise the information gathered from the secondary-sourced investigation and assess each text in terms of relevance, reliability and validity

Reporting

Inquiry question: What is the structure of a primary or secondary investigative report?

Students:
- engage with the conventions of writing a report on a primary investigation by reviewing a published and peer-reviewed scientific report
- prepare a report for each of the primary investigations completed in this module and engage with peer feedback for each investigation
- using a sample of a peer-reviewed and published secondary-sourced investigation, identify the purpose of the report, the language style used and the presentation and structure of the report
- compare and contrast the structures and functions of a scientific investigation and the report written about it
- prepare a report for a secondary-sourced investigation conducted in this module by drawing on a variety of different texts including combinations of language and visual texts, for example:
  - informative language
  - persuasive language
  - written text
  - visual images

UNIT 3 SCIENCE AND TECHNOLOGY

MODULE 6 TECHNOLOGIES

OUTCOMES

A student:

> develops and evaluates questions and hypotheses for scientific investigation IS12-1

> designs, plans and evaluates primary and secondary-sourced investigations IS12-2

> selects and represents key qualitative and quantitative data and information using a range of appropriate media IS12-4

> describes and explains how science drives the development of technologies IS12-9

Related Life Skills outcomes: SC6LS-1, SC6LS-2, SC6LS-4, SC6LS-11

CONTENT FOCUS

The rapid development of new technologies has enhanced industrial processes, agricultural processes, medical applications and communications. In this module students explore the dynamic relationship between science and technology where the continuing advancement of science is dependent on the development of new tools and materials and reflects the interdependence of science and technology.

In this module, students investigate the relationship between science and technology and consider experimental risks as they engage with the skills of Working Scientifically. Students will investigate the appropriateness of using a range of technologies in conducting primary investigations including the need for accuracy of measurement.

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 hypotheses and questions, justify and evaluate designs for investigations to collect and represent data using appropriate technologies.

CONTENT

The scientific investigation and technology

Inquiry question: How does technology limit scientific investigation?

Students:

- design a primary investigation that utilises available technologies to measure both independent and dependent variables to produce quantitative results, for example, measuring:
  - temperature
  - distance
  - change over time
  - reaction rates
  - pressure
  - volume
- conduct the primary investigation to obtain relevant data and evaluate the limitations of the technologies used
- investigate the range of measuring devices used in the primary investigation and assess the likelihood of random and systematic errors and their degree of accuracy

- using specific examples, compare the accuracy of analogue and digital technologies for making observations
- assess the safety of technologies selected for the primary investigation by using chemical safety data and Work Health and Safety guidelines as appropriate

New Technologies

Inquiry question: Why develop new technologies?

Students:

- investigate the development of a range of technologies that help answer a question or solve a problem in a scientific field, for example:
  - nanoparticles in medical applications
  - biotechnology in providing sustainable food sources
  - seismic equipment used to predict geological hazards
  - robotics used in space exploration
- assess the impact that the development of technologies has had on the accumulation of evidence to support scientific theories, laws and models, for example:
  - computer simulations used in biochemistry
  - modern analytical techniques using the Large Hadron Collider (LHC)
  - application of electromagnetic waves in detection technologies
- assess how the development of technologies progresses scientific research and how this in turn drives the development of new technologies, for example:
  - the (LHC)
  - the electron microscope
  - satellite imagery
- investigate the increasing awareness scientists have of the value of Aboriginal and Torres Strait Islander peoples' knowledge and understanding of the medicinal and material uses of plants and, in partnership with communities, the potential for ethical development of new drug treatments and synthetic chemicals through the bio-harvesting of plants from Country and Place

UNIT 4 CONTEMPORARY ISSUES INVOLVING SCIENCE

MODULE 7 FACT OR FALLACY?

OUTCOMES

A student:

> selects and represents key qualitative and quantitative data and information using a range of appropriate media IS12-4
> analyses primary and secondary information sources IS12-5
> solves scientific problems using primary and secondary data IS12-6
> communicates scientific understanding using suitable language and terminology IS12-7
> uses evidence-based analysis in a scientific investigation to support or refute a hypothesis IS12-10

Related Life Skills outcomes: SC6LS-4, SC6LS-5, SC6LS-6, SC6LS-7, SC6LS-12

CONTENT FOCUS

The scientific process is the most powerful tool we have for generating knowledge about our world. It uses evidence and measurement to find truth and to highlight misinterpretations and misrepresentations. Science as a human endeavour is subject to human failings which can contribute to fallacies, misinterpretations and, on occasion, fraud. It is for this reason scientific processes attempt to compensate for human failings by questioning evidence, re-testing ideas, replicating results and engaging with peer review in order to evaluate research.

In this module students investigate claims through primary and secondary-sourced investigations and evaluate claims based on scientific evidence. They explore examples of scientific claims made in the media and investigate the benefits of peer review.

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, analyse and evaluate trends, relationships and patterns and derive and justify valid conclusions to communicate, using a variety of media, ideas about scientifically factual or fallacious claims.

CONTENT

Testing claims

Inquiry question: How can a claim be tested?

Students:

- plan and conduct an investigation based on testing a claim and consider:
  - the validity of the experimental design
  - the reliability of the data obtained
  - the accuracy of the procedure including random and systematic error
- evaluate the claim based on the evidence collected and the impact of sample size in the investigation
- compare emotive advertising with evidence-based claims for example:
  - health claims on food packaging
  - claims about the efficacy of a product

Impacts on investigations

Inquiry question: What factors can affect the way data can be interpreted, analysed and understood?

Students:

- using examples, justify the use of placebos, double-blind trials and control groups for being able to draw valid conclusions
- evaluate the impact of societal and economic influences on the development of claims, including, but not limited to:
  - prediction of climate change
  - suggesting remedies for health conditions

Evidence-based analysis

Inquiry question: What evidence is needed to draw valid conclusions?

Students:

- assess the validity and reliability of the results of the primary investigation
- determine correlations and conclusions
- investigate the 'Hawthorne Effect' in regard to the validity of conclusion

Reading between the lines

Inquiry question: How does the reporting of science influence the understanding of science by the public?

Students:

- examine a current scientific debate and how it is portrayed in the mainstream media
- compare the difference between a peer reviewed journal article and a scientific article that has been published in popular media and analyse the benefits of peer review
- explore the the 'Halo Effect' and explain how the influence of positive perceptions can result in the rejection of valid alternative perspectives, for example:
  - celebrities endorsing products or viewpoints
  - misleading advertising claims
- using examples in popular media, analyse how the use of scientific language can be used to make misleading claims
- prepare a case study about a scientist who has been proven to falsify their results and discuss the process used to uncover the fraudulent research

UNIT 4 CONTEMPORARY ISSUES INVOLVING SCIENCE

MODULE 8 SCIENCE AND SOCIETY

OUTCOMES

A student:

> analyses primary and secondary information sources IS12-5
> solves scientific problems using primary and secondary data IS12-6
> communicates scientific understanding using suitable language and terminology IS12-7
> evaluates the implications of ethical, social, economic and political influences on science IS12-11

Related Life Skills outcomes: SC6LS-5, SC6LS-6, SC6LS-7, SC6LS-12

CONTENT FOCUS

Those who pursue science have created processes, tools and products that challenge society and some of its belief systems, ethics and societal norms. Society, in response, debates and regulates science to prevent harmful developments, unacceptable outcomes and to allow for new and beneficial products, processes and ideas. Science influences and can be affected by society, governments, industry, economic interests and cultural perspectives.

In this module students explore the impacts of ethical, social, economic and political influences on science and its 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 analysing and evaluating trends, relationships and patterns, derive and justify valid conclusions and communicate, using a variety of media, ideas about the position and application of science in society.

CONTENT

Incidents, events and science

Inquiry question: How can events affect society's view of science?

Students:

- investigate case studies of past events to consider how they affected the public image of science, including, but not limited to:
  - the meltdown of nuclear reactors
  - the development of the smallpox vaccine
  - the development of flight
  - the positive and negative aspects of damming rivers
- prepare a case study to describe how scientific evidence has been fabricated or misrepresented, accepted by society and later revealed to be fraudulent, and how it had an impact on society's views of science, for example:
  - manipulated pharmaceutical trials
  - fabricated fossil evidence
  - statistical analysis and representations designed to persuade based on a biased assumption

Regulation of Science

Inquiry question: Why is scientific research regulated?

Students:
- investigate the need for the regulation of scientific research opportunities, for example:
  - genetic modification of sex cells and embryos
  - the development biotechnological weaponry
  - testing of pharmaceuticals
  - the products and processes of the nuclear industry
  - protection of Indigenous Cultural and Intellectual Property (ICIP)
- investigate and assess ethical issues surrounding current scientific research, for example:
  - the use of radiation
  - issues involving pharmaceutical research
  - gene manipulation in biotechnology
  - mining practices
  - bioprospecting
- investigate a range of international scientific codes of conduct in regard to scientific research and practice, for example:
  - cloning
  - stem cell research
  - surrogacy
  - genetically modified foods
  - transplantation of organs
- evaluate the usefulness of regulation in scientific research

The influence of economic, social and political forces on scientific research

Inquiry question: How do economic, social and political influences affect scientific research?

Students:
- evaluate how personal, cultural and socio-economic perspectives can influence the direction of scientific research, for example:
  - perceptions about diet in a multicultural society
  - investigating traditional medical treatments
  - mining practices
- evaluate how scientific research aids in economic development and human progress, for example:
  - nuclear power generation
  - use of antimicrobial drugs
  - genetically modified food sources
  - use of petroleum products
- analyse the impacts that governments and large corporations have on scientific research, for example:
  - corporations and market opportunities
  - university research project budgets
  - governmental budgets and limited time priorities
  - benefit sharing in research using ICIP
- evaluate how scientific developments both impact on and respond to society's needs, for example:
  - renewable energy generation and storage
  - nanotechnology

- robotics in medicine and industry
- materials science
- colonisation of space
- artificial intelligence

YEAR 12 DEPTH STUDIES

OUTCOMES

Skills
A student:

> develops and evaluates questions and hypotheses for scientific investigation IS12-1
> designs, plans and evaluates primary and secondary-sourced investigations IS12-2
> conducts primary and secondary-sourced investigations individually or in a team IS12-3
> selects and represents key qualitative and quantitative data and information using a range of appropriate media IS12-4
> analyses primary and secondary information sources IS12-5
> solves scientific problems using primary and secondary data IS12-6
> communicates scientific understanding using suitable language and terminology IS12-7

Knowledge and understanding
A student:

> develops and evaluates the process of undertaking scientific investigations IS12-8
> describes and explains how science drives the development of technologies IS12-9
> uses evidence-based analysis in a scientific investigation to support or refute a hypothesis IS12-10
> evaluates the implications of ethical, social, economic and political influences on science IS12-11

Related Life Skills outcomes: SC6LS-1, SC6LS-2, SC6LS-3, SC6LS-4, SC6LS-5, SC6LS-6, SC6LS-7, SC6LS-11, SC6LS-12

CONTENT

Possible depth studies

Unit 3. Science and Technology

- Examine the potential for humans to live sustainably in space.
- Investigate controls for testing the effect of an oxidation of metals under differing preventative treatments.
- Research the history of the development of the Large Hadron Collider.
- Research historical misrepresentation of scientific evidence.
- Examine recommendations for improvements that would improve reliability and validity of research.
- Conduct a case study of a contemporary scientist and how a discovery in their field has come about as a result of new technologies being developed and supported.

Unit 4. Contemporary Issues Involving Science

- Examine nanotechnology and model its function.
- Explore the inert properties of biocompatible materials.
- Research water purification methods.
- Analysis data that could be used or is used to evidence climate change.
- Examine a development in genetic engineering.
- Research developments in the area of polymers.

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

consult

Glossary term	Definition
aim	The main purpose of the design of the experiment.
analyse	To consider in detail for the purpose of finding meaning or relationships, and identifying patterns, similarities and differences.
apply	Use, utilise, employ in a particular situation.
assess	Make a judgement of value, quality, outcomes, results or size.
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.
contrast	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
define	State meaning and identify essential qualities
demonstrate	Show by example
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.

Glossary term	Definition
digital technologies	Systems that handle digital data, including hardware and software, for specific purposes.
discuss	Identify issues and provide points for and against.
environment	All the 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.
extract	Choose relevant and/or appropriate.
extrapolate	To estimate (a function that is known over a range of values of its independent variable) to values outside the known range
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.
inquiry question	A driving question for an investigation.
interpret	Draw meaning from.
investigate	Conduct an investigation.
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
law	Statement about or a description of a phenomenon that is observed to be universally true across time and space or which always applies in a specific set of circumstances
model	A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.
plan	Decide on and make arrangements for in advance

Glossary term	Definition
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
recommend	Provide reasons in favour
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.
risk assessment	The determination of quantitative or qualitative estimate of risk related to a well-defined situation and a recognized threat (also called hazard)
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.
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.
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.