# SCIENCE

## Years 1 to 10 Syllabus

# Rationale

## Nature of the key learning area

### Science — a way of knowing

Humans are innately curious about their world. Science as a 'way of knowing' is used by people to explore and explain their experiences of phenomena of the universe. It is a process for constructing new knowledge. Science is part of the human quest for understanding and wisdom and reflects human wonder about the world. The study of science as a 'way of knowing' and a 'way of doing' can help students reach deeper understandings of the world.

### Scientific knowledge

Scientific knowledge is a set of explanations, made by communities of scientists, which attempts to account for phenomena and experiences. At times these explanations may seem to conflict with everyday understandings, but they are seen as viable in the light of current evidence and scientific argument. These explanations are tentative and continue to be modified.

Scientists are very much a part of the world which they study. Their observations and inferences are influenced by their prior experience and understandings, the social groups to which they belong and their status within these groups. Like scientists of the past and present, students understand and appreciate that current scientific knowledge has been built up over time and has been organised into disciplines and fields.

### Science and how it works

Scientists work in ways which influence the nature and credibility of the conclusions they draw. People who understand how scientists work are more likely to make thoughtful and critical decisions about scientific claims which influence their own lifestyle, health and environment.

### Working scientifically

'Working scientifically' is the term used in this syllabus to describe the practices and dispositions of science. These include a complex assortment of activities, mental processes, routines and protocols that are the essence of the scientific enterprise. Because it is a hallmark of the activities of scientists, 'working scientifically' features prominently in effective science education.

When 'working scientifically', students make sense of the phenomena they experience as they investigate, understand and communicate. They develop an

appreciation of 'working scientifically' when they learn the concepts of science through engaging in the widest range of active learning experiences. Engaging in science in this way contributes to students' sense of awe and wonder about the beauty and power of the universe.

### Nature of science education

Science education involves students and teachers working together as each constructs new understandings and compares their current ideas with those of the scientific community. Such collaboration challenges students, contributes to a sense of personal success as lifelong learners, and can generate a passion for learning and seeking new insights.

## Contribution of the key learning area to lifelong learning

The Queensland school curriculum is designed to assist students to become lifelong learners. The overall learning outcomes of the curriculum contain elements common to all key learning areas and collectively describe the valued attributes of a lifelong learner.

A lifelong learner is:

- a knowledgeable person with deep understanding;
- a complex thinker;
- a creative person;
- an active investigator;
- an effective communicator;
- a participant in an interdependent world;
- a reflective and self-directed learner.

The Years 1–10 Science key learning area provides many opportunities for students to develop the valued attributes of lifelong learners.

### Knowledgeable person with deep understanding

Learners understand and use conceptual ideas of science in their everyday lives. They understand the processes which scientists use to collect evidence to develop, verify and test scientific ideas.

They understand that science is a human endeavour and that it is one 'way of knowing' about the world. They recognise that scientific knowledge is constructed by the community of scientists seeking to explain phenomena and experiences, and that these explanations are influenced by the social and cultural contexts in which they are formed.

### Complex thinker

Learners identify and solve problems and make decisions about the applications of science using critical and complex reasoning, lateral thinking and intuition. They judge the adequacy, accuracy and worth of data and identify possible sources of error and bias in research and experimentation.

They critically evaluate their own and others' ideas and arguments as they investigate scientific phenomena. They understand that initial patterns and relationships used to make meaning of these phenomena can be applied to comparing new information, which may lead to new generalisations.

### Creative person

Learners generate new ways of viewing or resolving scientific problems and offer a range of possible solutions. They use a variety of methods and tools to envision possible, probable and preferred futures and use their scientific knowledge to make choices that lead to preferred futures related to the applications of science in their daily lives. They use enterprise, imagination, originality and aesthetic judgment to create products, systems or performances which demonstrate their understandings of scientific concepts.

### Active investigator

Learners initiate inquiries and propose hypotheses as they approach the problems of science. They draw conclusions, answer questions or form generalisations based on the evidence collected.

They use a variety of information-management techniques as they test hypotheses and develop understandings of the key concepts and processes of science.

### Effective communicator

Learners compose and comprehend written, spoken and visual texts that convey information about science. They understand that scientific concepts are constructed from particular viewpoints and for different purposes. They effectively use suitable types of texts to communicate scientific understandings. They listen to, debate and express ideas in order to construct and reconstruct their understandings about the physical and biological worlds.

They understand scientific terminology and symbols and use these appropriately in exploring and presenting their own scientific ideas. They use a variety of genres to critically explore ideas and to express insights about their experiences.

### Participant in an interdependent world

Learners perform confidently as self-directed individuals to investigate scientific ideas. They work individually and with others to appreciate that there are different ways of viewing the world, and display willingness to modify their ideas in the light of convincing, relevant evidence. They develop personally satisfying and socially responsible beliefs and values from their understandings of the physical and biological worlds.

They use interpersonal skills and cooperate with others in scientific investigations to achieve common goals. They identify unjust and unsustainable practices and applications of science. They take responsibility for their own actions and decisions to ensure ethical practices.

Learners critically reflect on ways in which gender and cultural, racial and economic status affect access to information, careers, life chances and

opportunities in the fields of science. They actively participate as informed citizens, exercising stewardship of the environment and acknowledging human responsibility for the impact of the practices of science.

### Reflective and self-directed learner

Learners consider their own learning styles, strengths and limitations as they evaluate and manage their own thinking and monitor their progress in developing scientific literacy. They use principles such as internal consistency and validity to justify conclusions. They maintain open-minded scepticism and curiosity and appreciate the tentative nature of conclusions drawn from scientific evidence. They transfer their learnings to novel situations and look for opportunities to do so.

Learners critically evaluate their own and others' viewpoints and the impact of decisions on themselves, others and the environment. They consider a comprehensive range of personal, social, cultural, economic, technological and environmental consequences of the uses of scientific knowledge.

## Cross-curricular priorities

The Years 1–10 Science key learning area incorporates the cross-curricular priorities of literacy, numeracy, lifeskills and a futures perspective.

### Literacy

Literacy involves an understanding of how language works, and an ability to apply language skills in a range of school and everyday social situations. Students develop literacy skills through reading, writing, speaking, viewing and listening. They seek and critically appraise information, make choices and acquire independence in learning. Students are encouraged to become critical consumers of texts, to view texts from a variety of perspectives and to interpret various levels of meaning. They understand that literacy is a means for shaping how people view themselves, their identities and their environments.

Literacy in the Science key learning area involves the ability to interpret and communicate scientific information. Students use the specialised language and symbols of science in a range of genres. They understand that the meaning of words in scientific contexts may differ from that in everyday use. Through developing literacy skills, students seek and critically appraise information, make choices and acquire independence in learning.

### Numeracy

Numeracy involves the ability to choose from known mathematical concepts and skills and to apply them in order to cope with the mathematical demands of schoolwork and everyday life. Numeracy skills are developed as students solve problems by applying numerical and spatial concepts and techniques.

In the Science key learning area, students collate and critique scientific data using measurement, approximation, calculation and estimation.

## Lifeskills

'Lifeskills' is a term used to describe the mix of knowledge, processes, skills and attitudes that are considered necessary for people to function adequately in their contemporary and changing life roles and situations. Demonstration of lifeskills takes place in two overlapping dimensions: practical performance of, and critical reflection on, those skills.

It is possible to identify at least four sets of lifeskills which enable students to participate in the four life roles. The lifeskills, and related life roles, are:

- personal development skills — growing and developing as an individual;
- social skills — living with and relating to other people;
- self-management skills — managing resources;
- citizenship skills — receiving from and contributing to local, state, national and global communities.

The Science key learning area contributes to the development of lifeskills by providing each student with opportunities to develop:

- understandings of the physical and biological worlds;
- practices and dispositions related to considering new ideas;
- communication skills;
- interpersonal skills in cooperative learning situations;
- ethical and cultural sensitivities and understandings.

## Futures perspective

'Futures' involves a variety of methodologies that aid the development of insights and knowledge about the past and present, leading to consideration of the consequences of personal and collective actions. The promotion of a futures perspective assists students to identify possible, probable and preferred individual and communal futures.

Skills developed through a learner-centred approach provide a sound basis for the critical and creative thinking, problem solving, decision making and strategic planning required to create a preferred future. Students are encouraged to take responsibility for their actions and decisions, to think ahead and to enact, with optimism, their visions of preferred futures.

In the Science key learning area, students consider natural, biological, geological, chemical and physical systems and the effects that human activities have on them. They are encouraged to use their scientific knowledge and consider their roles and responsibilities in relation to these effects when envisioning preferred futures.

# Understandings about learners and learning

## Learners and learning

The following assumptions about learners and learning are made in the Years 1–10 Science key learning area:

**Learners**

- Learners are unique individuals and thinkers with divergent views about the world.
- Learners have a broad range of knowledge and experience, shaped by their gender, socioeconomic status and geographical location, and by other aspects of their background, which form part of their learning environment. This prior knowledge and experience then influences the meaning they make of any new learning experience.
- Learners learn in different ways, in different settings and at different rates.
- Learners grow and develop at different rates.

**Learning**

- Learning is a lifelong process.
- Learning occurs within particular social and cultural contexts.
- Learning is most effective when it involves active partnerships, focusing on students, with collaboration and negotiation between parents and carers, teachers, school and community members.
- Learning contexts should acknowledge social justice principles by being inclusive and supportive and by celebrating diversity.
- Learning requires active construction of meaning and is most effective when it is developed in meaningful contexts and accommodates, acknowledges and builds on prior knowledge.
- Investigative and learner-centred strategies are most effective in enabling learners to make informed choices.
- Learning is enhanced by the use of a range of technologies.
- Competence in thinking and performance can be demonstrated in a variety of ways.

## Inclusive curriculum

In an inclusive curriculum, the learning process should be accessible to all students. This involves identifying and overcoming barriers that limit students' participation in and benefits from schooling. Learning should be based on the contributions of a full range of social and cultural groups and acknowledge diversity both within and among groups. Students should be empowered to critically analyse and question disadvantage in social structures, to challenge injustice and to participate in society as equals.

The syllabus provides a basis for teachers to design learning experiences and assessment tasks that encourage students to understand and appreciate difference and diversity, and to value and respect people with particular needs. It is important that students have opportunities to develop awareness of, and sensitivity to, differences between, or special needs of, all groups — girls; boys; students with an Aboriginal or Torres Strait Islander background; students from

different cultural or linguistic backgrounds; students from low socioeconomic backgrounds; students with disabilities; students who are geographically isolated; and students who are gifted and talented or who have particular learning needs.

## Learner-centred approach

A learner-centred approach to learning and teaching views learning as the active construction of meaning, and teaching as the act of guiding and facilitating learning. This approach sees knowledge as being ever-changing and built on prior experience.

In the Science key learning area, a learner-centred approach provides opportunities for students to practise critical and creative thinking, problem solving and decision making. These involve the use of skills and processes such as recall, application, analysis, synthesis, prediction and evaluation, all of which contribute to the development and enhancement of conceptual understandings. A learner-centred approach also encourages students to reflect on and monitor their thinking as they make decisions and take action. As students think and work scientifically, they construct understandings of scientific concepts.

# Outcomes

## Framework

This syllabus provides a framework for planning learning experiences and assessment tasks through which students have opportunities to demonstrate what they know and can do in the Years 1–10 Science key learning area.

### Key learning area outcomes

The key learning area outcomes highlight the uniqueness of the Science key learning area and its particular contribution to lifelong learning. During the compulsory years of schooling in the Science key learning area, students:

- understand and appreciate the evolutionary nature of scientific knowledge;
- understand the nature of science as a human endeavour, its history, its relationship with other human endeavours and its contribution to society;
- understand that scientific knowledge has been organised by the scientific community into disciplines based on recognisable patterns in the phenomena studied;
- apply scientific knowledge to explain and predict events and to reconstruct their understandings of the physical and biological worlds;
- use the practices and dispositions of scientific investigation, reflection and analysis to refine knowledge and pose new questions;
- develop dispositions such as intellectual honesty and commitment to scientific reasoning;
- use scientific language to communicate effectively;
- use decision-making processes that include ethical considerations of the impact of science on people and the environment;
- use the practices and dispositions of 'working scientifically' in all the disciplines of the scientific enterprise.

### Strands of the key learning area

The concepts of the key learning area are organised into strands. Each of these strands makes an equivalent contribution to the Science key learning area. Students develop their understanding of the concepts in the strands throughout the compulsory years of schooling.

There are five strands in the Science key learning area:

- Science and Society;
- Earth and Beyond;
- Energy and Change;

- Life and Living;
- Natural and Processed Materials.

**Science and Society**
Science as a 'way of knowing' is shaped by the ways in which humans understand natural phenomena. On the basis of these understandings, humans make decisions about science and its applications which have short- and long-term implications for the entire planet.

Students study the relationship between the nature and direction of science and society's perspectives and values. They construct understandings of the manner in which scientific knowledge is developed and the influence of historical and cultural factors on science.

The key concepts of the Science and Society strand are:

- Historical and cultural factors influence the nature and direction of science which, in turn, affects the development of society.
- Science as a 'way of knowing' is shaped by the ways that humans construct their understandings.
- Decisions about the ways that science is applied have short- and long-term implications for the environment, communities and individuals.

**Earth and Beyond**
The universe, of which the Earth is a part, has many components. Students explore ideas about the dynamic nature of the Earth, solar system and universe. They develop an understanding of the scales of time and space over which events on the Earth and in the universe occur. They investigate the many ways in which living things use the Earth, solar system and universe as resources and recognise the effects of this use.

The key concepts of the Earth and Beyond strand are:

- The Earth, solar system and universe are dynamic systems.
- Events on Earth, in the solar system and in the universe occur on different scales of time and space.
- Living things use the resources of the Earth, solar system and universe to meet their needs.

**Energy and Change**
The world in which we live has been moulded by forces which influence the motion, shape, behaviour and energy of objects. The efficient control of energy transfer and transformation is integral to the organisation and development of life.

Students explore the effects of forces in their lives. They consider methods of harnessing energy, the way energy is used, and the social and environmental consequences of energy use.

The key concepts of the Energy and Change strand are:

- The forces acting on objects influence their motion, shape, behaviour and energy.
- In interactions and changes, energy is transferred and transformed but is not created or destroyed.
- There are different ways of obtaining and utilising energy and these have different consequences.

**Life and Living**
Living things have great diversity of structure and lifestyle; they interact with each other and with the world in which they live.

Students collect information about the ways organisms live in order to develop an understanding of those structures which enable living things to function effectively in their environments. Students identify patterns of interactions within environments. They recognise that these interactions contribute to the dynamics of environments.

The key concepts of the Life and Living strand are:

- The characteristics of an organism and its functioning are interrelated.
- Evolutionary processes have given rise to a diversity of living things which can be grouped according to their characteristics.
- Environments are dynamic and have living and non-living components which interact.

**Natural and Processed Materials**
Properties of materials are determined by their underlying structure. Materials can be grouped according to different properties.

Students study the ideas that scientists have about the structure of materials. They investigate the properties of materials, how these properties can be changed, and the effect of changes on the usefulness of materials. They interpret data on factors which affect the rate at which materials react.

The key concepts of the Natural and Processed Materials strand are:

- The properties and structure of materials are interrelated.
- Patterns of interactions between materials can be identified and used to predict and control further interactions.
- The uses of materials are determined by their properties, some of which can be changed.

## Levels

The levels outlined on the following pages indicate progressions of increasing sophistication and complexity in learning outcomes. A level statement is included for each level of each strand of the syllabus. The level statement summarises learning outcomes at each level and provides the conceptual framework for developing the core and discretionary learning outcomes.

The level statements at Foundation Level have been developed for students demonstrating a level of understanding before that of Level 1. These statements can be used to develop a range of specific learning outcomes which are tailored to the individual needs of students with disabilities and related to their individualised curriculum programs.

## Core and discretionary learning outcomes

**Core**
Core learning outcomes describe those learnings which are considered essential for all students. They describe what students know and can do as a result of planned learning experiences. The core learning outcomes are presented in order of increasing complexity from Levels 1 to 6.

All students must be provided with opportunities to demonstrate the core learning outcomes during the compulsory years of schooling.

**Discretionary**
Discretionary learning outcomes describe what students know and can do beyond what is considered essential at a particular level. They indicate additional contexts or areas of learning and are considered desirable. It is not expected that these discretionary learning outcomes will be demonstrated by all students. The discretionary outcomes are included to assist teachers in broadening the understandings of those students who have already demonstrated the requirements of the core learning outcomes. Additional discretionary learning outcomes could be developed by schools or teachers.

At Beyond Level 6 all learning outcomes are discretionary.

The core and discretionary learning outcomes for the strands of the Science key learning area are presented on the following pages.

*L*earning outcomes

## Science and Society

Historical and cultural factors influence the nature and direction of science which, in turn, affects the development of society.

Science as a 'way of knowing' is shaped by the ways that humans construct their understandings.

Decisions about the ways that science is applied have short- and long-term implications for the environment, communities and individuals.

| Foundation Level | Level 1 |
|---|---|
| **Level statement**<br>*Students are developing an understanding of the ways that science affects aspects of their lives. They are developing an intuitive understanding of some common natural phenomena.* | **Level statement**<br>*Students describe their ideas about natural phenomena. They understand that information is collected in different ways to suit different purposes. Students understand some of the ways that science is applied in their daily lives.* |
| Foundation Level statements have been developed for students demonstrating a level of understanding before that of Level 1. These statements can be used to develop a range of specific learning outcomes which are tailored to the individual needs of students with disabilities and related to their individualised curriculum programs. | **Core learning outcomes**<br>1.1 Students discuss their own thinking about natural phenomena.<br>1.2 Students collect information about natural phenomena and recognise that some ways of collecting information are more appropriate than others in different situations.<br>1.3 Students illustrate different ways that applications of science affect their daily lives.<br>**Discretionary learning outcome**<br>D1.4 Students make generalisations from observations made during an investigation. |

*L*earning outcomes

## Science and Society

Historical and cultural factors influence the nature and direction of science which, in turn, affects the development of society.

Science as a 'way of knowing' is shaped by the ways that humans construct their understandings.

Decisions about the ways that science is applied have short- and long-term implications for the environment, communities and individuals.

### Level 2

**Level statement**

*Students understand that everybody has ideas about science and that everyone can take part in science. They understand that everyone is affected by science and its applications.*

**Core learning outcomes**

2.1 Students discuss their own ideas about the ways in which science can be described and compare their ideas with those of others.

2.2 Students identify some ways scientists think and work.

2.3 Students explain some of the ways that applications of science affect their community.

**Discretionary learning outcomes**

D2.4 Students create timelines showing how the science of tools and equipment has changed over time.

D2.5 Students compare the effectiveness of different ways of presenting scientific information.

### Level 3

**Level statement**

*Students understand that there are different philosophical and cultural approaches to science, and that people observe and explain phenomena in different ways for different purposes. Students are developing an awareness of the tools scientists use and the impact of the applications of science in society.*

**Core learning outcomes**

3.1 Students relate some of the ways that people of various historical and cultural backgrounds construct and communicate their understandings of the same natural phenomena.

3.2 Students recognise the need for quantitative data when describing natural phenomena.

3.3 Students make predictions about the immediate impact of some applications of science on their community and environment, and consider possible pollution and public health effects.

**Discretionary learning outcomes**

D3.4 Students consider the meaning and implications of information collected when differences of opinion arise.

D3.5 Students prepare presentations to inform others about some ethical implications of certain applications of science.

D3.6 Students collect information to form a view of how past cultures collected and used astronomical data.

*L*earning outcomes

## Science and Society

Historical and cultural factors influence the nature and direction of science which, in turn, affects the development of society.

Science as a 'way of knowing' is shaped by the ways that humans construct their understandings.

Decisions about the ways that science is applied have short- and long-term implications for the environment, communities and individuals.

### Level 4

**Level statement**

*Students understand that people of many cultures have contributed to the development of scientific knowledge. They understand what makes a fair test. They appreciate that the uses of science have implications for the community.*

**Core learning outcomes**

4.1 Students outline some contributions to the development of scientific ideas made by people from different cultural and historical backgrounds.

4.2 Students use the elements of a fair test when considering the design of their investigations.

4.3 Students present analyses of the short- and long-term effects of some of the ways in which science is used.

**Discretionary learning outcomes**

D4.4 Students examine and evaluate situations where their observations or conclusions are influenced by previous experience.

D4.5 Students examine and evaluate the potential applications of scientific ideas and inventions.

### Level 5

**Level statement**

*Students understand that scientific ideas have changed and will continue to change as new evidence is collected. They recognise the importance of believable evidence. They understand that applications of science have been influenced by changes in social attitudes.*

**Core learning outcomes**

5.1 Students consider how and why scientific ideas have changed over time.

5.2 Students refine investigations after evaluating variations and inconsistencies in experimental findings.

5.3 Students analyse the relationship between social attitudes and decisions about the applications of science.

**Discretionary learning outcomes**

D5.4 Students explore the influence of religious beliefs on scientific endeavour.

D5.5 Students present data in a variety of ways to support different interpretations.

*L*earning outcomes

## Science and Society

Historical and cultural factors influence the nature and direction of science which, in turn, affects the development of society.

Science as a 'way of knowing' is shaped by the ways that humans construct their understandings.

Decisions about the ways that science is applied have short- and long-term implications for the environment, communities and individuals.

### Level 6

**Level statement**

*Students understand that ethical, cultural, economic and political considerations influence scientific endeavours. They understand the role of scientific investigation in the development of scientific knowledge. They understand that the applications of science have immediate and long-term consequences for society.*

**Core learning outcomes**

6.1 Students evaluate contributions to the development of scientific ideas made by individuals and groups in the past and present, and consider factors which have assisted or hindered them.

6.2 Students design and perform controlled investigations to produce believable evidence.

6.3 Students use scientific concepts to evaluate the costs and benefits of applications of science (including agricultural and industrial practices).

**Discretionary learning outcomes**

D6.4 Students make presentations supporting the different sides in debates about controversial applications of science.

D6.5 Students discuss changes in attitudes towards particular applications of science this century.

D6.6 Students critically evaluate astrology from a scientific perspective.

### Beyond Level 6

**Level statement**

*Students understand the relationship between society and science and that there have been changes to this relationship throughout history. They understand the need to challenge science and the evidence it presents, and are willing to do so. Students understand social, economic, moral and ethical implications of the applications of science.*

**Discretionary learning outcomes**

DB6.1 Students discuss the influence of historical, cultural and sociopolitical factors on the resourcing of different areas of scientific research over time.

DB6.2 Students evaluate the reliability and validity of scientific information from different sources.

DB6.3 Students suggest probable, possible and preferred options regarding future applications of science, and the sustainability of those applications.

DB6.4 Students identify the elements of a common philosophy in the approaches taken by scientists in different fields.

DB6.5 Students compare the areas of scientific endeavour favoured now with those favoured over the past 200 years.

*L*earning outcomes

## Earth and Beyond

The Earth, solar system and universe are dynamic systems.

Events on Earth, in the solar system and in the universe occur on different scales of time and space.

Living things use the resources of the Earth, solar system and universe to meet their needs.

| Foundation Level | Level 1 |
|---|---|
| **Level statement**<br>*Students are developing an understanding of the features of the Earth and sky. They are developing an understanding of their immediate non-living environment and uses made of it.* | **Level statement**<br>*Students understand that there are significant features on the Earth and in the sky. They understand that aspects of their immediate environment change and that this environment is a resource.* |
| Foundation Level statements have been developed for students demonstrating a level of understanding before that of Level 1. These statements can be used to develop a range of specific learning outcomes which are tailored to the individual needs of students with disabilities and related to their individualised curriculum programs. | **Core learning outcomes**<br>1.1 Students identify and describe obvious features of the Earth and sky (including landforms and clouds).<br>1.2 Students describe obvious events (including day and night) that occur on the Earth and in the sky.<br>1.3 Students discuss the uses they make and the care they take of the Earth.<br>**Discretionary learning outcome**<br>D1.4 Students describe some less obvious features of the Earth and beyond. |

*L*earning outcomes

## Earth and Beyond

The Earth, solar system and universe are dynamic systems.

Events on Earth, in the solar system and in the universe occur on different scales of time and space.

Living things use the resources of the Earth, solar system and universe to meet their needs.

### Level 2

**Level statement**

*Students understand that easily observable features of the Earth and sky change and that some of these changes are repeated regularly. Students understand that the Earth and sky are resources for their community.*

**Core learning outcomes**

2.1 Students identify and describe changes in the obvious features of the Earth and sky (including changes in the appearance of the moon).

2.2 Students identify and describe short- and longer-term patterns of events (including weather and seasons) that occur on the Earth and in the sky.

2.3 Students discuss how their community uses resources and features of the Earth and sky.

**Discretionary learning outcome**

D2.4 Students suggest how weather and climate in different places influence local constructions, and outdoor and leisure activities.

### Level 3

**Level statement**

*Students understand that there are physical systems on the Earth and beyond it. They understand that changes occur as a result of interactions within systems, and that some of these changes follow predictable patterns. Students understand that living things can use the Earth and sun as resources.*

**Core learning outcomes**

3.1 Students identify and describe some interactions (including weathering and erosion) that occur within systems on Earth and beyond.

3.2 Students discuss regular and irregular events in time and space that occur on the Earth and in the sky.

3.3 Students collect information which describes ways in which living things use the Earth and the sun as resources.

**Discretionary learning outcomes**

D3.4 Students explore the relationship between distance and the perceived size of objects.

D3.5 Students explore changes which have occurred to a particular part of the Earth over a particular time scale.

*L*earning outcomes

## Earth and Beyond

The Earth, solar system and universe are dynamic systems.

Events on Earth, in the solar system and in the universe occur on different scales of time and space.

Living things use the resources of the Earth, solar system and universe to meet their needs.

### Level 4

**Level statement**

*Students understand that there are interactions between systems on Earth, in the solar system and in the universe. They understand that events occurring on Earth and those occurring in the universe are on different scales of time and space. Students understand that the Earth and solar system are used differently by different communities.*

**Core learning outcomes**

4.1 Students recognise and analyse some interactions (including the weather) between systems of Earth and beyond.

4.2 Students collect information which illustrates that changes on Earth and in the solar system occur on different scales of time and space.

4.3 Students summarise information to compare ways in which different communities use resources from the Earth and beyond.

**Discretionary learning outcomes**

D4.4 Students use models to demonstrate the relative positions of parts of the solar system.

D4.5 Students make observations of, and collect information about, geological samples from the local area.

### Level 5

**Level statement**

*Students understand that present-day features and events may provide clues to occurrences in the past. They understand that events at a particular time and place can have effects at other times and other places. Students understand that the Earth, the solar system and the universe are different types of resources which may be used for different purposes.*

**Core learning outcomes**

5.1 Students explain how present-day features and events can be used to make inferences about past events and changes in Earth and beyond.

5.2 Students infer from data that the events that occur on Earth and in the solar system can have effects at other times and in other places.

5.3 Students prepare scenarios about the use of renewable and non-renewable resources of the Earth and beyond.

**Discretionary learning outcomes**

D5.4 Students compare past and present uses of the Earth's non-living resources and forecast future scenarios regarding the consequences of such uses.

D5.5 Students describe geological cycles that occur over time and identify links between aspects of these cycles.

*L*earning outcomes

## Earth and Beyond

The Earth, solar system and universe are dynamic systems.

Events on Earth, in the solar system and in the universe occur on different scales of time and space.

Living things use the resources of the Earth, solar system and universe to meet their needs.

### Level 6

**Level statement**

*Students understand scientific ideas about interactions within and between systems of the Earth, solar system and universe. They understand that changes may result from concurrent events in the past or as the culmination of a series of events taking place over long periods of time. Students understand that the Earth, solar system and universe are resources which humans use.*

**Core learning outcomes**

6.1 Students use scientific ideas and theories about interactions within and between systems of the Earth and beyond to explain past and present features and events.

6.2 Students use scientific ideas about the Earth and components of the universe to explain how events over time and in space can lead to catastrophic changes.

6.3 Students argue a position regarding stewardship of the Earth and beyond, and consider the implications of using renewable and non-renewable resources.

**Discretionary learning outcome**

D6.4 Students access information to report on major astronomical phenomena.

### Beyond Level 6

**Level statement**

*Students understand that information about the Earth, solar system and universe is used to improve the accuracy of prediction of future events. They understand that research into the Earth, solar system and universe is influenced by scales of time and distance, and that information from space exploration can aid in understanding the Earth's origins and in forecasting its future.*

**Discretionary learning outcomes**

DB6.1 Students explain how scientific ideas of the Earth's dynamism can be used to predict natural catastrophes and help minimise their effects.

DB6.2 Students explain how the knowledge gained from astronomy has led scientists closer to understanding the evolution of the universe and to making predictions about its future.

DB6.3 Students use scientific ideas about events in the universe, and the magnitude of the different systems in the universe, to predict changes to the Earth and future directions in space research and exploration.

DB6.4 Students use the ideas and concepts of science to evaluate ways in which human activity could be modified to create a sustainable future.

DB6.5 Students recognise the occurrence of counterbalancing changes within Earth systems.

*L*earning outcomes

## Energy and Change

The forces acting on objects influence their motion, shape, behaviour and energy.

In interactions and changes, energy is transferred and transformed but is not created or destroyed.

There are different ways of obtaining and utilising energy and these have different consequences.

### Foundation Level

**Level statement**

*Students are developing an understanding of the ways that things move and behave and can communicate some of these ideas.*

Foundation Level statements have been developed for students demonstrating a level of understanding before that of Level 1. These statements can be used to develop a range of specific learning outcomes which are tailored to the individual needs of students with disabilities and related to their individualised curriculum programs.

### Level 1

**Level statement**

*Students understand that objects move and behave in different ways. They explore the concept of energy, sources of energy, and how energy is used in everyday life.*

**Core learning outcomes**

1.1 Students collect information about the ways that objects of different shapes and sizes move.

1.2 Students identify the effects of energy in their daily lives.

1.3 Students make links between the way they use energy and the immediate source of that energy.

**Discretionary learning outcomes**

D1.4 Students construct ideas about energy from playing with scientific motion toys.

D1.5 Students can explore and express ideas on the range of energy sources that are used in everyday life.

*L*earning outcomes

## Energy and Change

The forces acting on objects influence their motion, shape, behaviour and energy.

In interactions and changes, energy is transferred and transformed but is not created or destroyed.

There are different ways of obtaining and utilising energy and these have different consequences.

### Level 2

**Level statement**

*Students understand that there are ways to change the shape and motion of objects. They are aware that energy exists in different forms. They understand that their community uses energy in different ways.*

**Core learning outcomes**

2.1 Students demonstrate different ways that forces (including push and pull) change the shape and motion of objects.

2.2 Students identify and describe forms of energy in their community (including heat and energy of movement).

2.3 Students illustrate the ways that energy is used in their community.

**Discretionary learning outcomes**

D2.4 Students explore a variety of ways to change the motion of objects by manipulating materials and tools.

D2.5 Students examine ways to change the magnetic properties of common materials.

### Level 3

**Level statement**

*Students understand the effects of forces on the shape, motion and energy of objects. They are aware that there are different ways to obtain energy.*

**Core learning outcomes**

3.1 Students collect data and make and test inferences to describe the effects of forces (including magnetic and electrostatic forces) on the motion and shape of objects.

3.2 Students identify forms of energy (including electrical and sound energy) and describe the effects and characteristics of those different forms.

3.3 Students identify different ways of obtaining energy.

**Discretionary learning outcomes**

D3.4 Students consider how reducing and recycling waste reduces energy consumption.

D3.5 Students explore the types of energy used to make toys work.

*L*earning outcomes

## Energy and Change

The forces acting on objects influence their motion, shape, behaviour and energy.

In interactions and changes, energy is transferred and transformed but is not created or destroyed.

There are different ways of obtaining and utilising energy and these have different consequences.

### Level 4

**Level statement**

*Students understand that there are different forces which affect the motion, behaviour and energy of objects. They understand that energy is transferred and transformed, and that there are alternative ways to obtain and use energy.*

**Core learning outcomes**

4.1 Students design and perform investigations into relationships between forces, motion and energy.

4.2 Students collect and present information about the transfer and transformation of energy (including potential and kinetic energy).

4.3 Students present alternative ways of obtaining and using energy (including energy from the sun and from fossil fuels) for particular purposes.

**Discretionary learning outcomes**

D4.4 Students explore properties of some common force and energy phenomena by playing with toys.

D4.5 Students devise and use tools to compare the effectiveness of materials designed to protect the human body from impact forces.

### Level 5

**Level statement**

*Students understand that everyday situations can be analysed in terms of the motion of objects and energy transfer. They understand that ideas of energy transfer and transformation can be used to explain common phenomena and the ways of obtaining and using energy.*

**Core learning outcomes**

5.1 Students analyse situations where various forces (including balanced and unbalanced forces) act on objects.

5.2 Students explain how energy is transferred and transformed (including energy transfer by convection and conduction).

5.3 Students discuss the consequences of different ways of obtaining and using energy (including nuclear energy).

**Discretionary learning outcomes**

D5.4 Students apply ideas of energy transfer and transformation to common biological processes.

D5.5 Students outline the energy changes that occur in simple physical and chemical changes and link their observations to scientific understandings about the conservation of energy.

*L*earning outcomes

## Energy and Change

The forces acting on objects influence their motion, shape, behaviour and energy.

In interactions and changes, energy is transferred and transformed but is not created or destroyed.

There are different ways of obtaining and utilising energy and these have different consequences.

### Level 6

**Level statement**

*Students understand the relationships between laws of motion and energy and everyday experiences. They use these laws to explain energy transfers in the manipulation of forces, and to explore and express ideas about future energy use.*

**Core learning outcomes**

6.1 Students use scientific ideas of motion (including action and reaction) to explain everyday experiences.

6.2 Students model and analyse applications of energy transfer and transformation.

6.3 Students evaluate the immediate and long-term consequences of different ways of obtaining and using energy.

**Discretionary learning outcomes**

D6.4 Students critically analyse patterns of energy use by different socioeconomic groups.

D6.5 Students apply ideas of simple machines to human body systems.

D6.6 Students solve problems involving work and power.

### Beyond Level 6

**Level statement**

*Students understand and can apply scientific theories and models of the ways that things move and interact, and of energy transfer and transformation. They understand reasons for, and consequences of, using energy from particular sources, and envision alternative scenarios for energy use.*

**Discretionary learning outcomes**

DB6.1 Students participate in investigations to quantify the relationship between force and motion.

DB6.2 Students use particle and wave models when discussing their thinking about the transfer and transformation of energy (including light and sound energy).

DB6.3 Students critically analyse global patterns of energy use and make predictions about the effects of such use.

DB6.4 Students gather information about the way energy can be used to investigate phenomena beyond Earth.

*L*earning outcomes

## Life and Living

The characteristics of an organism and its functioning are interrelated.

Evolutionary processes have given rise to a diversity of living things which can be grouped according to their characteristics.

Environments are dynamic and have living and non-living components which interact.

| Foundation Level | Level 1 |
|---|---|
| **Level statement**<br>*Students are developing an understanding that some things are living and some things are non-living, and can use observable features to communicate the difference.* | **Level statement**<br>*Students understand that living things have needs. They understand that different living things and different environments have different identifying features.* |
| Foundation Level statements have been developed for students demonstrating a level of understanding before that of Level 1. These statements can be used to develop a range of specific learning outcomes which are tailored to the individual needs of students with disabilities and related to their individualised curriculum programs. | **Core learning outcomes**<br>1.1 Students discuss their thinking about needs of living things.<br>1.2 Students group living things in different ways based on observable features.<br>1.3 Students observe and describe components of familiar environments.<br>**Discretionary learning outcome**<br>D1.4 Students collect information about sources of food and shelter for animals in their local environment. |

*L*earning outcomes

## Life and Living

The characteristics of an organism and its functioning are interrelated.

Evolutionary processes have given rise to a diversity of living things which can be grouped according to their characteristics.

Environments are dynamic and have living and non-living components which interact.

| Level 2 | Level 3 |
|---|---|
| **Level statement**<br>*Students understand that the ability of living things to meet their needs is influenced by their characteristics and their environment. Students understand that particular features can be used to describe how living things change in the course of their life span.* | **Level statement**<br>*Students recognise that the characteristics of different living things are adaptations to different environments. They understand that there are different kinds of living things, each of which produces young of its own kind. They understand that interactions occur between living things and between living things and environments.* |
| **Core learning outcomes** | **Core learning outcomes** |
| 2.1 Students look for patterns and relationships between the features of different living things and how those living things meet their needs. | 3.1 Students draw conclusions about the relationship between features of living things and the environments in which they live. |
| 2.2 Students illustrate changes which take place in the course of the life span of living things (including the growth of a plant and an animal). | 3.2 Students present information which illustrates stages in different types of life cycles (including metamorphosis) of familiar living things. |
| 2.3 Students make links between different features of the environment and the specific needs of living things. | 3.3 Students describe some interactions (including feeding relationships) between living things and between living and non-living parts of the environment. |
| **Discretionary learning outcomes** | **Discretionary learning outcomes** |
| D2.4 Students relate their ideas about forces to the way familiar living things move. | D3.4 Students recognise patterns of similarity and difference within and between groups of familiar living things. |
| D2.5 Students collect information showing the diversity of plant and animal forms. | D3.5 Students establish a model environment which meets the needs of living things within it. |

*L*earning outcomes

## Life and Living

The characteristics of an organism and its functioning are interrelated.

Evolutionary processes have given rise to a diversity of living things which can be grouped according to their characteristics.

Environments are dynamic and have living and non-living components which interact.

### Level 4

**Level statement**

*Students understand that living things have external and internal structures which enable them to survive and reproduce in their own environment. They understand the types of interaction occurring between living and non-living parts of the environment.*

**Core learning outcomes**

4.1 Students examine the internal and external structure of living things (including animal respiratory systems and plant systems) and account for observed similarities and differences in terms of adaptation.

4.2 Students identify and analyse similarities and differences in the ways that different living things reproduce.

4.3 Students make generalisations about the types of interaction which take place between the living and non-living parts of the environment.

**Discretionary learning outcomes**

D4.4 Students explain why some features are more useful than others when used as a basis for grouping living things.

D4.5 Students describe how body structure and behaviour assist in reducing resistance to movement.

### Level 5

**Level statement**

*Students understand that the survival of living things is determined by interactions which occur within and between systems in living things. They understand that reproductive processes and strategies influence survival of individuals and species. They understand that there are consequences of the interactions which occur between living and non-living parts of the environment.*

**Core learning outcomes**

5.1 Students collect information about the structure (including cell structure) and function of living things and relate structure and function to survival.

5.2 Students evaluate different processes and strategies of reproduction (including asexual reproduction and care of young) in terms of their relative efficiency in ensuring survival of offspring.

5.3 Students evaluate the consequences of interactions between the living and non-living parts of environments.

**Discretionary learning outcomes**

D5.4 Students use scientific ideas of classification to group living things.

D5.5 Students apply ideas of energy transfer and transformation to explain the importance of photosynthesis and respiration.

*L*earning outcomes

## Life and Living

The characteristics of an organism and its functioning are interrelated.

Evolutionary processes have given rise to a diversity of living things which can be grouped according to their characteristics.

Environments are dynamic and have living and non-living components which interact.

### Level 6

**Level statement**

*Students understand that the effects of change can be recognised in systems within living things as well as within environments. They understand scientific ideas about how the variety of life forms has arisen.*

**Core learning outcomes**

6.1 Students seek reasons for and can explain why functioning and behaviour change in response to variations in internal and external conditions (including disease, temperature, water and light).

6.2 Students use scientific ideas (including concepts of genetics and natural selection) to explain how variation in living things leads to change in species over time.

6.3 Students prepare scenarios to describe the potential long-term effects of changes in biodiversity caused by human action on ecosystems.

**Discretionary learning outcomes**

D6.4 Students discuss the purposes and long-term usefulness of different classification schemes used to group living things.

D6.5 Students formulate questions and make judgments about the use of reproductive technologies and genetic manipulation.

### Beyond Level 6

**Level statement**

*Students understand that many sorts of change can have short- and long-term impacts on the functioning of living things as well as on systems within environments. They understand principles and management practices related to maintaining biodiversity and ecological sustainability.*

**Discretionary learning outcomes**

DB6.1 Students use scientific explanations to account for the way that the internal environment of living things is kept relatively constant.

DB6.2 Students envision possible future effects of the manipulation of reproductive processes and genetic inheritance.

DB6.3 Students examine potential long-term effects of human activities on the environment.

DB6.4 Students collect information on the role of organic molecules in the inheritance of genetically determined characteristics.

DB6.5 Students explore the role and action of enzymes in chemical processes in living things.

DB6.6 Students examine and evaluate local and global examples where issues related to biodiversity and ecological sustainability are being considered.

*L*earning outcomes

## Natural and Processed Materials

The properties and structure of materials are interrelated.

Patterns of interactions between materials can be identified and used to predict and control further interactions.

The uses of materials are determined by their properties, some of which can be changed.

| Foundation Level | Level 1 |
|---|---|
| **Level statement**<br>*Students are developing and can communicate an understanding that familiar materials have different properties and particular uses, and that the properties of materials may change.* | **Level statement**<br>*Students understand that different materials have different properties. They understand that materials can undergo changes and that materials can be used in a variety of ways.* |
| Foundation Level statements have been developed for students demonstrating a level of understanding before that of Level 1. These statements can be used to develop a range of specific learning outcomes which are tailored to the individual needs of students with disabilities and related to their individualised curriculum programs. | **Core learning outcomes**<br>1.1 Students describe observable properties of familiar materials (including solids and liquids).<br>1.2 Students describe observable changes (including change of state) that occur in materials.<br>1.3 Students look for alternative ways that familiar materials can be used.<br>**Discretionary learning outcome**<br>D1.4 Students explore changes caused by the action of living things on the properties of common materials. |

*L*earning outcomes

## Natural and Processed Materials

The properties and structure of materials are interrelated.

Patterns of interactions between materials can be identified and used to predict and control further interactions.

The uses of materials are determined by their properties, some of which can be changed.

### Level 2

**Level statement**

*Students understand that different materials can be grouped according to different properties and that these properties can be changed. They understand that different materials are used for particular purposes.*

**Core learning outcomes**

2.1 Students group materials on the basis of properties (including solubility, texture and hardness).

2.2 Students recognise ways in which changes in properties of familiar materials occur (including temperature change and magnetism).

2.3 Students explain why common materials are used in particular situations.

**Discretionary learning outcome**

D2.4 Students identify patterns when investigating the properties and uses of different materials.

### Level 3

**Level statement**

*Students understand that some materials are composed of smaller visible parts. They understand that the properties of materials after a change may be different from the properties before a change. They understand that combining materials in different ways can affect the usefulness of those materials.*

**Core learning outcomes**

3.1 Students examine and describe the smaller visible parts of common materials and relate these to the properties of the materials.

3.2 Students compare properties of materials before and after physical and chemical changes.

3.3 Students collect information to illustrate how combining different materials influences their usefulness.

**Discretionary learning outcome**

D3.4 Students apply ideas and concepts about how changes in materials affect their properties.

*L*earning outcomes

## Natural and Processed Materials

The properties and structure of materials are interrelated.

Patterns of interactions between materials can be identified and used to predict and control further interactions.

The uses of materials are determined by their properties, some of which can be changed.

### Level 4

**Level statement**

*Students understand that the underlying structure determines the properties of materials. They understand that materials can undergo different types of change and that these alterations can change the usefulness of the material.*

**Core learning outcomes**

4.1 Students collect information and propose ideas to explain the properties of materials in terms of each material's underlying structure.

4.2 Students identify patterns in the types of change that take place in materials.

4.3 Students examine and assess ways that materials can be changed to make them more useful.

**Discretionary learning outcome**

D4.4 Students recognise, and report on, the environmental impact of some manufacturing processes.

### Level 5

**Level statement**

*Students understand that scientific ideas about the particle nature of matter can be used to explain the properties of matter. They understand that there are factors which affect the nature and rate of reactions. Students understand that the choice of materials for specific purposes should be based on the properties of the materials.*

**Core learning outcomes**

5.1 Students present information in a variety of ways to explain the structure and behaviour of matter in terms of particles of which it is made.

5.2 Students make inferences about the effect of various factors (including temperature of the reaction and surface area of the reactants) on the nature and rate of reactions.

5.3 Students devise tests and interpret data to show that the properties and interactions of materials influence their use.

**Discretionary learning outcome**

D5.4 Students collect information and report on manufacturing processes that develop materials for specific purposes.

*L*earning outcomes

## Natural and Processed Materials

The properties and structure of materials are interrelated.

Patterns of interactions between materials can be identified and used to predict and control further interactions.

The uses of materials are determined by their properties, some of which can be changed.

### Level 6

**Level statement**

*Students understand that scientific ideas about the structure of the particles which make up matter can be used to explain the different types of changes that can take place between materials. Students understand how physical and chemical properties of materials are considered in the planning of their commercial production.*

**Core learning outcomes**

6.1 Students explain the structure and properties of matter using models of atoms and molecules.

6.2 Students use identified patterns of change to predict interactions between materials.

6.3 Students collect and present information about the relationship between the commercial production of industrial, agricultural and fuel products and their properties.

**Discretionary learning outcome**

D6.4 Students observe and quantify the changes that take place in a reaction.

### Beyond Level 6

**Level statement**

*Students understand that interactions between atoms and molecules can be represented symbolically. They understand how materials can be tested to determine their properties. Students understand how materials can be produced with certain properties to suit particular requirements.*

**Discretionary learning outcomes**

DB6.1 Students describe interactions between atoms and molecules using scientific representations of subatomic particles.

DB6.2 Students explain and use chemical formulae and equations to describe the reactions and energy changes that take place between materials.

DB6.3 Students design qualitative and quantitative investigations to compare natural and alternative synthetic materials.

DB6.4 Students design procedures for testing properties of a new substance.

DB6.5 Students explore chemical processes which adversely affect the environment and consider ways of minimising these effects.

DB6.6 Students assess the development of new materials with desired properties, and compare the new with earlier counterparts or with natural materials put to similar use.

## Using outcomes for planning and assessment

Outcomes of the syllabus provide a framework for planning and assessment by describing what it is that students should know and be able to do. Using outcomes for planning and assessment involves:

- adopting a learner-centred approach to learning and teaching;
- assisting students to work towards being able to demonstrate the outcomes;
- planning learning experiences and assessment tasks at the same time;
- establishing clear expectations of student performance as a basis for monitoring the progress of student learning.

The core learning outcomes are sequenced conceptually in six progressive levels. This conceptual development is represented in the level statements for each strand.

An outcome at one level is continuous with, but qualitatively different from, the outcomes at the levels before and after. This sequencing across levels assists teachers in planning learning experiences to cater for the range of students' abilities.

When planning units of work, teachers could select learning outcomes from within a strand, across strands within a key learning area, across levels within a key learning area, or across key learning areas. Assessment tasks may address more than one learning outcome.

Multiple opportunities for the demonstration of learning outcomes should be planned. A range of activities incorporating contents and contexts should be utilised to provide these opportunities.

Planning at Foundation Level may involve outcomes that teachers have written using a broad interpretation of the level statements; however, the intent of the statements should be retained.

### Working scientifically

'Working scientifically' is the essence of science. This syllabus describes three aspects of 'working scientifically':

- investigating;
- understanding;
- communicating.

Each of these aspects has a number of components. The demonstrations of students' knowledge described in the core and discretionary learning outcomes have been selected from these components of 'working scientifically'. Progression through the levels of outcomes and use of the components of 'working scientifically' provide opportunities for students to demonstrate their understandings and applications of the key concepts. The components of 'working scientifically' need to be considered when planning learning experiences and related assessment tasks.

A table showing the aspects and components of 'working scientifically' follows.

## Working scientifically

| Aspects of 'working scientifically' and their components are: | | |
|---|---|---|
| **INVESTIGATING which may involve:** | **UNDERSTANDING which may involve:** | **COMMUNICATING which may involve:** |
| • accessing resources<br>• clarifying and challenging<br>• collecting information<br>• designing and performing experiments<br>• designing and performing investigations<br>• engaging with problems<br>• exploring phenomena<br>• forecasting and backcasting<br>• formulating questions<br>• handling materials<br>• hypothesising<br>• identifying<br>• identifying and controlling variables<br>• looking for patterns and meanings<br>• making and judging observations<br>• making plans<br>• measuring<br>• playing<br>• predicting<br>• seeking reasons<br>• … | • analysing<br>• applying ideas and concepts<br>• assessing and reassessing<br>• constructing meaning<br>• creating analogies<br>• dealing in an orderly manner with the parts of a complex whole<br>• developing possible, probable and preferred options<br>• drawing conclusions<br>• examining and evaluating<br>• formulating and elaborating ideas<br>• generalising<br>• inferring from data<br>• interpreting data<br>• judging credibility<br>• looking for alternatives<br>• making and judging deductions<br>• making and judging inductions<br>• making comparisons<br>• making links<br>• preparing scenarios<br>• recognising and analysing options<br>• reflecting and considering<br>• selecting and justifying<br>• suggesting<br>• synthesising<br>• using ideas, theories and principles<br>• … | • arguing a position<br>• clarifying ideas and concepts<br>• constructing and using models<br>• creating diagrams<br>• creating presentations<br>• creating tables and graphs<br>• describing<br>• discussing thinking<br>• envisioning alternative futures<br>• explaining ideas and decisions<br>• exploring and elaborating ideas<br>• expressing points of view<br>• illustrating<br>• improvising and performing<br>• listening and questioning<br>• negotiating<br>• relating<br>• responding and debating<br>• retelling and restating<br>• summarising and reporting<br>• supporting decisions<br>• using scientific report genres<br>• using scientific terminology<br>• … |

## Core content

The primary tools for planning learning experiences and assessment tasks are the core learning outcomes. Students will engage with the core content when they are provided with opportunities to demonstrate the core learning outcomes in the syllabus.

While the content is listed in strands for organisational convenience, no one part of that content is to be viewed as discretely associated with a single strand. For example, the particle model of matter is described in the Natural and Processed Materials strand, but it also relates to the Energy and Change strand. The organisation of the content within a strand should not be considered to be hierarchical. Any of the content can be addressed at any appropriate year level; also, not all of the content need be addressed at every year level.

While it is required that the core content of each strand be addressed during Years 1–10, the sequencing of, and amount of time allocated to, individual topics within strands are the responsibilities of school authorities.

Reference to the aspects and components of 'working scientifically', and the core content of each conceptual strand, can provide additional insights into the core learning outcomes. The aspects and components of 'working scientifically' are to be considered in conjunction with all the strands.

The core content of each strand is identified on the following pages.

| Core content | Science and Society | |
|---|---|---|
| *Historical and cultural factors influence the nature and direction of science which, in turn, affects the development of society.* | *Science as a 'way of knowing' is shaped by the ways that humans construct their understandings.* | *Decisions about the ways that science is applied have short- and long-term implications for the environment, communities and individuals.* |
| **History and philosophy of science**<br>**Influential scientists**<br>• Australian<br>• Western<br>• other cultures<br>**Uses of science**<br>• influence on Australia<br>• Western influence<br>• indigenous use<br>• other cultures<br>**Disciplines of science**<br>• traditional disciplines<br>• change with time<br>• new disciplines and fields<br>• societal imperatives<br>**The work of scientists**<br>• ethics<br>• gender<br>• culture<br>• economics<br>• media<br>**Communication of scientific ideas**<br>**Changes in scientific ideas over time**<br>• factors which assist/hinder the development of scientific ideas<br>• comparison of ideas | **Use of tools to assist observation**<br>• accuracy<br>• measurement<br>• appropriateness<br>• aberrations<br>**Different people see things differently**<br>• culture<br>• society<br>• education<br>• experience<br>**Valuing alternative ideas**<br>• envisioning alternative solutions<br>• intuition<br>**Investigations**<br>• controlled — fair testing<br>• different ways of collecting evidence provide different information<br>• usefulness to explain observations<br>• justification of decisions and conclusions<br>**Ways scientists think and work**<br>• locations and fields of work<br>• different ways of collecting information<br>• different ways of problem solving<br>**People's views of science and scientists**<br>• stereotypes | **Applications of science**<br>• home<br>• community<br>• industry<br>• medicine<br>• environment<br>• agriculture<br>**Short-term effects (costs and benefits) for:**<br>• individuals and communities<br>– health<br>– lifestyle<br>– recreation<br>• environment<br>– pollution of air, water, soil<br>**Long-term effects (costs and benefits) for:**<br>• the environment<br>– degradation<br>– urbanisation<br>– habitat loss<br>– agricultural practices<br>– sustainability<br>– biodiversity<br>• the home and community<br>– use and supply of energy and chemicals<br>**Futures**<br>• sustainability<br>• planning<br>• envisioning alternatives |

| Core content | Earth and Beyond | |
|---|---|---|
| *The Earth, solar system and universe are dynamic systems.* | *Events on Earth, in the solar system and in the universe occur on different scales of time and space.* | *Living things use the resources of the Earth, solar system and universe to meet their needs.* |
| **The Earth as a system**<br>• features — landforms, bodies of water, rock types, soil, wind, clouds<br>• components — layers of Earth, hydrosphere, lithosphere, atmosphere<br>• interactions between components — corrasion, erosion, weathering<br><br>**The solar system as a system**<br>• features — sunrise/sunset, eclipses<br>• components — sun, moon, planets, comets, meteors<br>• interactions — orbits of planets/moons, rotations and revolutions<br><br>**The universe as a system**<br>• components — the solar system, other star systems, galaxies<br>• interactions — light from stars<br><br>**Changes on Earth and beyond**<br>• rock cycle, water cycle<br>• weather, climate, seasons<br>• phases of the moon, day/night<br>• position of stars<br><br>**Theories and ideas to explain changes on Earth and beyond**<br>• plate tectonics<br>• 'big bang' theory<br>• 'steady state' theory | **Scales of distance**<br>• distance on Earth<br>• astronomical distance — effect on space research and exploration<br><br>**Scales of time**<br>• human lifetime<br>• geological time<br>• astronomical time<br><br>**Changes in Earth and beyond**<br>• cyclical — day/night, seasons, tides, phases of the moon<br>• catastrophic — droughts/floods, earthquakes, tsunamis, volcanic eruptions<br>• magma intrusions and extrusions, regional metamorphosis<br><br>**Evidence of past events in present-day events and features**<br>• folding, faulting, layering<br>• soil and rock types<br>• patterns of erosion<br>• sedimentation<br>• fossils<br>• composition of soils, rocks, planets | **Using the Earth's environment**<br>• to obtain needs — sun, water, shelter, gases<br>• for human recreation — aesthetics, mountains, parks, waterways, littoral zones, roads, farms, built environment<br>• navigation<br>• regeneration<br><br>**Using materials from the Earth**<br>• minerals<br>• building materials<br>• materials used in commercial products<br><br>**Renewable/non-renewable resources of the Earth**<br><br>**Caring for the environment**<br>• managing human impact on land, water and atmosphere<br><br>**Information as a resource**<br>• from the Earth, solar system and universe<br>• for making predictions<br>• for utilising and conserving resources<br>• for considering ideas of futures and sustainability |

| Core content | Energy and Change | |
|---|---|---|
| *The forces acting on objects influence their motion, shape, behaviour and energy.* | *In interactions and changes, energy is transferred and transformed but is not created or destroyed.* | *There are different ways of obtaining and utilising energy and these have different consequences.* |
| **Motion and forces**<br>• floating, sinking, rolling, sliding, falling<br>• pushing/pulling<br>• magnetic — attraction and repulsion, north and south poles, magnetic and non-magnetic materials, electromagnets, making magnets<br>• electrostatic — positive and negative charges<br>• gravity — on Earth, moon and other planets relative to size<br>• friction — opposing motion, everyday applications and implications<br>• balanced/unbalanced forces — forces acting in pairs<br>• Newton's laws of motion — inertia, $F = ma$, action and reaction<br>• speed, velocity, acceleration<br>• momentum<br><br>**Motion and energy changes**<br>• kinetic energy<br>• potential energy — elastic, gravitational, electrical, chemical<br><br>**Manipulation of forces**<br>• simple machines — levers, pulleys, inclined planes<br>• mechanical advantage<br>• efficiency<br>• perpetual motion | **Transfer and transformation of energy types**<br>• heat — conduction, convection, radiation, Celsius and Kelvin temperature scales<br>• sound — vibration, pitch, frequency, volume, echo, travel of sound in solids, liquids and gases<br>• light — reflection, refraction, diffraction, visible spectrum, ray diagrams<br>• electrical — static and current, AC-DC, voltage, current, resistance, power, Ohm's law, series and parallel circuits, circuit symbols and diagrams<br>• potential — elastic, gravitational, electrical, chemical<br>• kinetic<br><br>**Conservation of energy**<br><br>**Energy transfers that occur in:**<br>• home<br>• community<br>• transport<br><br>**Energy converters**<br>• efficiency | **Sources of energy**<br>• fossil fuels — coal, oil, gas<br>• sun — wind energy, photo-electric cells<br>• geothermal<br>• hydroelectric<br>• tidal<br>• nuclear<br><br>**Alternative ways of obtaining energy**<br>• solar cells<br>• solar hot water<br>• wind turbines<br><br>**Ways of utilising energy**<br>• coal-fired power stations<br>• nuclear power stations<br>• use of fuels in transport<br>• electric cars<br><br>**Consequences of energy use**<br>• short-term effects — pollution<br>• long-term effects — greenhouse effect<br>• renewable/non-renewable energy sources, long-term sustainability<br>• design efficiency<br>• social and cultural patterns of energy use |

| Core content | Life and Living | |
|---|---|---|
| *The characteristics of an organism and its functioning are interrelated.* | *Evolutionary processes have given rise to a diversity of living things which can be grouped according to their characteristics.* | *Environments are dynamic and have living and non-living components which interact.* |
| **Needs of living things** — water, oxygen (plants and animals), carbon dioxide (plants), nutrients, suitable temperature<br><br>**Observable features of plants and animals**<br>• external — body covering, sense organs, limbs and other appendages, external skeleton, leaves, roots, stems, flowers, cones<br>• internal — tissues, organs, systems<br><br>**Observable behaviours** — nocturnal/diurnal, care of young, hibernation, deciduous/evergreen<br><br>**Functioning of systems of animals** — digestive, respiratory, circulatory, excretory, nervous, endocrine, skeletal, reproductive<br><br>**Functioning of systems of plants** — water and food transport, photosynthetic, reproductive<br><br>**Cell structure** — cell wall, cell membrane, nucleus, cytoplasm, chloroplasts<br><br>**Homeostasis** — temperature, water<br><br>**Disease** — infectious, genetic, environmental, auto-immune<br><br>**Adaptations** — structural, functional, behavioural | **Characteristics of living and non-living things**<br><br>**Characteristics which differ or are similar among living things**<br>• methods of obtaining nutrition<br>• plants — flowering/non-flowering, woody/herbaceous<br>• animals — body covering, appendages<br>• fungi and bacteria<br><br>**Changes in an organism over time**<br>• infant to adult<br>• egg to adult<br>• metamorphosis<br>• aging<br>• puberty<br>• seed to mature plant<br><br>**Life cycles** — plant and animal<br><br>**Reproductive processes** — sexual, asexual<br><br>**Reproductive strategies** — parental care, numbers of offspring, eggs, courtship<br><br>**Variation in species** — sexual reproduction, mutation, genetics, evolution<br><br>**Mendelian genetics** — dominant/recessive, incomplete dominance, sex-linkage<br><br>**Theory of evolution** — natural selection, adaptation, supporting evidence, alternative ideas about the mechanisms of evolution | **Components of environments** — biotic/abiotic<br><br>**Types of environments** — aquatic/terrestrial<br><br>**Features of different environments**<br><br>**Natural relationships**<br>• interactions between living things<br>– symbiosis<br>– predator/prey<br>– food chains/webs<br>– competition for resources<br>• interactions between living and non-living things to meet needs<br>• interactions between non-living things<br>– effects on environments<br><br>**Ecosystems**<br>• roles of organisms — producer, consumer, decomposer<br>• cycling of matter — nitrogen, oxygen, carbon, water<br>• flow of energy — photosynthesis, respiration<br><br>**Human influence**<br>• changes in biodiversity — conservation, preservation, introduced species<br>• modification of habitat<br>– agricultural practices — monoculture, grazing, irrigation, soil degradation<br>– urbanisation<br>– tourism/ecotourism<br><br>**Effects of fire, flood, drought, seismic activity** |

| Core content | Natural and Processed Materials | |
|---|---|---|
| *The properties and structure of materials are interrelated.* | *Patterns of interactions between materials can be identified and used to predict and control further interactions.* | *The uses of materials are determined by their properties, some of which can be changed.* |
| **Types of materials**<br>• solid, liquid, gas, plasma<br>– crystals, fibres, fabrics, plastics, wood<br>– metals, non-metals<br>– polymers, acids/bases<br>– building materials<br>**Properties of materials**<br>• taste, odour, colour<br>• lustre, texture, acoustic characteristics<br>• absorbent, porous<br>• transparent, translucent, opaque<br>• magnetic, non-magnetic<br>• density — light/heavy, floats/sinks<br>• solubility<br>• strength, hardness, flexibility, viscosity<br>• conduction/insulation — heat/electricity<br>• reactivity with other substances<br>**Structure of materials**<br>• macro<br>• micro — crystalline/non-crystalline<br>• atoms, elements, molecules, compounds<br>• electrons, protons, neutrons, ions<br>**Theories of structure/organisation**<br>• particle theory<br>• Periodic Table | **Nature of change**<br>• fast/slow<br>• requires heat/releases heat<br>• physical<br>– change of state: melting/freezing, evaporation/condensation<br>– magnetising/demagnetising<br>• chemical<br>– combination, decomposition<br>– combustion, neutralisation, precipitation<br>**Causes of change**<br>• heating/cooling<br>• oxidising — burning, rusting<br>**Rate of change is affected by:**<br>• surface area<br>• temperature<br>• concentration<br>• catalysts<br>**Predicting and controlling changes**<br>**Techniques for separating mixtures**<br>• filtration<br>• decantation<br>• distillation<br>• evaporation<br>**Word equations** | **Natural materials**<br>• organic<br>– plants: wood, fibres<br>– animals: wool, leather, glue<br>• inorganic — rocks, ores, minerals<br>**Processed materials**<br>• metals — alloys<br>• plastics<br>• salts<br>• synthetic fibres<br>• paper<br>• glass<br>• brick<br>• cement<br>**Uses**<br>• building<br>• tools<br>• clothing<br>• food<br>• cleaning<br>• medicine<br>• recreation<br>**Changes made to properties of materials to meet required uses** |

## Relationship of outcome levels to year levels

For the purposes of planning and assessment, outcome levels typically relate to year levels as follows:

- students demonstrating Level 2 outcomes are at the end of Year 3;
- students demonstrating Level 3 outcomes are at the end of Year 5;
- students demonstrating Level 4 outcomes are at the end of Year 7;
- students demonstrating Level 6 outcomes are at the end of Year 10.

During the compulsory years of schooling, most students will demonstrate the core learning outcomes at each level for each strand. Some students will, however, achieve beyond the typical levels described above. Similarly, not all students will reach these levels as they will progress at a slower rate than their peers, and will require an extended period of time to demonstrate the core learning outcomes.

## Indicative time allocations

Indicative time allocations are based on an estimate of the minimum time needed to provide students with opportunities to demonstrate the core learning outcomes. The following have been used to guide the design and development of the syllabus for the Years 1–10 Science key learning area:

- Years 1–3: 180 hours across the three years;
- Years 4–7: 240 hours across the four years;
- Years 8–10: 180 hours across the three years.

# Assessment

Assessment within an outcomes framework is the purposeful, systematic and ongoing collection of information about students' demonstrations of learning outcomes. In this syllabus, core learning outcomes are presented in levels progressively increasing in sophistication and complexity to form a continuum of learning. This is represented by the level statement of each syllabus strand. Students' progress in the key learning area can be monitored by their demonstrations of the core learning outcomes.

Teachers use assessment information to monitor students' progress and to make professional judgments in order to:

- inform students, parents, carers and schools about demonstrations of learning outcomes;
- make decisions about students' needs, the learning and teaching processes and resource requirements;
- set learning goals with students, parents and carers;
- guide the planning of school and class curriculum programs.

## Principles of assessment

For assessment to be effective, it should:

- focus on students' demonstrations of learning outcomes;
- be comprehensive;
- develop students' capacities to monitor their own progress;
- reflect current knowledge of child and adolescent development;
- be an integral part of the learning process;
- be valid and reliable;
- reflect social justice principles.

### Demonstrations of learning outcomes

Within an outcomes framework, assessment focuses on students' demonstrations of learning outcomes. When assessment is focused on learning outcomes, students are aware of what is being assessed, the assessment techniques being used, and the criteria by which their demonstrations of learning outcomes will be judged. Teachers may then use information from assessment to plan and direct students' further learning.

## Comprehensive range

Using a comprehensive range of assessment techniques and related instruments allows students multiple opportunities and a range of contexts in which to demonstrate learning outcomes. A variety of assessment instruments supports different learning styles. The assessment tasks developed in specific situations provide opportunities for students to negotiate assessment and approach assessment in different ways.

At any one period in their schooling, students could demonstrate their learning in different ways, and at different levels, across the range of learning outcomes. Assessment techniques must take into account that every student will progress at a different rate across and within the key learning areas.

## Student monitoring of own progress

Students need to develop skills in self-monitoring and to reflect on the processes in which they engage, the skills they use and the products of their learning experiences. Self-monitoring enables students to gather important information that they can use to set goals and monitor their progress towards particular learning outcomes. Student self-monitoring also provides valuable information to help teachers, parents and carers make decisions about future learning and teaching.

## Current knowledge of child and adolescent development

Assessment that reflects current knowledge of child and adolescent development considers the ways children and adolescents behave, grow, think, interact and learn. These are important elements to consider in the planning, development and implementation of assessment techniques.

## Integral part of the learning process

Assessment is an integral part of the learning process. As they plan learning experiences, teachers should also plan how they will monitor students' progress. Authentic assessment tasks should match the students' learning experiences and the teaching methods they have experienced. Assessment tasks should also reflect real-life situations, where this is appropriate.

## Valid and reliable information

Assessment should provide valid and reliable information that relates directly to specific learning outcomes. Assessment tasks should accurately test what they are supposed to test and provide students with opportunities to demonstrate one or more of the learning outcomes.

## Social justice principles

Assessment based on the principles of social justice allows students to demonstrate learning outcomes in ways which are sensitive to, and inclusive of, the circumstances of every student. Assessment tasks should be planned to take into account students' learning styles, culture, ethnicity, abilities, disabilities, gender, sexual identity, geographical location, socioeconomic status and linguistic backgrounds.

## Techniques for gathering information

Assessment is effective and efficient when embedded within a learning and teaching sequence. When lesson sequence models based on constructivist views of learning are used, parts of the sequence may themselves provide assessment opportunities. For example, it can be part of a diagnostic assessment strategy to ascertain students' prior understandings of scientific concepts at the beginning of a unit of work.

A variety of techniques should be used to gather information about students' performances in the Science key learning area. This variety of techniques will provide a comprehensive body of information from which teachers can draw valid and reliable conclusions about students' demonstrations of learning outcomes, or the reasons they have not been demonstrated.

Techniques for gathering assessment information could include observation, consultation and focused analysis of students' demonstrations of learning outcomes. Self- and peer-assessment can also provide opportunities for students to reflect on their own and others' performances.

Open-ended questioning, dialogue and listening can be effective means of assessing students' demonstrations of learning. Reflective student self-assessment at the culmination of a unit may assist students to clarify their understandings while also contributing to summative assessment.

Portfolios of students' work can provide a comprehensive picture of students' learning. They can provide information about learning contexts and can involve students in self-assessment and the selection of appropriate demonstrations of their learning. Portfolios offer a variety of ways of monitoring and recording students' learning and demonstrations of outcomes. These could include drawings, diagrams, maps, sketches, graphs, journal entries, other items of written work, videos, web pages, electronic presentations and photographs of students' models or products.

## Making judgments and reporting

Within an outcomes framework, the outcomes to be demonstrated are made explicit to students so that they can plan for, and demonstrate, the learning outcomes. Evidence of demonstrations of learning outcomes can be drawn from ongoing observation of performance, or from assessment tasks specifically designed to allow students to demonstrate learning outcomes. Teachers can make judgments about students' demonstrations of learning outcomes when they are satisfied that they have sufficient evidence of such demonstrations.

Decisions about a student's demonstration of learning outcomes preferably should be made without reference to the performance of other students. It is important that the outcome be demonstrated consistently, to a high standard and in a range of contexts.

The exercise of teachers' professional judgment is fundamental to assessment and reporting processes. Decisions should be based on explicit criteria, using a range of evidence to determine demonstrations of outcomes. The criteria should be made known to students so that the basis for judgments is clear.

Materials and processes to support the consistency of teacher judgments within and between schools can be developed through:

- shared understandings;
- descriptions of ideal responses;
- criteria sheets;
- common planning and assessment tasks;
- examination of students' folios;
- progress maps;
- moderation processes (formal and informal).

Students, parents and carers need timely and accurate information from teachers about the student's progress along the learning continuum. Reporting of students' progress in terms of demonstrated learning outcomes can be provided in a variety of ways, including progress charts, verbal feedback, the results of formal assessment and formal reporting.