QUEENSLAND
SCHOOL
CURRICULUM
COUNCIL

# Science (1999)

# Years 1 to 10
# Sourcebook Guidelines

Queensland Government

Queensland Studies Authority
Partnership and Innovation

# Nature of the key learning area

## Background

The Years 1–10 Science key learning area is informed by:

- *A Statement on Science for Australian Schools* (Curriculum Corporation 1994) and *Science — a Curriculum Profile for Australian Schools* (Curriculum Corporation 1994);
- contemporary models of science education;
- current views of science.

Curriculum programs for the Science key learning area should involve students and teachers working in partnership to plan meaningful experiences that promote learning. Useful contexts for these experiences reflect the interplay between science and society. Experiences that promote learning should provide opportunities for students to develop understandings of the concepts of science and the practices and dispositions associated with 'working scientifically'.

In the syllabus, concepts are organised into five strands:

- Science and Society;
- Earth and Beyond;
- Energy and Change;
- Life and Living;
- Natural and Processed Materials.

In the syllabus 'working scientifically' (pp. 32–33) is described by three aspects: investigating, understanding and communicating. Each of these aspects has a number of possible components. Core learning outcomes at each level comprise selected components of 'working scientifically' together with conceptual understanding relevant to a particular stage of development.

Students 'working scientifically' explore and seek to make sense of the natural phenomena they experience. In particular, students:

- learn that science is both a process and a set of evolving ideas refined and elaborated through discussion;
- learn that science is a way of knowing about the world around them;
- learn to apply their understandings of social, cultural and historical factors as they consider the interactions between science and society;
- learn that science involves people around the world working in diverse communities gathering and communicating information to construct meaning about natural phenomena;
- develop the practices and dispositions related to posing questions and investigating hypotheses;

- use their intuition and imagination, and apply their conceptualisation, problem-solving and decision-making skills, as well as the methodical procedures of scientific investigation;
- generate and evaluate a range of models, hypotheses and scenarios through the use of lateral thinking and analogy, as well as through trend analysis of data, hypothesising and experimentation;
- develop an understanding of, and ability to utilise, concepts constructed by scientists.

## Contribution to lifelong learning

The key learning area contributes to a general education by providing students with opportunities to learn through, and about, science. Students engage in activities through which they may develop the valued attributes of lifelong learners identified in the syllabus.

A lifelong learner is described as:

- 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 sourcebook modules support students' development of the valued attributes of lifelong learners by actively engaging them in problem-solving and decision-making strategies. The activities in the sourcebook modules assist students to become scientifically literate citizens through developing their understanding of the concepts of science and their ability to think and work in a scientific way.

## Cross-curricular priorities

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

### Literacy

Students develop literacy skills as they engage in a range of science activities. As students investigate, understand and communicate they learn:

- to understand and use the codes and symbols of written and spoken texts;
- to spell science words accurately;
- to know the purposes, conventions and structure of language;
- to compose and make meaning from written and spoken texts as they comprehend and use the specialised language of science;
- to discriminate between everyday and scientific use of words and terms;

- to understand the purposes of different written and spoken texts as they select a genre appropriate to the text's purpose and audience;
- to recognise that written and spoken text is not neutral and will reflect interest, bias and, in some cases, personal agenda.

Students develop and communicate their scientific understandings through learning to engage with and use scientific information conveyed in a range of media, including manuals, pamphlets, posters, recipes, cartoons, videos, journals, diagrams, flow charts, magazine items, interviews and role-plays. They develop and apply critical literacy skills and develop an understanding of the historical, social and cultural aspects of science and of the interactions between science and society.

## Numeracy

Students develop their numeracy skills by engaging in a range of science activities. As they investigate, understand and communicate, students develop a sense of number, measurement, data, space and algebra. Through engaging with scientific information and conducting their own scientific investigations, they learn to:

- tabulate numerical information;
- manipulate numerical information including the application of formulae, and assign appropriate units;
- present numerical information in graphs with appropriate scales and different starting points, and apply appropriate extrapolation and interpolation techniques;
- construct their own presentations;
- comment critically on the strengths and weaknesses of various forms of data collection, analysis and display;
- support an argument using mathematics;
- represent, describe and explain natural phenomena using mathematics.

## Lifeskills

Students develop lifeskills as they engage in a range of science activities. As they 'work scientifically' and develop understandings about key concepts, students:

- begin to understand how personal identities and other aspects of growth are shaped by factors such as gender, disability, race, culture, religion, economic status and ethnic background;
- develop social skills as they work cooperatively or interact in other situations;
- develop self-management skills as they work both independently and cooperatively;
- critically evaluate issues such as the use of resources, sustainability and the applications of science.

Students 'working scientifically', individually and together, develop their personal, social, self-management and citizenship skills as they explore familiar and unfamiliar natural phenomena and objects. Problem-solving and decision-making strategies are developed concurrently. Students also develop competency in selecting and using tools and equipment appropriate to a task.

Skills of negotiation, turn taking, active listening and assertive speaking are developed in cooperative learning groups.

## Futures perspective

During the compulsory years of schooling students also develop a futures perspective as they engage in a range of science activities. As students investigate, understand and communicate they acquire the ability to use futures tools such as:

- timelines;
- futures wheels;
- space–time grids.

They learn futures methodologies such as:

- environmental scanning;
- scenario construction;
- trend analysis;
- forecasting;
- modelling;
- critical review and analysis of discourse.

As students 'work scientifically' and integrate conceptual understandings from Science and Society and the other four strands, they use futures tools and methodologies to construct insights, data and knowledge about natural phenomena and the impact of science and human activity on people and the environment. They envision possible, probable and preferred futures. They suggest solutions and plan alternative courses of action.

**References**

Curriculum Corporation 1994, *A Statement on Science for Australian Schools*, Carlton, Vic.

Curriculum Corporation 1994, *Science — a Curriculum Profile for Australian Schools*, Carlton, Vic.

# Learners and learning in Science

The Science key learning area recognises that students are innately curious about their world and explore it in a variety of ways. From an early age students use their physical, social and cultural experiences to make sense of the phenomena around them. Students of different genders, with different socioeconomic, cultural, geographic, ethnic and linguistic backgrounds, and with disabilities and learning difficulties, will have experienced life differently. Students may use different language and different ways to describe their understandings of their experiences.

Through their interactions with, and observations of, natural objects and events, peer culture, language, and everyday sayings, students develop their own intuitive understandings of why things happen in the physical and biological worlds.

From their unique experiences, students may develop concepts that do not conform to current scientific ideas. Recognition that learners may have alternative ideas and ways of learning encourages teachers to:

- develop strategies to access students' ideas;
- provide experiences that promote learning to:
  - assist students reflect on their understandings;
  - develop in students scientific understandings, dispositions and practices;
  - assist students apply these scientific understandings, dispositions and practices in their everyday life.

## Developmental characteristics

As students mature, they exhibit different developmental characteristics. Students develop and achieve in different ways, at different rates and at different stages. One way to consider these ways, rates and stages is to look at them as four broad overlapping phases of typical development corresponding to the bands of schooling — lower primary, middle primary, upper primary and lower secondary.

### Lower primary students

These students tend to focus on the world around them. They often have their own explanations of how things work. They interpret new information in terms of their own experience, and new experiences in terms of their existing ideas. Learning takes place through direct experience, observation, discussion, stories, play and a range of problem-solving strategies. As their view of the world expands, students begin to develop a scientific vocabulary and begin exploring the relationships between natural phenomena. Although students may be cooperative, they tend to work in parallel rather than in collaboration.

### Middle primary students

These students are beginning to explore their local environment and the world beyond. They are increasing their skills at seeing things from other points of view. They make links between their personal knowledge and experiences, and information obtained from other sources. Most students need assistance in finding patterns in their data, making summaries and suggesting explanations for their observations. Independently and cooperatively they work scientifically to develop their conceptual understandings. They are developing confidence in changing, generating and adapting ideas and techniques for different situations.

### Upper primary students

These students are developing a sense of wonder that extends beyond the world around them. They are concerned to know how science ideas can be used to improve the environment. They understand that different cultures may approach problems in science in different ways, and that this may have affected past scientific and technological developments. Students are able to deal with more than one concept at a time, and they begin to progress in their thinking from the concrete to the abstract. They are able to relate familiar contexts to unfamiliar situations. They learn to value and recognise logical reasoning and fairness. They need considerable practice and encouragement to examine all the evidence they collect and to challenge their own views.

### Lower secondary students

These students begin to develop their concerns about issues beyond their communities. They are interested in understanding the world in relation to how it affects them and how human activity impacts on the environment. Students are interested in their own physiology and development. They endeavour to use science to assist their understandings. Students question existing practices and priorities and challenge teachers to provide tasks that they perceive as relevant.

## Inclusiveness

Diversity in students' ethnic, cultural and family backgrounds and individual interests and values should be considered and respected when implementing activities for students. These differences, while requiring students to be accepting and sensitive about individuals' diversity, can stimulate rich and varied discussion on a wide range of issues.

The syllabus provides teachers with the basis to design a science curriculum that is inclusive of all students. It encourages and provides teachers with the flexibility to:

- acknowledge, value and build upon the diverse backgrounds, life experiences and interests of students;
- determine and build upon students' prior understandings;
- be cognisant of students' diverse learning styles;
- provide learning activities that consider the needs of students with a disability or particular learning needs;

- utilise a diverse range of assessment techniques and instruments that are in accordance with the principles of social justice;
- draw upon a diverse range of real-life and lifelike contexts.

The syllabus makes provision for all students to:

- value contributions that women and men from diverse backgrounds have made to science;
- appreciate the beauty, wonder and awe of many natural phenomena;
- understand some ways that science has improved the quality of human life;
- recognise the non-neutral nature of many scientific endeavours and contributions;
- view science as a human endeavour that is not free from bias.

## Using a 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.

# Scope and sequence of learning outcomes

## Outcomes approach

An outcomes approach to education defines the end product of education in terms of what it is that students know and are able to do. It is based on a belief that there are certain things that all students should learn and that these things, expressed as outcomes, should be made explicit to all concerned. This approach accepts that learning is progressive, and that stages along a continuum leading to the desired outcome can be identified. It emphasises the provision of developmentally appropriate experiences which give students opportunities to learn, and to demonstrate this learning. This approach places a high importance on real-life, learner-centred contexts, as well as on how and what students learn. These contexts are used to develop the knowledge, processes, skills and attitudes they need for now and, as lifelong learners, for the future.

In an outcomes approach to education, the emphasis is on what students learn, rather than on what they have been taught. Progressive monitoring of students' demonstrated outcomes is fundamental to ensure that curriculum programs can be personalised to meet the particular needs of students, based on their current demonstrations of specific outcomes.

### Principles of an outcomes approach

The principles of an outcomes approach include:

- a clear focus on learning outcomes;
- high expectations for all students;
- a focus on development;
- planning curriculum with learners and outcomes in mind;
- expanded opportunities to learn.

**Clear focus on learning outcomes**

This involves:

- focusing on demonstrations of learning outcomes, rather than on the content being used in the activity;
- students, teachers, parents, carers and appropriate members of the community knowing the outcomes that students are working towards;
- students understanding the reasons for learning what they are learning.

**High expectations for all students**
This involves:

- recognising that all students can succeed;
- challenging students to achieve high standards by providing experiences that promote learning;
- giving students time to produce work of a high standard;
- establishing clear expectations of student performance, including criteria, and referring to these when monitoring the progress of student learning.

**Focus on development**
This involves:

- a knowledge of students' progression along the outcomes continuum;
- providing opportunities for self-assessment so that students can monitor their own progress;
- a knowledge of the different preferred learning styles of students;
- the use of a wide range of strategies to cater for the developmental differences and prior knowledge and skills of students;
- building comprehensive and cumulative developmental assessment using the techniques of observation, consultation, focused analysis and peer- or self-assessment to monitor student progress and to facilitate further learning.

**Planning curriculum with learners and outcomes in mind**
This involves:

- planning assessment at the same time as planning experiences that promote learning;
- using assessment to inform future planning and to provide opportunities to learn;
- planning activities for students that provide them with opportunities to progress and be assessed in their demonstration of outcomes;
- valuing students' backgrounds, interests, prior understandings, experiences and learning styles, and considering these when planning activities;
- recognising the different ways and settings in which learning and assessment take place;
- identifying and overcoming barriers that might limit students or groups of students in their progression and in their demonstrations of outcomes;
- maintaining a learner-centred approach to learning and teaching.

**Expanded opportunities to learn**
This involves:

- giving students opportunities to progress and to demonstrate core learning outcomes in more than one context;
- developing activities, units and programs that are sufficiently flexible to cater for the different characteristics and learning needs of students;
- involving students in planning, assessment and evaluation processes.

## Learning outcomes

### 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 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

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

The five strands are:

- 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 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**

Our world 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 activities through which students can demonstrate the core and discretionary learning outcomes.

Within the scope of the outcomes, there is a sense of sequencing from a fundamental understanding through to a high-order demonstration of the knowledge, practices and dispositions of science. There is a progression from:

- novice to expert;
- familiar context to unfamiliar context;
- self to community;
- concrete to abstract;
- consideration of a single aspect to consideration of multiple aspects;
- simple to complex concepts;
- far past to immediate time and from present time to far future time;
- immediate location or circumstance to a distant location or circumstance.

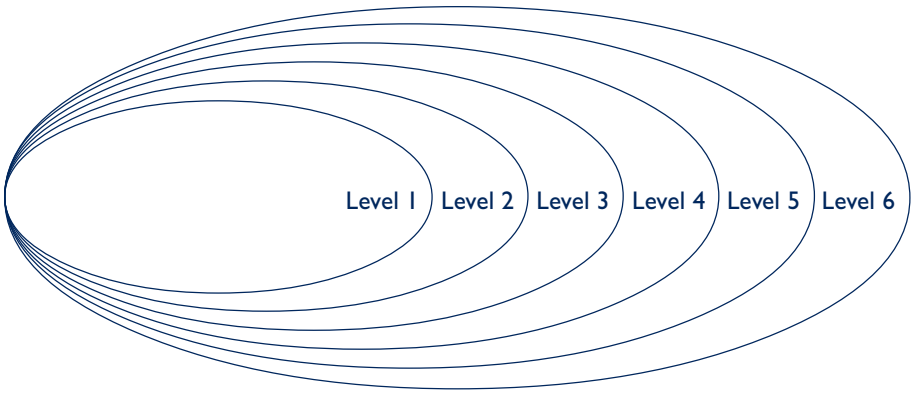
## Core and discretionary learning outcomes

Core and discretionary learning outcomes describe what students know and can do with what they know. The core and discretionary learning outcomes in the Science syllabus are organised according to the five concept strands of the Science key learning area. The core learning outcomes are sequenced conceptually in six progressive levels along a continuum, and the discretionary outcomes into seven levels.

The conceptual dimensions of the core learning outcomes are elaborated in the core content of the strands, while the 'doing' or processes dimension of the core and discretionary outcomes is elaborated in the 'Working scientifically' section of the syllabus (pp. 32–33).

Three core learning outcomes are described for each level of each strand — one for each key concept for each strand. The core learning outcomes allow a wide range of approaches to learning and teaching to cater for diverse student needs.

Each corresponding learning outcome requires, at each subsequent level, an increasing sophistication and complexity of conceptual understanding and ability to use the components of 'working scientifically' — there is a sequencing from level to level. The sequencing of core learning outcomes is such that each level is 'nested' within the level above it, as shown in the following diagram.




**Progression of conceptual development of outcomes**

## Elaborations of core learning outcomes

### Levels 1–6

The tables on pp. 16–30 contain elaborations to help teachers understand the intent of core learning outcomes. They suggest possible content and contexts through which students might demonstrate core learning outcomes. These elaborations have informed the development of the activities in the modules.

### Foundation Level

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

Appendix 1 provides examples of learning outcomes for Foundation Level. They have been developed from the level statements of the syllabus and are included to assist teachers to develop specific outcomes for students who are unable to demonstrate outcomes from other levels of the syllabus. The examples of outcomes are intended to be personalised to meet the specific needs of individual students.

The examples of Foundation Level learning outcomes link with the sequence of core learning outcomes in Levels 1–6. For example, the first example outcome at the Foundation Level (F.1) aligns with the first core learning outcome at Level 1 (1.1) in each of the respective strands. The second example outcome at the Foundation Level (F.2) aligns with the second core learning outcome at Level 1 (1.2), and so on.

| Foundation Level | → Level 1 | → Level 2 | → Level 3 |
|---|---|---|---|
| F.1 | → 1.1 | → 2.1 | → 3.1 |
| F.2 | → 1.2 | → 2.2 | → 3.2 |

## Sequence of core learning outcomes with elaborations for Levels 1–6

The tables on pp. 16–30 present elaborations of each core learning outcome in sequence from Level 1 through to Level 6. This presentation shows how the conceptual understandings become broader, deeper and more sophisticated at each successive level.

Sequence of core learning outcomes with elaborations

## Science and Society

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

| | |
|---|---|
| ***1.1*** *Students discuss their own thinking about natural phenomena.* | ***2.1*** *Students discuss their own ideas about the ways in which science can be described and compare their ideas with those of others.* |
| **Different ideas about natural phenomena:**<br>• comparing ideas<br>• discussing why there are different ideas<br>**Natural phenomena for example:**<br>• sunrise/sunset<br>• stars<br>• weather — wind and rain<br>• floating and sinking<br>• where food comes from — milk, sugar, fruit and vegetables | **Descriptions of science and scientists in the media:**<br>• television, film and video<br>• stereotypes of science and scientists<br>**Scientists in the local area:**<br>• medical laboratories<br>• mines<br>• food processing and testing<br>**How people learn about phenomena:**<br>• oral history, stories<br>• authority sources<br>• trial and error; experimentation<br>• traditional, cultural and religious practices |

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

| | |
|---|---|
| ***1.2*** *Students collect information about natural phenomena and recognise that some ways of collecting information are more appropriate than others in different situations.* | ***2.2*** *Students identify some ways scientists think and work.* |
| **Different ways of collecting information:**<br>• senses<br>• text — books, electronic resources, magazines, newspaper articles<br>• discussion<br>• experimentation<br>• resource people — librarian, education officer<br>**Considerations affecting choice of method:**<br>• safety<br>• availability of resources, equipment | **Ways scientists think and work:**<br>• experimenting, observing, questioning, intuition and hunches<br>• problem solving, decision making<br>• fields of work — research, technical<br>• work locations — laboratory, field, industry, school, home<br>• 'working scientifically' — investigating, understanding, communicating |

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

| | |
|---|---|
| ***1.3*** *Students illustrate different ways that applications of science affect their daily lives.* | ***2.3*** *Students explain some of the ways that applications of science affect their community.* |
| **Examples of applications of science in daily life:**<br>• providing electrical energy — cooking, entertainment (TV, film, computers, music)<br>• clothing — manufacture, synthetic fibres<br>• in the garden — chemical and organic fertilisers, how and where to grow plants<br>• cleaning products — soap and detergent, toothpaste | **Ways that applications of science affect the community:**<br>• food production and packaging<br>• diagnosis and treatment of illness and disease<br>• improved forms of transport — quicker, more environmentally friendly<br>• local industry — mining, chemical manufacture, agriculture<br>• changes in community as a result of computer technology<br>• recreation — chemicals in swimming pools, streamlining of water sports equipment |

Sequence of core learning outcomes with elaborations

## Science and Society

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

| | |
|---|---|
| ***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.* | ***4.1*** *Students outline some contributions to the development of scientific ideas made by people from different cultural and historical backgrounds.* |
| **Different ways of constructing and communicating understanding:**<br>• approaches of different cultural groups to problem solving<br>• different beliefs about the formation of the Earth which stem from traditions, religious beliefs, superstitions<br>• naming of stars and constellations by different cultural groups<br>• ways different cultures use natural resources to meet their needs — food, clothing, shelter, medication<br>• use of story, dance, ritual | **Value of traditional science:**<br>• medicines<br>• oral traditions, including Dreamtime stories<br>• use of astronomy — Incas, Chinese<br>**Chinese science:**<br>• medicine<br>• gunpowder<br>• paper<br>• ceramics<br>**Western scientific tradition:**<br>• ancient Greeks<br>• alchemists<br>• influential scientists, including women<br>• organisation into disciplines |

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

| | |
|---|---|
| ***3.2*** *Students recognise the need for quantitative data when describing natural phenomena.* | ***4.2*** *Students use the elements of a fair test when considering the design of their investigations.* |
| **Importance of quantitative data:**<br>• difference between quantitative and qualitative data<br>• communication of information<br>• comparison — not open to personal opinion<br>**Collection of quantitative data:**<br>• measurement<br>• use of appropriate tools for taking different measurements — telescope, microscope, meters, gauges<br>• correct use and care of tools<br>• appropriate display of data for identification of patterns<br>• need to repeat experiments | **Elements of a fair test:**<br>• develop a researchable question<br>• dependent and independent variables<br>• control of variables — only one changes<br>• measurement of change<br>• presentation of results to suit different purposes |

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

| | |
|---|---|
| ***3.3*** *Students make predictions about the immediate impact of some applications of science on their own community and environment, and consider possible pollution and public health effects.* | ***4.3*** *Students present analyses of the short- and long-term effects of some of the ways in which science is used.* |
| **Impact of applications of science on the community:**<br>• changed disease patterns — immunisation, health awareness, improved hygiene<br>• water treatment<br>• local industry practices — air and water quality, cost of products to the consumer<br>• packaging of materials — more environmentally friendly, easier to use, child-safe, cost of products to the consumer<br>• impact on building — research leads to changed approaches and better materials<br>• caring for the environment — breeding threatened species, conserving areas where threatened species live | **Short-term effects:**<br>• improved products for the consumer; cost of products for the consumer<br>• improved lifestyle and medical care<br>• greater security<br>• pollution and habitat loss<br>• production of non-biodegradable items<br>• increased toxicity in plants and animals<br>• greater understanding of processes occurring on Earth and in the universe<br>• alternative ways of using and conserving non-renewable resources<br>**Long-term effects:**<br>• greenhouse effect, ozone depletion, reduced biodiversity, depletion of non-renewable resources<br>• many long-term effects unknown |

Sequence of core learning outcomes with elaborations

## Science and Society

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

| | |
|---|---|
| ***5.1*** *Students consider how and why scientific ideas have changed over time.* | ***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.* |
| **Changes in scientific ideas over time:**<br>• disease — causes and treatment<br>• structure of the Earth<br>• organisation of the solar system<br>• origin of life on Earth<br>• structure of the atom<br>**Why scientific ideas change:**<br>• improved technology for collecting and interpreting information — telescopes, microscopes, computers, probes, lasers<br>• improved approaches to investigations — controlled experiments, validity, reliability | **Societal constraints on the acceptance of theories:**<br>• Darwin — evolution by natural selection<br>• Copernicus, Galileo, Brahe, Kepler — relationships in the solar system<br>**Ethical issues:**<br>• reproductive technologies, genetic manipulation<br>• production of chemicals and wastes<br>• use of uranium and other sources of nuclear energy<br>**Research funding:**<br>• societal and political influences<br>• role of lobby groups — conservationists<br>**Influence of media:**<br>• impact on the public view of science |

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

| | |
|---|---|
| ***5.2*** *Students refine investigations after evaluating variations and inconsistencies in experimental findings.* | ***6.2*** *Students design and perform controlled investigations to produce believable evidence.* |
| **Using variations and inconsistencies in experimental findings to identify:**<br>• sources of error<br>• lack of precision<br>• inappropriate use of tools<br>• lack of evidence in support of hypotheses<br>**In light of the above, suggest changes to:**<br>• hypotheses being tested<br>• experimental design<br>• type of equipment used and how it is used<br>• how data may be displayed to highlight patterns | **Consideration of the elements of design:**<br>• hypothesising<br>• controlling variables<br>• measurement techniques<br>• data recording techniques<br>**Analysis of results:**<br>• reliability and validity<br>• identification of sources of error<br>• supporting evidence for hypotheses<br>• further investigation pathways |

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

| | |
|---|---|
| ***5.3*** *Students analyse relationships between social attitudes and decisions about the applications of science.* | ***6.3*** *Students use scientific concepts to evaluate the costs and benefits of applications of science (including agricultural and industrial practices).* |
| **Green movement:**<br>• awareness of environmental concerns<br>• community action — Clean up Australia<br>• pressure on industry to change practices<br>• global action — to reduce CFC and $CO_2$ emissions<br>**Affluence of Western society:**<br>• increased demand for consumer goods<br>• increased awareness of health issues<br>• urbanisation — pressure on environment and available space<br>**Global economy:**<br>• optical fibre technology, instant communication<br>• electronic age<br>• worldwide transport of food<br>**Ethical and moral concerns:**<br>• genetic and reproductive technologies<br>• organ transplant technology | **Needs and wants of societies:**<br>• consumer society<br>• affluence and the demand for luxury<br>• increasing gap between Western and third world nations<br>**Agricultural practices:**<br>• increased food production<br>• pollution and habitat destruction/degradation<br>**Industrial practices:**<br>• treatment and re-use of water<br>• 'scrubbing' of air before release<br>• waste treatment<br>• recycling<br>• research into environmentally friendly products<br>**Medicine:**<br>• reduced illness and death due to immunisation<br>• cost of an ageing population<br>• changed disease patterns due to affluent society |

Sequence of core learning outcomes with elaborations

## Earth and Beyond

### The Earth, solar system and universe are dynamic systems.

| | |
|---|---|
| ***1.1*** *Students identify and describe obvious features of the Earth and sky (including landforms and clouds).* | ***2.1*** *Students identify and describe changes in the obvious features of the Earth and sky (including changes in the appearance of the moon).* |
| **Features of the Earth:**<br>• land — soil, rocks, mountains, beaches, playgrounds, farms<br>• bodies of water — rivers, oceans, dams, lakes; tides, currents, wave action<br>• air — winds, clouds<br>• ice — glaciers, icebergs<br>• built environment<br>**Features of the sky:**<br>• sun, moon, stars, star groups<br>• sky colours, amount of light, shadows | **Changes in features of the Earth:**<br>• land — rearrangement, movement, submersion of soil, rocks, sand<br>• waterways — rise and fall, change in direction of flow of water<br>• air — cloud size and movement, wind direction and magnitude<br>• seasons, climate, weather<br>**Changes in features of the sky:**<br>• sun — time and position of sunrise and sunset at different times of the year<br>• colour changes; day, night<br>• moon — appearance, when and where<br>• position of stars and star groups<br>• eclipses |

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

| | |
|---|---|
| ***1.2*** *Students describe obvious events (including day and night) that occur on the Earth and in the sky.* | ***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.* |
| **Obvious events on the Earth and in the sky:**<br>• changes to land, water and air<br>• changes to built environment<br>• day and night<br>• visibility of sun and stars<br>• colour of the sky<br>• temperature and winds<br>• animal activity | **Patterns of events on the Earth:**<br>• weather, climate, seasons<br>• activity of plants and animals<br>• fires<br>• storms<br>• erosion<br>• tidal changes<br>**Patterns of events in the sky:**<br>• when and where objects are visible — sun, moon, stars and star groups<br>• daily and longer changes in direction and time that objects are visible<br>• sunrise, sunset |

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

| | |
|---|---|
| ***1.3*** *Students discuss the uses they make and the care they take of the Earth.* | ***2.3*** *Students discuss how their community uses resources and features of the Earth and sky.* |
| **Using and caring for:**<br>• own home and yard, schoolyard, local waterways, parks and other places visited by<br>- walking in designated areas<br>- disposing of wastes appropriately<br>- taking care of plants and animals | **Use of resources and features of the Earth:**<br>• playgrounds, public spaces, schoolyards, backyards, waterways, farms, forests, built environment<br>• winds and clouds — predicting weather changes<br>• air — hang gliding, parachuting, transport, aerial spraying<br>**Use of features of the sky:**<br>• navigation<br>• appreciation of its beauty<br>**Use of Earth's resources by living things:**<br>• food, water, air, living space |

Sequence of core learning outcomes with elaborations

## Earth and Beyond

### The Earth, solar system and universe are dynamic systems.

| ***3.1*** *Students identify and describe some interactions (including weathering and erosion) that occur within systems on Earth and beyond.* | ***4.1*** *Students recognise and analyse some interactions (including the weather) between systems of Earth and beyond.* |
|---|---|
| **Interactions within Earth systems:**<br>• layers of the Earth — lithosphere, hydrosphere, atmosphere<br>• rock cycle, water cycle<br>• weather cycles, seasonal changes<br>• weathering, corrosion, erosion, soil formation<br>• volcanoes, earthquakes<br>**Interactions within systems beyond Earth:**<br>• interactions in the solar system — orbits; day and night; moon phases; meteors, comets, satellites, telescopes<br>• interactions within star systems — galaxies, constellations | **Some interactions between systems of the Earth:**<br>• between atmosphere, water and land — weather, water cycle<br>• between land and water — weathering, erosion, mountain building, changing course of rivers, formation of rocks (sedimentary, metamorphic, igneous)<br>**Some interactions between systems beyond Earth:**<br>• between Earth, moon and sun — moon phases, tides, eclipses, day, night, seasons<br>• interactions in the solar system — orbits, rotations<br>• asteroids, meteors, comets<br>• space exploration |

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

| ***3.2*** *Students discuss regular and irregular events in time and space that occur on the Earth and in the sky.* | ***4.2*** *Students collect information which illustrates that changes on Earth and in the solar system occur on different scales of time and space.* |
|---|---|
| **Regular events on Earth and in the sky:**<br>• daily, seasonal and yearly cycles of change<br>• weathering and erosion cycles<br>• effect of sun's radiation on all its planets<br>• cycles of levels of moonlight and effect on nocturnal vision<br>• hourly and yearly changes in position of sun, constellations<br>• meteor showers, comets<br>**Irregular events on Earth and in the sky:**<br>• earthquake — compare site of epicentre to total area affected<br>• volcanic eruption — compare location of volcano to area affected, distant sky coloration<br>• rainfall or cyclone — compare local area to total area affected<br>• sunset coloration caused by distant fires<br>• asteroid movements in the vicinity of planets and moons<br>• supernovas, exploding stars | **Changes occurring on different scales of time and space:**<br>• sites and rates of erosion compared to the sites and rates of rock formation<br>• timelines involved in various erosion and deposition processes — the rock cycle<br>• catastrophic events (volcanic eruptions, earthquakes, flooding, tsunamis) and size of affected areas<br>• movement of pollutants<br>• magnitude of atmospheric events — storms compared to cyclones<br>• climatic changes, rainfall and temperature patterns, El Niño and La Niña<br>• continental drift<br>• time space probes take to pass various bodies<br>• times for revolutions and rotations |

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

| ***3.3*** *Students collect information which describes ways in which living things use the Earth and the sun as resources.* | ***4.3*** *Students summarise information to compare ways in which different communities use resources from the Earth and beyond.* |
|---|---|
| **Human use of the Earth's resources:**<br>• building and art materials, ores for minerals and jewellery<br>• fossil fuels, soil<br>• water for irrigation, households, industry, transport and recreation<br>**Use of the sun by all living things:**<br>• light, warmth, energy<br>• telling time and direction<br>• navigation, photosynthesis, signal to begin particular activities, drives water cycle | **Community use of Earth's resources:**<br>• making bricks, dyes, petrochemical products, pottery<br>• extracting products from ores, fossil fuels<br>• using waterways — transport, irrigation, washing, bathing, town water supplies, recreation<br>• farming, recreation, forestry<br>• use of land and water<br>**Community use of resources from beyond:**<br>• sun's radiation<br>• navigation using sun and stars<br>• yearly calendar, time of day, omens<br>• to determine crop plantings and harvesting<br>• festivals and religious events<br>• information from the universe |

Sequence of core learning outcomes with elaborations

## Earth and Beyond

### The Earth, solar system and universe are dynamic systems.

| ***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.* | ***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.* |
|---|---|
| **Present-day features and events:**<br>• Earth's crust, mantle and core; conduction and convection currents<br>• earthquake and volcanic activity, ocean trenches<br>• fossils, sedimentary layers<br>• rock types and their location<br>• location of ore bodies, coal seams<br>• distribution of plant and animal species<br>• climatic similarities and differences<br>**Inferences about past events:**<br>• folding and faulting<br>• birth and death of stars<br>• meteorite collisions with Earth and moon<br>• continental drift<br>• earthquake and volcanic activity | **Ideas and theories to explain:**<br>• rock types, ores, land and water features in a particular place<br>• eclipses<br>• composition, weather and climatic features of planets and their moons<br>• location of fossils<br>• origin of the universe<br>• nebulae<br>• magnetic alignment of crystals within rocks of various ages<br>• angles of axis and directions of rotation of the planets and the moon<br>**Scientific ideas and theories:**<br>• plate tectonics<br>• 'big bang' theory<br>• 'steady state' theory |

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

| ***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.* | ***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.* |
|---|---|
| **Earth data:**<br>• build-ups in Earth's crust<br>• plate tectonics<br>• land slippages<br>• volcanic build-ups<br>• weather fronts<br>• El Niño and La Niña<br>• climatic changes<br>• erosion and deposition<br>• pollution — place and time of origin compared to area affected and time of effect<br>**Solar system data:**<br>• solar flares and communication interference | **Earth:**<br>• earthquakes<br>• droughts<br>• floods<br>• El Niño, La Niña<br>• meteorite collisions<br>• changes to Earth's crust<br>• ice ages<br>• rises and falls of oceans<br>• continental drift<br>• global warming<br>**Other systems:**<br>• birth and death of stars<br>• meteorite collisions with other planets<br>• collision of galaxies<br>• collision between Earth and moon |

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

| ***5.3*** *Students prepare scenarios about the use of renewable and non-renewable resources of the Earth and beyond.* | ***6.3*** *Students argue a position regarding stewardship of the Earth and beyond, and consider the implications of using renewable and non-renewable resources.* |
|---|---|
| **Significance of using renewable resources:**<br>• should not run out — water, air<br>• quality can deteriorate<br>• inequitable distribution on Earth and amongst people<br>• needed by other living things<br>**Significance of using non-renewable resources:**<br>• will run out — fossil fuels, ores<br>• impact of collecting and transporting<br>• alternative uses<br>• inequitable distribution on Earth and amongst people<br>**Using information about the universe:**<br>• to determine present and past events<br>• to predict events, to prepare for further exploration | **Implications of using renewable resources:**<br>• emission of particles and $CO_2$, pollution<br>• overharvesting, for recreation<br>• effects on interactions occurring in land, water, air systems<br>**Implications of using non-renewable resources:**<br>• accidents during mining and transport<br>• dwindling supplies<br>• competing interests of miners, industry, farmers, recreational users and indigenous peoples<br>• extracting and refining — pollution, environmental damage<br>**Visiting or colonising other planets:**<br>• life supplies, timelines, protection<br>• feasibility of colonisation, potential benefits |

Sequence of core learning outcomes with elaborations

## Energy and Change

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

| | |
|---|---|
| ***1.1*** *Students collect information about the ways that objects of different shapes and sizes move.* | ***2.1*** *Students demonstrate different ways that forces (including push and pull) change the shape and motion of objects.* |
| **Ways that different objects move:**<br>• slip, slide<br>• grip, stick<br>• roll, tumble, fall<br>• flow, float, fly, sink<br>• spin, bounce, shake<br>**What affects the ways things move:**<br>• size, shape<br>• texture<br>• mass — heavy, light<br>• different surfaces | **Different ways forces can be used to change shape and motion of objects:**<br>• dropping, throwing<br>• pushing, pulling<br>• squeezing, stretching, twisting<br>• colliding<br>• propelling<br>**Factors which can affect motion and shape of objects:**<br>• size, shape<br>• texture<br>• mass — heavy, light<br>• different surfaces<br>• size of force |

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

| | |
|---|---|
| ***1.2*** *Students identify the effects of energy in their daily lives.* | ***2.2*** *Students identify and describe forms of energy in their community (including heat and energy of movement).* |
| **Experiences and observations to raise awareness of the presence of energy:**<br>• rubbing hands together warms them<br>• hair moves when near a fan<br>• feeling hot when running around<br>• plucking guitar strings makes musical sounds<br>• putting an egg in boiling water cooks it | **Exploration of students' own concepts of different energy forms — electricity, light, heat, movement, sound:**<br>• different ways of making a golf ball or balloon move<br>• produce and describe different types of sound and different coloured light<br>• sources of heat in the home<br>• ways to control heating and cooling in the home<br>• sources of heat — fuels, friction<br>• items in the classroom that use electrical energy<br>• sources of sound — doorbells, musical instruments, various objects in the school<br>• animals use light to see |

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

| | |
|---|---|
| ***1.3*** *Students make links between the way they use energy and the immediate source of that energy.* | ***2.3*** *Students illustrate the ways that energy is used in their community.* |
| **Links between immediate source and the way energy is used:**<br>• a light works when you turn on the switch<br>• a car works when you put petrol in it<br>• energy needed to walk to school or play sport<br>• battery in a torch<br>• spring in a toy<br>• electricity needed to make the toaster work<br>• heat needed to cook food | **Uses of energy in the community:**<br>• cars, trucks, boats, planes require fuel to move<br>• electricity in shops, factories, dentists' surgeries and for street lighting<br>• sounds<br>• heating in the home — oven, kettle<br>• different ways people use solar energy — drying clothes, heating water in the home, growing plants |

Sequence of core learning outcomes with elaborations

## Energy and Change

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

| | |
|---|---|
| ***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.* | ***4.1*** *Students design and perform investigations into relationships between forces, motion and energy.* |
| **Effects of forces:**<br>• attraction and repulsion caused by magnetic forces<br>• electrostatic forces created by rubbing some non-metals with different fabrics<br>• influence of magnetic forces on electric current<br>• motion and shape of objects affected by gravitational forces — falling raindrops, planes<br>• forces operating in liquids — floating, sinking<br>• forces operating in simple machines<br>• friction<br>• cohesive and adhesive forces | **Relationships between forces, motion and energy:**<br>• seesaws<br>• machines<br>• floating, sinking<br>• flight, space travel<br>• gravity<br>• electromagnetism<br>• friction<br>• static situations — holding a bag of groceries, building dams, preventing a bus from toppling |

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

| | |
|---|---|
| ***3.2*** *Students identify forms of energy (including electrical and sound energy) and describe the effects and characteristics of those different forms.* | ***4.2*** *Students collect and present information about the transfer and transformation of energy (including potential and kinetic energy).* |
| **Characteristics and effects of different forms of energy:**<br>• pushing a bike causes movement<br>• water can be heated<br>• musical instruments<br>• wind-up toys, electrical appliances<br>• circuits, batteries<br>• insulation affects the rate at which ice melts<br>• bouncing balls, elastic bands, springs<br>• sound — vibration, volume, pitch, frequency, echo<br>• food as a form of chemical energy<br>• effects of applying heat to different substances — wax, plastic, plant or animal tissue | **Types of energy:**<br>• potential energy<br>• kinetic energy<br>**Transformation of types of energy:**<br>• kinetic, chemical, heat to electrical<br>• electrical to kinetic, sound and heat<br>**Energy transfer from one substance to another:**<br>• light transfer through different media — rainbows<br>• reflection and refraction of light<br>• absorption and transmission<br>• conduction and convection of heat<br>• conduction of electricity<br>**Energy converters:**<br>• in the home — appliances<br>• in industry<br>• in the biological world — plants, animals |

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

| | |
|---|---|
| ***3.3*** *Students identify different ways of obtaining energy.* | ***4.3*** *Students present alternative ways of obtaining and using energy (including energy from the sun and from fossil fuels) for particular purposes.* |
| **Types and sources of energy:**<br>• water, wind, fossil fuels, the sun<br>• geothermal, electrostatic, nuclear generators<br>• power stations<br>• batteries (and associated circuits), generators<br>**Energy storage:**<br>• hydro-electric dams, batteries, food | **Alternative ways of obtaining or harnessing energy:**<br>• fossil fuels<br>• hydro-electric<br>• wind, geothermal<br>• solar, nuclear<br>**Alternative ways of using energy:**<br>• generating electrical energy, transport<br>• heating, cooling<br>• communications<br>**Reasons for use of particular energy forms in particular ways:**<br>• cost, convenience<br>• environmental effects<br>• renewability, energy conservation |

Sequence of core learning outcomes with elaborations

## Energy and Change

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

| ***5.1*** *Students analyse situations where various forces (including balanced and unbalanced forces) act on objects.* | ***6.1*** *Students use scientific ideas of motion (including action and reaction) to explain everyday experiences.* |
|---|---|
| **Forces acting on objects:**<br>• balanced and unbalanced forces<br>• action and reaction<br>**Identifying forces and energy transfers:**<br>• pushes, pulls, collisions<br>• machines<br>• floating, sinking<br>• flight, space travel<br>• electromagnetism, electric circuits<br>• static situations — holding a bag of groceries, preventing a bus from toppling<br>• road cambers and vehicles going around corners | **Scientific ideas of motion:**<br>• Newton's laws — balanced and unbalanced forces, action and reaction<br>• inertia, momentum<br>• speed, velocity, acceleration<br>• mathematical expressions of relationships between force and motion and energy and work<br>**Using scientific ideas of motion to explain everyday experiences:**<br>• use of machines, flight, floating and sinking<br>• space travel, electric circuits, skate boards<br>**Efficiency:**<br>• achieving changes in motion — setting up reaction forces, depending on friction<br>• using machines to obtain greater forces<br>• perpetual motion machines and why they don't work |

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

| ***5.2*** *Students explain how energy is transferred and transformed (including energy transfer by convection and conduction).* | ***6.2*** *Students model and analyse applications of energy transfer and transformation.* |
|---|---|
| **Explanations of ways energy is transferred and transformed:**<br>• why copper is a better conductor of electricity than is plastic<br>• why birds fluff their feathers to keep warm<br>• how colour and texture affect insulation from, and absorption of, heat, sound and light<br>• the series of changes that occur as food is converted to energy for use by muscles which produce movement<br>• use of mirrors and lenses in industry, medicine and space exploration<br>• kinetic energy transferred through pushes, pulls and collisions<br>• transfer of sound — string telephones, vibrations<br>• energy transfers in an electric circuit | **Energy transfer used to achieve desired outcomes:**<br>• use of electricity to create a permanent magnet<br>• use of wind generators to convert kinetic energy into electricity<br>• energy transfers in distribution of electricity —power station to end use<br>• calculation of V, I, R, P in simple circuits<br>• use of digital and analog electrical signals in telecommunications and home entertainment<br>• use of X-rays, lasers and ultrasound in industry and medicine<br>**Using concepts related to energy transfer:**<br>• relationship between energy and work<br>• efficiency of machines<br>• how factors affecting friction influence design of machines<br>• conservation of energy — pendulums, roller coasters |

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

| ***5.3*** *Students discuss the consequences of different ways of obtaining and using energy (including nuclear energy).* | ***6.3*** *Students evaluate the immediate and long-term consequences of different ways of obtaining and using energy.* |
|---|---|
| **Consequences of different ways of obtaining and using energy:**<br>• cost, convenience<br>• environmental impact<br>• community priorities — employment<br>• sustainability<br>• energy conservation<br>**Analysis of energy use in the home:**<br>• which appliances use the most energy over time<br>• how use of energy changes from winter to summer | **Efficiency:**<br>• cost of obtaining and using different energy forms<br>• long-term economics of alternative energy sources<br>• short- and long-term environmental impact of alternative energy<br>• feasibility and convenience of alternative energy sources<br>• sustainability of obtaining energy from particular sources<br>• energy conservation, energy storage |

Sequence of core learning outcomes with elaborations

## Life and Living

### The characteristics of an organism and its functioning are interrelated.

| | |
|---|---|
| ***1.1*** *Students discuss their thinking about needs of living things.* | ***2.1*** *Students look for patterns and relationships between the features of different living things and how those living things meet their needs.* |
| **Needs of living things:**<br>• animals — food, water, air (oxygen), shelter, suitable temperature<br>• plants — air (oxygen, carbon dioxide), water, nutrients, sunlight, suitable temperature | **Relationships between features and needs being met:**<br>• limbs — food collection, movement, protection<br>• beaks, teeth — feeding, protection<br>• skeleton — support, protection<br>• body covering — protection, temperature control, camouflage<br>• sense organs — finding food, water; avoiding harm; communicating<br>• behaviour — nocturnal or diurnal, hibernation, care of young; deciduous or evergreen<br>• roots — taking in water, nutrients<br>• leaves — taking in sunlight, gases<br>• flowers, cones, seeds — reproduction |

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

| | |
|---|---|
| ***1.2*** *Students group living things in different ways based on observable features.* | ***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).* |
| **Grouping of living versus non-living based on:**<br>• growth, movement, respiration, sensitivity, reproduction, excretion, nutrition<br>**Grouping of animals versus plants based on:**<br>• method of obtaining food; method of obtaining air (oxygen)<br>**Grouping of plants and animals based on:**<br>• body covering, type and number of limbs, method of feeding, type of skeleton<br>• flowers, cones, leaves, woody, herbaceous, height | **Changes in living things during their life span:**<br>• growth, change in size and shape<br>• change in colour<br>• loss of leaves, hair<br>• fruiting, flowering<br>• germination of seeds<br>• failing eyesight, loss of hearing<br>• ageing, wrinkling of skin<br>• wilting, withering<br>• producing young, offspring<br>• death |

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

| | |
|---|---|
| ***1.3*** *Students observe and describe components of familiar environments.* | ***2.3*** *Students make links between different features of the environment and the specific needs of living things.* |
| **Components of the environment:**<br>• living parts — plants and animals<br>• physical parts — water, air, light, temperature<br>• features — soil types, rocks, rivers, lakes, forests, deserts, mountains, scrub, fields<br>**Different types of environment:**<br>• aquatic and terrestrial<br>• rainforest — many different animals and plants; humid; low light<br>• arid — dry; high light; little water<br>• city — buildings; numerous people<br>• agricultural — single type of plant in a crop | **Components of the environment and supplying needs:**<br>• food — from other living things<br>• air — for both plants and animals<br>• shelter — in trees, in bark, under rocks; nests, burrows<br>• water — from the ground, bodies of water<br>• sunlight — for plants<br>• temperature — ways of keeping warm or cool |

Sequence of core learning outcomes with elaborations

## Life and Living

### The characteristics of an organism and its functioning are interrelated.

| ***3.1*** *Students draw conclusions about the relationship between features of living things and the environments in which they live.* | ***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.* |
|---|---|
| **Relationship between features and environments:**<br>• body covering — long thick hair conserves body warmth in cold climates<br>• beak shapes and type of food eaten<br>• tongue size and shape — long sticky tongue of a frog helps it catch insects<br>• teeth — help animals to eat particular foods<br>• foot shape — wide, spreading toes of wading birds help them to walk in mud<br>• limbs — fins help animals swim<br>• eye and ear shape and size — help animals see and hear in ways which are most useful in their own environment<br>• root types and leaf orientation and shape — big leaves help rainforest trees to get enough light | **Internal and external structures:**<br>• systems, organs, tissues<br>• structures working together — sense organs, nerves, muscles and bones sense and respond (movement)<br>– leaves and roots collect light and water needed for photosynthesis<br>**Similar and different structural adaptations:**<br>• respiratory systems — gills, lungs, skin<br>• digestive systems — long or short intestines<br>• circulatory system — open or closed system<br>• shoot systems — reduced leaves and stems reduce water loss<br>• root systems — food storage (carrots); support; tap or fibrous systems<br>• reproductive mechanisms — plants and animals<br>**Adaptation:**<br>• structural, functional, behavioural features help living things meet needs in their own environment |

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

| ***3.2*** *Students present information which illustrates stages in different types of life cycles (including metamorphosis) of familiar living things.* | ***4.2*** *Students identify and analyse similarities and differences in the ways that different living things reproduce.* |
|---|---|
| **Different types of life cycles:**<br>• vegetative reproduction — cuttings, suckers, tubers, bulbs<br>• egg to adult, seed to mature plant<br>• different forms of the same plant or animal — caterpillar and butterfly; tadpole and frog; seed, fruit and adult plant<br>• metamorphosis — insect (caterpillar), frog (tadpole)<br>• baby to adult<br>**Stages in different life cycles:**<br>• egg laying, hatching<br>• larva–pupa–nymph stages<br>• reproductive stages, puberty<br>• germination, pollination | **Similarities and differences in the ways that living things reproduce:**<br>• sexual reproductive systems in different animals and plants<br>• reproductive processes — internal and external fertilisation and development; parental care, courtship; eggs<br>• sex cells and fertilisation in animals and plants<br>• pollen transfer and seed dispersal in plants by wind, water, other organisms<br>• alternation of generations in different plant groups<br>• asexual — vegetative reproduction (cuttings, suckers, tubers, bulbs, runners); budding, binary fission |

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

| ***3.3*** *Students describe some interactions (including feeding relationships) between living things and between living and non-living parts of the environment.* | ***4.3*** *Students make generalisations about the types of interactions which take place between the living and non-living parts of the environment.* |
|---|---|
| **Interactions between living things:**<br>• feeding relationships<br>• living together — communities, mates, families<br>• harmful or helpful<br>**Interactions between living and non-living parts:**<br>• different living things in different climates<br>• living things affected by changes in temperature, availability of water, light, shelter<br>• the environment affected by living things — growth of tall plants may reduce light available to lower-growing plants<br>**Natural changes:**<br>• weathering, erosion<br>• changes in temperature, water availability<br>• volcanic eruptions, fire, drought, earthquake | **Types of interactions between living things:**<br>• food chains and webs — producer, consumer, decomposer<br>• herbivore, carnivore, omnivore<br>• predator–prey; competition<br>• symbiosis — parasitism, mutualism, commensalism<br>• ecosystems — populations, communities<br>**Types of interactions between living and non-living parts:**<br>• adaptations — structural, functional, behavioural<br>• survival after bushfires, volcanoes<br>• nutrient cycles<br>• living things — tolerance limits for external factors<br>**Interactions between non-living parts:**<br>• cycling of water, nutrients<br>• temperature changes and water availability due to weather conditions, seasonal changes, daily changes |

Sequence of core learning outcomes with elaborations

## Life and Living

### The characteristics of an organism and its functioning are interrelated.

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

**Structure and function of animal systems related to survival:**
- digestive — changes food into useable form
- circulatory — carries nutrients and oxygen to cells, wastes away from cells; moves heat around body
- excretory — removes harmful wastes
- nervous and endocrine — control functioning

**Structure and function of plant systems related to survival:**
- shoot systems — photosynthesis; gas exchange for respiration and waste removal
- transport systems — carry water, organic matter, hormones; remove wastes

**Cells and survival:**
- comparison of animal and plant cell structure
- chemical processes — photosynthesis and respiration

***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).*

**Changes in functioning and behaviour (homeostasis):**
- temperature control in plants and animals
- water and salt balance in plants and animals
- plant response to light intensity and direction
- immune response in animals
- hormonal responses in plants and animals

**Internal and external conditions which may affect functioning and behaviour:**
- disease-causing pathogens, parasites in plants and animals
- vaccination, prior exposure to pathogens, auto-immunity
- temperature changes in plants and animals
- water and salts in external and internal environment in plants and animals
- lifestyle and diet, heredity

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

***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.*

**Evaluation of contribution of asexual vs. sexual reproduction to survival of offspring:**
- cell division to produce identical daughter cells vs. producing gametes with different genetic makeup
- fertilisation producing increased genetic variety vs. production of identical offspring
- greater chances of survival if environment changes vs. few or many offspring

**Evaluation of contribution of different reproductive strategies to survival of offspring:**
- separate sexes vs. hermaphroditism
- courtship behaviours and sex differences — birds, flowers
- internal vs. external fertilisation, eggs, development of young
- degree of development of young and need for nurture and protection
- numbers of offspring — parental care, nurture, protection, chances of survival

***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.*

**Ideas about genetic variation:**
- cell division to produce gametes
- fertilisation — mixing of genetic information produces variety in offspring
- role of chromosomes
- Mendelian genetics — dominant and recessive characteristics, incomplete dominance, sex-linkage
- mutation

**Ideas about how genetic variation can lead to change in species over time:**
- natural selection leads to change in species characteristics which leads to adaptation — ideas of Darwin and Lamarck
- evidence of evolution and alternative ideas

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

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

**Consequences of interactions:**
- energy flow — photosynthesis, respiration
- cycling of matter — oxygen, carbon, nitrogen, water
- role of bacteria, decomposition
- variations in temperature, rainfall, soil type, topography, water availability, salt and mineral content of soil and water, food availability
- tolerance limits to variations in physical conditions
- changes in habitat, population numbers, feeding relationships
- weathering and erosion
- pollution, succession

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

**Human actions affecting ecosystems:**
- agricultural practices, pest control, plant and animal breeding, introduction of plants and animals, biological control measures
- industry, urbanisation, forestry, tourism
- revegetation, conservation, preservation

**Potential effects:**
- habitat — modification or destruction
- increased food supply leading to further population growth
- increased awareness of need to protect and maintain genetic variation and biodiversity

Sequence of core learning outcomes with elaborations

## Natural and Processed Materials

### The properties and structure of materials are interrelated.

| | |
|---|---|
| ***1.1*** *Students describe observable properties of familiar materials, including solids and liquids.* | ***2.1*** *Students group materials on the basis of properties (including solubility, texture and hardness).* |
| **Observable properties:**<br>• visual — shape, colour; transparent, translucent, opaque<br>• tactile — flexibility, rigidity, texture, shape, softness, hardness; liquid, solid, heavy, light<br>• olfactory<br>• taste<br>• auditory — tone, volume<br>**Familiar materials:**<br>• water, playdough, paper<br>• food, plastics, wood<br>• fabrics, metals, sand | **Group according to properties such as:**<br>• solubility in water<br>• lustre, colour, texture<br>• transparent, translucent, opaque<br>• flexibility, rigidity, elasticity, strength<br>• softness, hardness<br>• heavy, light; floats, sinks<br>• solid, liquid, gas<br>• magnetic, non-magnetic<br>• odour, taste<br>**Materials:**<br>• water, playdough, paper, food, plastic<br>• wood, fabrics, metal, sand |

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

| | |
|---|---|
| ***1.2*** *Students describe observable changes (including change of state) that occur in materials.* | ***2.2*** *Students recognise ways in which changes in properties of familiar materials occur (including temperature change and magnetism).* |
| **Familiar materials:**<br>• eggs, pikelets<br>• ice, water, steam<br>• sugar, salt<br>• playdough<br>**Observable changes:**<br>• coagulates, cooks<br>• melts, solidifies<br>• evaporates, condenses, freezes, melts<br>• dissolves<br>• change of shape<br>• change of sound<br>• change of colour<br>• change of texture | **Familiar materials:**<br>• glass, wood, playdough<br>• eggs, pikelets, sugar, salt<br>• ice, water, steam<br>**Nature of change:**<br>• breaks, melts, solidifies<br>• evaporates, condenses, freezes, melts<br>• decomposes, combines, dissolves<br>• change of shape, change of sound<br>• change of colour, change of texture<br>**Possible causes of change:**<br>• mixing, shaking<br>• heating, cooling, cooking, burning<br>• wetting, washing<br>• combining, squeezing, manipulating<br>• magnetism |

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

| | |
|---|---|
| ***1.3*** *Students look for alternative ways that familiar materials can be used.* | ***2.3*** *Students explain why common materials are used in particular situations.* |
| **Familiar materials:**<br>• water, fabrics, glass<br>• plastics, wood, paper, air<br>• soap<br>**Uses:**<br>• drinking, building, clothing<br>• drawing on, cleaning<br>• listening through or with<br>• seeing through or with | **Common materials:**<br>• water<br>• fabrics, glass, plastics, wood, metals<br>• paper, soap<br>• food — sugar, salt<br>• sunscreen<br>**Uses:**<br>• drinking, keeping cool, recreation<br>• clothing, seeing through or with, building<br>• drawing on, cleaning<br>• food, tools<br>• medicine |

Sequence of core learning outcomes with elaborations

## Natural and Processed Materials

### The properties and structure of materials are interrelated.

| | |
|---|---|
| ***3.1*** *Students examine and describe the smaller visible parts of common materials and relate these to the properties of the materials.* | ***4.1*** *Students collect information and propose ideas to explain the properties of materials in terms of each material's underlying structure.* |
| **Examination and description of smaller visible parts of common materials:**<br>• rocks, crystals, fibrous materials<br>• building materials — chipboard, ply, plasterboard<br>• food — bread, fruit, salt, sugar, flour<br>**Properties:**<br>• solubility in water<br>• lustre, colour, texture, shape; magnetic, non-magnetic<br>• transparent, translucent, opaque<br>• flexibility, rigidity, elasticity, strength<br>• softness, hardness; heavy, light; floats, sinks<br>• solid, liquid, gas<br>• odour, taste | **Properties:**<br>• solubility<br>• porous, non-porous<br>• conductor or insulator of heat or electricity<br>• ability to conduct sound<br>• filters, blocks, transmits, reflects or refracts light<br>• odour<br>• viscosity, density<br>• absorbent, waterproof<br>**Underlying structure of materials:**<br>• food — sugar, salt, bread, flour<br>• soil, sand, rocks, fibrous materials<br>• manufactured materials |

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

| | |
|---|---|
| ***3.2*** *Students compare properties of materials before and after physical and chemical changes.* | ***4.2*** *Students identify patterns in the types of change that take place in materials.* |
| **Physical changes:**<br>• evaporating, condensing, solidifying, melting<br>• dissolving<br>• thickening<br>• wetting, drying<br>• mixing<br>• crystallising<br>• separating<br>**Chemical changes:**<br>• cooking, burning, decomposing, combining<br>**Properties before and after change:**<br>• shape, texture, colour<br>• flexibility, elasticity, hardness, strength, viscosity<br>• odour, taste, ability to conduct sound<br>• solid, liquid, gas<br>• crystallinity | **Patterns in types of changes caused by:**<br>• heating, cooling<br>• burning, rusting<br>• dissolving<br>• crystallising<br>• magnetising, demagnetising<br>• freezing, melting<br>• evaporating, condensing<br>• mixing<br>• combining<br>• decomposing<br>• filtering<br>• decanting<br>• distilling |

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

| | |
|---|---|
| ***3.3*** *Students collect information to illustrate how combining different materials influences their usefulness.* | ***4.3*** *Students examine and assess ways that materials can be changed to make them more useful.* |
| **How combining materials influences their usefulness:**<br>• solubility in water<br>• lustre, colour, texture, shape; magnetic, non-magnetic<br>• transparent, translucent, opaque<br>• flexibility, rigidity, elasticity, strength<br>• durability, malleability, wettability<br>• softness, hardness; heavy, light; floats, sinks<br>• solid, liquid, gas<br>• odour, taste<br>• conducting or insulating properties, adhesive properties<br>• filters, blocks, transmits, reflects or refracts light<br>**For materials such as:**<br>• fibrous materials, building materials — brick, cement<br>• packaging materials, glue, food, soil, rocks, alloys | **Changing materials for greater usefulness:**<br>• fibres — wool, cotton, hemp, synthetic<br>• leather<br>• paper, glass, sponge<br>• detergent, soap<br>• foods — sugar, flour<br>• particle board, wood<br>• ores, minerals, metals<br>**Changed by:**<br>• heating, cooling, dissolving<br>• dehydrating, adding water<br>• crystallising<br>• colouring, painting<br>• rubbing, manipulating, moulding<br>• cleaning, shining<br>• recycling process |

Sequence of core learning outcomes with elaborations

## Natural and Processed Materials

### The properties and structure of materials are interrelated.

| ***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.* | ***6.1*** *Students explain the structure and properties of matter using models of atoms and molecules.* |
|---|---|
| **Structure of matter:**<br>• particle theory<br>• atoms, elements<br>• molecules, compounds<br>• crystalline or non-crystalline<br>**Behaviour of matter:**<br>• solid, liquid, gas, plasma<br>• density, viscosity<br>• conductor or insulator of heat or electricity<br>• solubility<br>• mixture, pure substance, suspension, solution<br>• acidic or basic | **Structure of matter:**<br>• Periodic Table<br>• atomic structure — nucleus, protons, electrons, neutrons<br>• molecular structure — elements, compounds, ionic and non-ionic molecules, polymers, acids and bases, organic and inorganic molecules, metals<br>**Physical properties of matter:**<br>• solid, liquid, gas, plasma<br>• conductor or insulator of heat or electricity<br>• density, solubility, viscosity<br>**Chemical properties of matter:**<br>• reactivity, stability |

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

| ***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.* | ***6.2*** *Students use identified patterns of change to predict interactions between materials.* |
|---|---|
| **Nature of reaction:**<br>• requires or releases heat<br>• changes state<br>• reversible, irreversible<br>• combustion<br>• acid–base, acid–metal, acid–carbonate<br>• displacement<br>• precipitation<br>• electrochemical<br>• crystallisation<br>• fast or slow<br>**Effect of factors such as:**<br>• catalysis<br>• surface area, temperature, concentration of reactants | **Identifying patterns of change:**<br>• requires or releases heat<br>• reversible or irreversible<br>• changes colour<br>• precipitates<br>• crystallises<br>• combines<br>• separates<br>• dissolves<br>• neutralises<br>• changes state<br>• produces a gas<br>• fast or slow<br>**Word equations** |

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

| ***5.3*** *Students devise tests and interpret data to show that the properties and interactions of materials influence their use.* | ***6.3*** *Students collect and present information about the relationship between the commercial production of industrial, agricultural and fuel products and their properties.* |
|---|---|
| **Properties that influence use:**<br>• solubility in water<br>• lustre, colour, texture, shape; magnetic, non-magnetic<br>• transparent, translucent, opaque<br>• flexibility, rigidity, elasticity, strength<br>• durability, malleability, wettability<br>• softness, hardness; heavy, light; floats, sinks<br>• solid, liquid, gas<br>• odour, taste<br>• conducting or insulating properties, adhesive properties<br>• filters, blocks, transmits, reflects or refracts light<br>**Interactions that influence use:**<br>• combining materials | **Chemical properties and commercial production:**<br>• salts suitable for plant uptake (sulfates, phosphates, ammonium salts) — fertiliser production<br>• nature of mineral ore (sulfide, oxide, carbonate) — froth flotation, smelting<br>**Physical properties and commercial production:**<br>• mixture of liquids with different boiling points (crude oil) — fractional distillation<br>• mixture of solids with different magnetic or electrostatic properties (mineral sands) — magnetic or electrostatic separation<br>• mixture of gases with different liquefaction temperatures (air) — production of oxygen, carbon dioxide, nitrogen |

## Elaborations for Foundation Level
## *Years 1 to 10 Science key learning area*

When the Years 1 to 10 Science curriculum materials were initially developed, they did not include elaborations at the Foundation Level. They did, however, include level statements and example learning outcomes (see pp. 58–59 Science Sourcebook Guidelines) for this level.

Elaborations are lists of possible contexts, contents, and activities through which students working at Foundation Level might demonstrate learning outcomes. They assist teachers in their planning for learning, teaching and assessing students at this level. Elaborations are not learning outcomes. They are neither core nor mandated.

The lists of elaborations that follow are not intended to be exhaustive and are not intended as checklists. They provide examples only and it is not expected that all aspects of the elaborations will be addressed.

It is not intended that all elaborations will 'suit' all students. It is intended that teachers select specific contexts and contents to meet the needs, abilities and interests of their students. Teachers can use these elaborations to assist in the development of individualised learning outcomes. At the class program level, teachers are encouraged to develop purposeful and authentic learning activities that incorporate a number of learning outcomes from various key learning areas.

These elaborations were developed from the level statements and key concepts for each of the strands in Science.

These elaborations are not meant to be goals for students' Individual Education Plan (IEP). However, there should be links between the school / class curriculum program and students' IEP goals.

The examples of Foundation Level learning outcomes link with the sequence of core learning outcomes in Levels 1 to 6. For example, first set of example outcomes at the Foundation Level (F.1) aligns with the first core learning outcome at Level 1 (1.1) in each of the respective strands. The second set of example outcomes at the Foundation Level (F.2) aligns with the second core learning outcome at Level 1 (1.2), and so on.

| Foundation Level → | Level 1 → | Level 2 → | Level 3 → |
|---|---|---|---|
| F.1 → | 1.1 → | 2.1 → | 3.1 → |
| F.2 → | 1.2 → | 2.2 → | 3.2 → |
| F.3 → | 1.3 → | 2.3 → | 3.3 → |

The Years 1 to 10 Studies of Society and Environment (SOSE) Sourcebook Guidelines include elaborations at Foundation Level on pages 28–31. The soon to be published Years 1 to 10 The Arts and Years 1 to 10 Technology curriculum materials will also have elaborations, level statements and example learning outcomes for Foundation Level in Sourcebook Guidelines.

Teachers, therapists and principals from special schools, teachers from special education units, key learning area specialists, and representatives from the following associations and organisations were involved in the development of these elaborations:

- the Association of Special Education Administrators of Queensland (ASEAQ)
- the Australian Association of Special Education (AASE)
- the Queensland Teachers' Union (QTU)
- Education Queensland
- The Association of Independent Schools of Queensland (AISQ)
- the Queensland Catholic Education Commission (QCEC).

The elaborations were further developed through consultation with a range of organisations, associations and individuals throughout the state via print and electronic media.

For each of the sets of elaborations a communication statement is included. This is to draw attention to the breadth and variety of modes and ways in which students may demonstrate the learning outcomes.

**Communication statement**
Students with disabilities may communicate their understandings in a variety of ways and modes (both unaided and aided), for example:

*Gestural*: pointing, touching, manipulating, hand squeezing, giving eye contact, eye blinking, moving towards/away from, miming, signing, using body language or facial expressions
*Vocal:* vocalising, communicative vocalisations, speaking
*Visual / Written:* cutting and pasting, using books, drawing pictures or diagrams, matching, sorting, Braille, software programs, multi-level communication book, using spell and phrase board
*Aided*: using a manufactured aid which is either: low-tech, for example: object symbol, daily schedule, multi-level communication book, topic pages, spell and phrase board; or high-tech, for example: voice output communication devices (VOCAs), computers

**Context statement**
Learning opportunities should be provided through a variety of contexts, routines and activities to assist students develop their knowledge, practices and dispositions. Opportunities for demonstrations of the learning outcomes should be in these same contexts, routines and activities.

Some of these contexts replicate real-life situations and so provide practical opportunities for students to engage with learning outcomes from a number of key learning areas. For example: cooking activities might include learning outcomes from Health and Physical Education, Science, Mathematics and English; going shopping might include learning outcomes from Studies of Society and Environment, Mathematics, Health and Physical Education, The Arts and English.

When monitoring and reporting on students' demonstrations of learning outcomes, the contexts, routines, activities and personnel involved in the learning opportunities and demonstrations should be indicated. Students may demonstrate their learning in one context, routine or activity but not another; with one person, but not with another. Therefore, it is important to engage students in purposeful activities in a range of contexts and with a variety of personnel.

The following are examples of contexts in which learning experiences and assessment opportunities might take place:

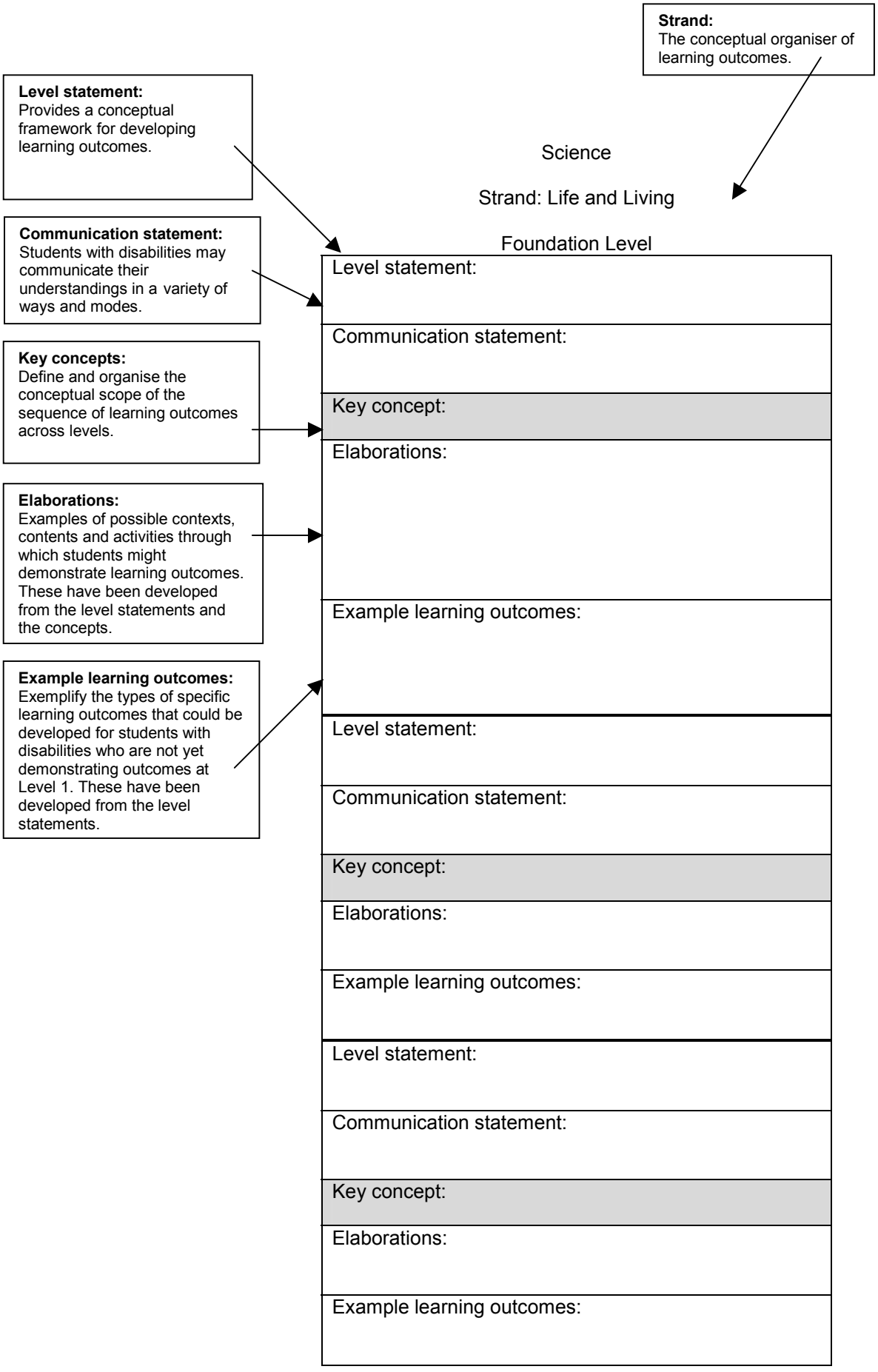
Places:

- School
  - multi-sensory environments
  - classroom
  - playground
- Residential
  - home
  - respite
  - camp
- Community
  - recreation, leisure and cultural centres or facilities
  - services: health, social, transport, financial, retail
  - workplaces

The following are examples of personnel who might be involved in the learning experiences and assessment opportunities:

- parents, immediate family, extended family, carer
- friends
- teachers, therapists
- familiar people in the school and the community
- unfamiliar people in the community.

For further information on assessment and reporting, refer to the Council's *Position Paper and Guidelines: An Outcomes Approach to Assessment and Reporting*.


Strand:
The conceptual organiser of learning outcomes.
Level statement:
Provides a conceptual framework for developing learning outcomes.
Science
Strand: Life and Living
Foundation Level
Communication statement:
Students with disabilities may communicate their understandings in a variety of ways and modes.
Level statement:
Communication statement:
Key concept:
Key concepts:
Define and organise the conceptual scope of the sequence of learning outcomes across levels.
Elaborations:
Elaborations:
Examples of possible contexts, contents and activities through which students might demonstrate learning outcomes. These have been developed from the level statements and the concepts.
Example learning outcomes:
Example learning outcomes:
Exemplify the types of specific learning outcomes that could be developed for students with disabilities who are not yet demonstrating outcomes at Level 1. These have been developed from the level statements.
Level statement:
Communication statement:
Key concept:
Elaborations:
Example learning outcomes:
Level statement:
Communication statement:
Key concept:
Elaborations:
Example learning outcomes:

**SCIENCE**
**Strand:** Science and Society
**FOUNDATION LEVEL**

*Level statement:* *Students are developing an understanding of the ways science affects aspects of their lives. They are developing an intuitive understanding of some common natural phenomena.*

Students may communicate their understandings in a variety of ways and modes (both unaided and aided), for example:
**Gestural**: pointing, touching, manipulating, hand squeezing, giving eye contact, eye blinking, moving towards/away from, miming, signing, using body language or facial expressions
**Vocal**: vocalising, communicative vocalisations, speaking
**Visual / Written**: displaying, cutting and pasting, using books, drawing pictures or diagrams, matching, sorting, Braille, pre-writing, software programs, multi-level communication book, using spell and phrase board
**Aided:** using a manufactured aid which is either: low-tech, for example: object symbol, daily schedule, multi-level communication book, topic pages, spell and phrase board; or high-tech, for example: voice output communication devices (VOCAs), computers

**Key concept:**
*Historical and cultural factors influence the nature and direction of science which, in turn, affects the development of society*

**Identifies / recognises a range of natural phenomena that affect their lives in different ways, for example:**

- weather conditions:
  - wind – dries washing; sails boats; flies kites, causes tree branches to fall down, messes up your hair, can be noisy /distractive
  - rain – makes the garden grow, limits play outside, makes you wet if you stand in it
  - hot – go swimming, drink more water, want to be near a fan / in airconditioning
- day and night:
  - day – go to school, sunlight, wear clothes
  - night – dark, go to bed, wear pyjamas
- seasons:
  - spring / summer – warm / hot, rain, go swimming, holidays
  - autumn / winter – cool / cold, clothing choices

**Identifies /recognises / responds to common easily observable natural elements, for example:**

- grass / sand / water / sea creatures
- gravel / grass / gardens / wildlife at school
- ponds / animal life / plant life in parks

**Identifies /recognises / responds to changes in familiar natural environments, for example:**

- growth and ageing in both plants and animals (seedlings, caterpillars, butterflies)
- human intervention (pruning or removal of trees, feeding animals)
- effects of weather (storm clouds, wind in trees)

**Responds to a variety of changes in familiar settings, for example:**

- sensory stimulation (massage, aromas, music, tastes, colours, multi-sensory experiences)
- range of weather conditions (sunny/cloudy; raining / fine; still / breezy; lightning / thunder)
- range of environments (home / school / transport; beach / rainforest; indoors / outdoors)
- day to night, night to day

**Example learning outcomes: F.1**

- Students identify basic cause–effect relationships across a range of environments, e.g. because the sun has set, it is night-time.
- Students recognise obvious weather phenomena, e.g. wind, rain, thunder, lightning.
- Students identify changes in plants and animals (including humans), e.g. aspects of growth; ageing; life cycles.

**Key concept:**
*Science as a 'way of knowing' is shaped by the way humans construct their understandings.*

**Reacts to a range of sensory experiences, for example:**
- multi-sensory experience rooms
- colours, sizes, shapes, sounds, tastes, smells, textures

**Indicates when sensory experiences are 'new' or different**

**Makes choices and establishes preferences for particular sensory stimuli, for example:**
- indicates likes and dislikes
- requests preferred sensory stimuli

**Explores a range of familiar natural phenomena, for example:**
- movement of water or sand
- action of wind
- light and heat from the sun
- effects of magnets
- fallen leaves on the ground
- action of waves, tides
- lightning and thunder

**Assembles collections of various objects and artefacts, for example:**
- rocks, leaves, toys, cards

**Example learning outcomes: F.2**
- Students use their senses to identify differences between familiar objects, e.g. texture — food, fabrics, floor coverings; smells — food, flowers, body odour.
- Students use their senses to collect information about their immediate environment, e.g. classroom, school, home, playground, shop.
- Students participate in water-play activities to investigate, e.g. wave action in pool, pond or basin; exploring whether objects float or sink.

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

**Recognises own specialised equipment, for example:**
- switches, splints, glasses, hearing aids, communication systems, wheelchairs

**Explores connections and/or uses simple patterns of cause and effect and/or time sequences in familiar environments, for example:**
- food – raw, fresh, cooked
- plants – water, soil, sun
- switches – on / off; fans, TV, radio
- 'buttons' – to open / close (doors) to move up / down (in elevators), 'walk / don't walk' (road crossings)
- plants / animals – changes, young to old
- hot / cold – stove / fridge, hot water / ice
- sun – dry clothes, heat, sunburn, creates shade
- pool – getting wet, getting cool

**Follows procedures that apply science concepts to meet personal needs, for example:**
- to grow – eating and drinking
- health and safety – dressing appropriately for prevailing weather conditions
- movement – playing, getting to particular destinations
- materials – making things

**Follows procedures to apply science concepts to familiar environments, for example:**
- water plants
- feed animals
- hang washing to dry
- use switches
- participate in cooking activities
- carry out domestic chores
- have mobility in the community – walk / ride
- use community facilities: toilets, rubbish bins, grocery shops, park lands
- use various forms of transportation: bicycles, buses, trains, lifts, escalators

**Example learning outcomes: F.3**
- Students recognise familiar health-care workers, e.g. physiotherapist, occupational therapist, nurse, doctor.
- Students identify their own specialised equipment, e.g. wheelchair, glasses, communication board, hearing aid.
- Students demonstrate healthy hygiene practices when preparing food, e.g. washing hands beforehand; cleaning preparation surfaces; cleaning utensils.

**SCIENCE**
**Strand:** Earth and Beyond
**FOUNDATION LEVEL**

***Level statement:*** *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.*

Students may communicate their understandings in a variety of ways and modes (both unaided and aided), for example:
**Gestural**: pointing, touching, manipulating, hand squeezing, giving eye contact, eye blinking, moving towards/away from, miming, signing, using body language or facial expressions
**Vocal**: vocalising, communicative vocalisations, speaking
**Visual / Written**: displaying, cutting and pasting, using books, drawing pictures or diagrams, matching, sorting, Braille, pre-writing, software programs, multi-level communication book, using spell and phrase board
**Aided:** using a manufactured aid which is either: low-tech, for example: object symbol, daily schedule, multi-level communication book, topic pages, spell and phrase board; or high-tech, for example: voice output communication devices (VOCAs), computers

**Key concept:**
*The Earth, solar system and universe are dynamic systems.*

**Identifies / recognises / responds to different features of the Earth, for example:**

- beaches
- hills
- watercourses
- oceans
- rocks
- deserts

**Identifies / recognises / responds to differences, for example:**

- earth
  - ground / water
  - flat / hilly
  - grass / gravel
- sky
  - day / night
  - cloudy / clear

**Identifies / recognises / responds to different features of the sky, for example:**

- sky
- sun
- mist, fog
- clouds
- rain
- rainbows
- sunsets
- moon
- wind

**Example learning outcomes: F.1**

- Students identify different aspects of a feature of the Earth, e.g. beach, garden, ocean, desert.
- Students identify features of the sky, e.g. stars, clouds.
- Students identify differences between the sun and the moon.

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

**Identifies / recognises / responds to events, for example:**

- day / night
- storms
- wind
- rain
- tides
- sun

**Matches a range of events to their daily activities, for example:**

- When the tide is out, walk out to the water to swim.
- When it is raining, play inside.
- When it is night-time, wear pyjamas and go to bed.

**Example learning outcomes: F.2**

- Students recognise aspects of their school environment, e.g. classroom, toilet, oval.
- Students identify aspects of their classroom, e.g. desk, table, chair, communication board.
- Students identify different sounds, smells and sights of their immediate environment.
- Students identify the difference between daytime and night-time.

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

**Identifies / recognises / responds to activities carried out in various natural environments, for example:**

- beach / river / lakes / dams /
  - sensory experiences
  - swimming, fishing
  - boating or sailing
  - playing
- bush
  - camping, bushwalking
- garden
  - digging, painting, watering, playing
- sky
  - flying kites, balloons
  - blowing bubbles
  - stargazing

**Follows routines for caring for the natural environment, for example:**

- using water wisely; recycling
- being tidy by putting rubbish in bins

**Identifies / examines how familiar animals use resources of the Earth, for example:**

- familiar animals include birds, insects, lizards, frogs, ants, possums, fish, cows, horses, pets
- use of resources for eating, drinking, moving, building / finding homes

**Identifies / examines how people use resources from the natural environment, for example:**

- for eating, drinking, moving, building/finding homes
- for decoration: plants, flowers
- for making collections: feathers, rocks, shells, leaves

**Example learning outcomes: F.3**

- Students identify activities carried out on a beach, e.g. swimming, boating, building sand castles.
- Students demonstrate activities appropriate to going to the shops, e.g. buying food, staying with carer, sitting appropriately in cafe.
- Students locate places in their immediate environment according to their use, e.g. playground is for playing, lunch area for eating lunch.
- Students identify and grow plants appropriate for a specific style of garden, e.g. vegetables, flowers.

**SCIENCE**
**Strand:** Energy and Change
**FOUNDATION LEVEL**

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

Students may communicate their understandings in a variety of ways and modes (both unaided and aided), for example:
**Gestural**: pointing, touching, manipulating, hand squeezing, giving eye contact, eye blinking, moving towards/away from, miming, signing, using body language or facial expressions
**Vocal**: vocalising, communicative vocalisations, speaking
**Visual / Written**: displaying, cutting and pasting, using books, drawing pictures or diagrams, matching, sorting, Braille, pre-writing, software programs, multi-level communication book, using spell and phrase board
**Aided:** using a manufactured aid which is either: low-tech, for example: object symbol, daily schedule, multi-level communication book, topic pages, spell and phrase board; or high-tech, for example: voice output communication devices (VOCAs), computers

**Key concept:**
*The forces acting on objects influence their motion, shape, behaviour and energy.*

**Explores different ways of moving self, for example:**
- whole body: locomotor such as swimming, running, jumping, wheelchairs (manual and power), rolling, crawling, pedalling; non-locomotor such as rocking, twisting, swaying
- body parts: upper/lower limbs, head, neck, hands, fingers, eyes, feet, toes

**Explores different ways of moving objects, with or without a motor (fans, waterwheels, straws, trolleys, squirting hose, water pistols), for example:**
- pushing, pulling,
- throwing, kicking
- turning, twisting
- using switches
- using wheels
- floating
- blowing

**Example learning outcomes: F.1**
- Students demonstrate that pushing or pulling objects on wheels will make them move.
- Students demonstrate that running water can make some things move.
- Students demonstrate that blowing some things will make them move, e.g. wind, fan, mouth.
- Students demonstrate that they can move their bodies in various ways.
- Students show that the shape of an object may change if it is dropped or thrown.

**Key concept:**
*In interactions and changes, energy is transferred and transformed but is not created or destroyed.*

**Explores different ways of stopping moving objects, for example:**
- balls: on the ground or suspended

**Explores the effects (look, sound, smell, taste, feel) of gravity, for example:**
- by dropping objects such as playdough, eggs or food from a table

**Observes changing shapes and behaviour of objects when moving, for example:**
- kites: soar, float, drop
- parachute games: inflation and deflation
- materials and fabrics: flags, mobiles, windsocks
- play equipment: ball with ribbons, ball in sock, ribbons on sticks, balloons
- stretching: elastics, rubber bands, balloons

**Recognises that some appliances/objects become hot, for example:**
- heater, toaster, stove, kettle, hot food counters
- playground equipment, bike seats, concrete, sand, road, seatbelt buckle

**Recognises that some appliances/objects make sound, for example:**
- radio, CD player, television, toys, cooking appliances, musical instruments, cars

**Recognises that some appliances/objects make light, for example:**
- torches, light bulbs, sun, heaters, lamps, television, disco ball, digital displays, fireworks, candles

**Example learning outcomes: F.2**
- Students recognise that some objects move if pushed/pulled.
- Students recognise that some toys need something to make them work, e.g. pushing, batteries, electricity, winding up.
- Students recognise that light is needed at night-time to carry out various activities.
- Students demonstrate that the more energy transformed the more movement created, e.g. pushing harder on a swing makes it go faster and higher.

**Key concept:**
*There are different ways of obtaining and utilising energy and these have different consequences.*

**Explores concepts of on/off, works/does not work, cause / effect, for example:**
- using a switch to turn on/off music, toys, lights, electrical appliances
- push/pull and wind-up toys such as friction cars
- blowing: hand-held windmills, wind chimes, noisemakers, windsocks, candles
- movement: waterwheel, sand wheel

**Example learning outcomes: F.3**
Students use various forms of energy to:
- move an object along the floor by pushing, pulling, batteries, winding up, throwing;
- move a boat on water by pushing, pulling, batteries, winding up, throwing;
- move around on playground equipment in ways such as swinging, running, walking, pushing a swing, jumping;
- keep warm by running, rubbing hands together, putting on a heater, lighting a fire.

**SCIENCE**
**Strand:** Life and Living
**FOUNDATION LEVEL**

***Level statement:*** *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.*

Students may communicate their understandings in a variety of ways and modes (both unaided and aided), for example:
**Gestural**: pointing, touching, manipulating, hand squeezing, giving eye contact, eye blinking, moving towards/away from, miming, signing, using body language or facial expressions
**Vocal**: vocalising, communicative vocalisations, speaking
**Visual / Written**: displaying, cutting and pasting, using books, drawing pictures or diagrams, matching, sorting, Braille, pre-writing, software programs, multi-level communication book, using spell and phrase board
**Aided:** using a manufactured aid which is either: low-tech, for example: object symbol, daily schedule, multi-level communication book, topic pages, spell and phrase board; or high-tech, for example: voice output communication devices (VOCAs), computers

**Key concept:**
*The characteristics of an organism and its functioning are interrelated.*

**Observes that living things have certain needs and characteristics, for example:**
- plants
  - needs: food, water, air, correct environment, growing medium
  - characteristics: grows, reproduces, dies
- animals (including people)
  - needs: food, water, shelter, correct environment
  - characteristics: born, grows, reproduces, dies

**Observes own body parts and their functions, for example:**
- eyes for seeing
- mouth for eating, drinking and talking
- ears for hearing
- nose for smelling
- legs for moving

**Uses senses to observe characteristics of animals, for example:**
- touching: fur, feather; smooth, rough, texture; hard / soft, wet / dry
- smelling: odours of some insects
- hearing: noises of familiar/known animals
- seeing: shapes, sizes, colours, body coverings, number of legs

**Uses senses to observe characteristics of plants, for example:**
- touching: smooth, rough, texture, hard / soft, wet / dry
- smelling: flowers, bark, fruit, crushed leaves
- hearing: seeds popping
- seeing: shapes, sizes, colours, coverings, leaves/petals, roots, branches, thorns, prickles
- tasting: vegetables, herbs, fruits

Example learning outcomes: F.1
- Students identify and label some living things, e.g. people, cat, dog, plants, flowers, insects.
- Students identify the observable features of particular animals, e.g. cats have fur (that can be seen and touched), legs (that can be seen or touched); miaow (that can be heard).
- Students identify the observable features of particular plants, e.g. rose bush — flower, petals (see, touch); perfume (smell); thorns (touch, see); leaves (touch, see); branches (touch, see).
- Students identify features about themselves that show they are living things, e.g. they eat, grow, breathe.

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

**Sorts animals from plants based on observable characteristics**

**Uses senses to observe non-living objects, for example:**
- playground equipment, balls, rivers, rocks, buildings, toys

**Sorts living things from non-living objects:**
- Non-living things do not eat, do not breathe, do not grow, are not plants, are not animals.

**Example learning outcomes: F.2**
- Students identify and label some non-living things, e.g. rock, car, road, house, sun, shirt, cup.
- Students recognise that non-living things have particular characteristics, e.g. they do not grow, breathe, reproduce.
- Students identify observable features that differentiate non-living things from dead animals or plants.
- Students identify features of a non-living object (e.g. rock, car, shirt, cup) that show that it is not living.

**Key concept:**
*Environments are dynamic and have living and non-living components which interact.*

**Identifies / sorts / examines the living and non-living things in a range of environments, for example:**

- beach:
  - living: people, fish, crabs, birds, seaweed
  - non-living: empty shells, sand, water, rocks, plastic bags, rubbish
- playground:
  - living: children, grass, ants, teachers
  - non-living: rubbish bins, equipment, clothes.
- classroom:
  - living: children, fish, bird, teachers, aides

  non-living: furniture, carpet, books, pens

**Example learning outcomes: F.3**

- Students group various objects as living or non-living, e.g. person, cat, insect, rock, car.
- Students communicate the observable differences between living and non-living things to show an understanding of their status.
- Students group features of a garden according to whether they are living or non-living, e.g. trees, flowers, insects and grass are living; rocks, soil, water and garden gnomes are non-living.

**SCIENCE**
**Strand:** Natural and Processed Materials
**FOUNDATION LEVEL**

*Level statement: 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.*

Students may communicate their understandings in a variety of ways and modes (both unaided and aided), for example:
**Gestural**: pointing, touching, manipulating, hand squeezing, giving eye contact, eye blinking, moving towards/away from, miming, signing, using body language or facial expressions
**Vocal**: vocalising, communicative vocalisations, speaking
**Visual / Written**: displaying, cutting and pasting, using books, drawing pictures or diagrams, matching, sorting, Braille, pre-writing, software programs, multi-level communication book, using spell and phrase board
**Aided:** using a manufactured aid which is either: low-tech, for example: object symbol, daily schedule, multi-level communication book, topic pages, spell and phrase board; or high-tech, for example: voice output communication devices (VOCAs), computers

**Key concept:**
*The properties and structure of materials are interrelated.*

**Groups / sorts / explores familiar materials according to their observable properties, for example:**

- seeing: colours, shapes, sizes
- touching: textures such as hard or soft, rough or smooth, wet or dry
- smelling: pleasant or unpleasant
- tasting: same or different foods
- hearing: talking or music

**Example learning outcomes: F.1**

- Students group familiar materials according to an observable property, e.g. physical state (same or different, liquid or solid, wet or dry), size (same or different, big or small).
- Students identify observable properties of a familiar material or object, e.g. they identify the taste, smell, texture and colour of a particular food.
- Students recognise their personal belongings (e.g. bag, chair, clothing), according to observable features.

**Key concept:**
*Patterns of interactions between materials can be identified and used to predict and control further interactions.*

**Uses senses to observe changes that occur in materials or objects, for example:**

- by mixing or dissolving:
  - water and cordial concentrate
  - varying ratios of ingredients for playdough
  - noting the changing properties of ingredients when making a cake
- by dropping:
  - playdough
  - eggs
- by temperature changes:
  - freezing: iceblocks, ice-creams, water
  - heating / cooking: eggs – raw, boiled, fried, scrambled; vegetables – raw, boiled, fried, mashed; melting ice-cream and iceblocks
  - toasting: bread, waffles, crumpets, marshmallows

**Uses previous experiences to predict changes in materials, for example:**

- Yesterday I put bread in the toaster and it became toast. Today when I put the bread in the toaster …
- Yesterday when I got into the pool, my togs got wet. Today when I get into the pool

**Example learning outcomes: F.2**

- Students recognise an object or material after its properties have changed, e.g. egg (raw, boiled, scrambled); writing paper (different colours, sizes, shapes); apple (red, green, tinned, dried).
- Students observe changes that occur in materials through: • dissolving, for example, sugar/ salt/coffee/tablets; • mixing, for example, cordial/flour in water, food colouring in playdough; • burning, for example, toast, wood, marshmallows.

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

**Identifies the uses of familiar materials, for example:**

- food for eating
- toys for playing
- clothes for wearing, keeping warm
- furniture for sitting on or at
- water for drinking, bathing, playing, swimming
- leaves for making collages, paintbrushes, decorations, cooking, eating
- sand for playing, building, pouring, painting, growing plants in
- paper for making hats, planes, wall charts, cards, collages, paintbrushes, decorations
- plastic for straws used for drinking, painting, blowing bubbles, bending, gluing, threading, sucking, blowing
- fabrics, materials, cords or threads for making mats, and carpets; can be sewn, cut, glued, folded, frayed or fringed

**Example learning outcomes: F.3**

- Students can identify different familiar materials that have similar uses, e.g. you can drink from a cup, glass or mug; to keep warm you can put on a jumper or gloves, put on a heater, eat hot food and drinking warm drinks.
- Students can identify different uses for familiar materials, e.g. paper can be used for drawing, cutting, gluing and folding; sand can be used to play with in a sandpit, in gardening and in collages.
- Students group different familiar materials according to their use, soap, detergent and cloths are used for cleaning.

# Evaluation

Evaluation is the process of collecting, analysing and interpreting information so that judgments can be made regarding the appropriateness, effectiveness and efficiency of:

- the implementation of the syllabus and sourcebook;
- the development and implementation of school-based activities, units and programs that reflect syllabus requirements.

**Appropriateness** refers to the extent to which activities, units and programs:

- are suited to the developmental levels and learning styles of students;
- are inclusive of, and relevant to, all students;
- promote active learner involvement and self-reflection.

**Effectiveness** refers to the extent to which activities, units and programs are sequenced and comprehensive in their focus on the requirements of the syllabus.

**Efficiency** refers to the extent to which activities, units and programs make timely and cost-effective use of resources.

The purpose of evaluation is to provide a basis for decision making about the need for and the direction of change. Sometimes it provides reassurance that current programs and practices are continuing to meet specific needs. On the other hand, evaluation may show discrepancies between students' needs and programs and practices, requiring changes to be made in one or more areas.

Evaluation may be ongoing or may take place at the conclusion of a program, unit, or period of time. Ongoing evaluation allows continuous refinement of a program; end-point evaluation enables a holistic picture of a program or unit to be formed. The timing of evaluation depends on its purpose.

Evaluation may be conducted by teachers, administrators or other stakeholders working alone or in collaboration with one or more of their colleagues.

## Implementation of the syllabus and sourcebook

### Syllabus

Judgments to determine the appropriateness, effectiveness and efficiency with which the syllabus requirements have been implemented in the school will include considering the extent to which:

- the characteristics and needs of students, including those in target groups, have been identified and catered for in school programs;

- programs have encompassed the requirements of the syllabus, in particular:
  - key learning area outcomes;
  - core learning outcomes;
  - core content;
  - principles of assessment;
  - cross-curricular priorities;
  - inclusive curriculum principles;
  - valued attributes of lifelong learning;
  - learner-centred approach;
- the outcomes approach to education promoted in the syllabus has been accepted by all members of the community, including students;
- relevant school authority policies have been identified and acted upon;
- physical, human and material resources have been managed effectively.

### Sourcebook

Judgments to determine the appropriateness, effectiveness and efficiency with which the sourcebook has been implemented in the school will include considering the extent to which:

- teachers have used modules as a model for planning units focusing on learning outcomes, core content and the cross-curricular priorities;
- modules, elaborations of core learning outcomes and other features of the sourcebook have been used to inform the planning and assessment of programs, units and activities which are inclusive and relevant to student needs;
- modules have informed the use of resources in accordance with school authority policies;
- information in the sourcebook has influenced the updating, modification or acquisition of resources.

## Evaluation of programs, units and activities

### Learners

Judgments to determine the appropriateness, effectiveness and efficiency with which the needs of learners have been met will include considering the extent to which students have:

- had their life experiences and interests acknowledged and incorporated into the curriculum;
- perceived that their learning is relevant to their current and future needs;
- had opportunities to inform teachers of their prior learnings, understandings, learning styles and abilities;
- been actively involved and can negotiate the sequence and pace of their own learning;
- had opportunities to develop an understanding of the aspects and components of 'working scientifically' described in the learning outcomes;
- had multiple opportunities to demonstrate the outcomes;
- had equitable access to resources of suitable quality and quantity to support them in their learning.

## Experiences that promote learning

Judgments to determine the appropriateness, effectiveness and efficiency of delivery of experiences that promote learning will include considering the extent to which they:

- are appropriate to the interests, life experiences and learning styles of students;
- are contextualised to suit the needs of students;
- cater for the possible range of student development;
- lead to the demonstration of learning outcomes;
- allow students multiple opportunities for demonstrating learning outcomes;
- overcome barriers to equitable demonstrations of outcomes;
- actively engage students in the learning process;
- challenge the students;
- include opportunities for self-reflection and self-assessment;
- display continuity in the planned development of conceptual understandings and 'working scientifically';
- focus on the learning outcomes, core content and cross-curricular priorities;
- use physical, human and material resources in ways that enhance students' opportunities to learn;
- are further enhanced by the purchase and distribution of resources in a timely and cost-efficient manner;
- adhere to school authority policies.

## Assessment

Judgments to determine the appropriateness, effectiveness and efficiency with which assessment is embedded in programs, units and activities will include considering the extent to which assessment:

- is inclusive of all students;
- actively engages students;
- is based on current knowledge of child and adolescent development and caters for the possible range of student developmental levels;
- uses a variety of forms to suit the individual learning styles and abilities of students;
- focuses on learning outcomes;
- is effective in allowing students to demonstrate outcomes;
- is related to the sequenced development of conceptual understanding, and to the aspects and components of 'working scientifically';
- is an integral part of the learning process;
- provides opportunities for reflection and self-monitoring;
- incorporates where appropriate the cross-curricular priorities;
- uses a learner-centred approach;
- incorporates techniques for gathering information that suit the learning outcome and context;
- is adequately resourced.

## Outcomes approach

Judgments to determine the appropriateness, effectiveness and efficiency with which an outcomes approach to education is embedded in programs, units and activities will include considering the extent to which:

- there is a clear focus on learning outcomes;
- students are aware of the reasons for learning what they are learning;
- it is recognised that all students can succeed;
- students are given time to produce work of a high standard;
- there is a focus on current knowledge of child and adolescent development;
- students are provided with opportunities for self-assessment so that they can monitor their own progress;
- a wide range of teaching strategies is used to cater for the developmental differences, prior knowledge and skills of students;
- there is a learner-centred approach to learning and teaching;
- barriers to students' demonstrations of learning outcomes are identified and overcome;
- the different backgrounds, interests, prior understandings, experiences and learning styles of students are valued;
- students are provided with opportunities to progress and demonstrate core learning outcomes in more than one context;
- there is sufficient flexibility in the curriculum to cater for the different characteristics and learning needs of students;
- planning of experiences that promote learning and of assessment occur at the same time;
- assessment is seen as a learning opportunity and the results used to inform future planning;
- clear expectations of student performance have been established.

# Planning curriculum and assessment

The syllabus provides a framework for planning activities through which students have opportunities to demonstrate what they know and can do in the key learning area. Activities, units and programs are the main organisational structures used in schools. Experiences that promote learning and strategies for gathering information about that learning can be developed within these structures. Despite the common use of these terms, the nature, size, purpose and organisation of activities, units and programs differ widely, depending on student needs, teacher strengths, the local context and school authority requirements. This section provides advice to support appropriate, effective and efficient planning and assessment practices.

## Characteristics of worthwhile activities, units and programs

Activities, units and programs that are consistent with the principles of the outcomes approach promoted in the syllabus are characterised by:

- comprehensiveness;
- promotion of self-reflection;
- appropriateness;
- sequencing;
- relevance and authenticity;
- inclusiveness;
- promotion of active learner involvement;
- efficient and innovative use of resources;
- adherence to pertinent school authority requirements.

### Comprehensiveness

A comprehensive range of experiences will involve students in using a variety of learning processes so that they can achieve deeper understandings identified in the syllabus. Assessment will be comprehensive if it enables all students to demonstrate core learning outcomes and other aspects of the planned curriculum.

### Promotion of self-reflection

Activities that promote reflective and self-directed learning are opportunities for students to control their own learning. These opportunities need to be provided at relevant intervals to enable students to reflect on what they have learned, on their strengths and weaknesses as learners, on their progress in demonstrating learning outcomes, and on ways to improve their learning.

## Appropriateness

Activities will be appropriate when they are suited to the developmental levels and learning styles of students. This requires determining learners' current developmental levels and providing students with experiences that are realistic challenges. This process enables them to grow beyond their present level of understanding and to construct new meaning from experiences provided. Appropriateness for all students therefore requires that experiences be varied and, to some extent, individualised by providing extra scaffolding for the development towards and demonstration of learning outcomes by some students.

## Sequencing

The sequencing of activities should provide time for students to assimilate new ideas and offer opportunities for students to demonstrate learning outcomes. Students should be aware of the criteria for demonstrating outcomes at different levels, and know how they are progressing in relation to them. Where there is a focus on outcomes from more than one level, it is necessary to keep in mind the conceptual sequencing of the outcomes and the embedded differences that characterise outcomes at each of the levels.

## Relevance and authenticity

Activities will be relevant and authentic when their content and contexts link with students' sociocultural or geographic background and prior understandings to allow them to construct new understandings. Students' interests and understandings prior to beginning an activity should be determined, and students should be involved in the planning process. Relevant and authentic activities should also involve students in content or contexts that are engaging and enjoyable. The more relevant and authentic activities are, the more likely it is that many students will demonstrate the learning outcomes.

## Inclusiveness

Activities are inclusive when they recognise the backgrounds and value the experiences of all students or groups of students, taking into account their socioeconomic status, gender, race, ability, disability, ethnic or linguistic background or geographic location. Recognition of such backgrounds and experiences will prompt consideration of how all students have equitable access to resources and participation in the classroom, and have multiple opportunities to demonstrate learning outcomes in an equitable and supportive way. Opportunities should be provided for students to value the differences between them and to challenge disadvantage and injustice through participation in activities.

## Promotion of active learner involvement

Activities should actively involve each student and provide opportunities to challenge existing understandings. Sharing of ideas and intellectual risk-taking are encouraged. Active involvement promotes student ownership, which allows for more purposeful and realistic opportunities to demonstrate learning outcomes.

### Efficient and innovative use of resources

Activities should make efficient, cost-effective and timely use of resources. It is necessary to support demonstrations of outcomes with adequate resources to cater for differences in learning styles or characteristics of socioeconomic background. Where appropriate, students should be encouraged to use resources in innovative ways as they strive to demonstrate learning outcomes. Teachers are encouraged to access and use a variety of resources efficiently and in innovative ways to support students' demonstrations of learning outcomes.

### Adherence to pertinent school authority policies

Activities should adhere to and observe pertinent policies of schools and school authorities. These policies may relate to safety, social justice, pedagogy or other curriculum requirements. Observing such policies will improve opportunities for students' demonstrations of learning outcomes.

## Planning curriculum for demonstrations of outcomes

### Considerations for planning activities

When planning activities for science, teachers are encouraged to consider the needs of their students, the ways their students learn, current understandings about science and the ways students learn about science, available human and material resources, and requirements of schools and school authorities.

Consideration of how cultures other than Western ones view natural phenomena will assist students in developing their understandings of Western science, and facilitate their access to its scientific language. For example, for those Aboriginal students and Torres Strait Islander students who are steeped in the Dreaming stories and Creation stories of their cultures, special consideration in planning experiences to provide learning can assist them to move freely between their indigenous perspectives and Western science perspectives.

**Learners**

Planning activities involves ensuring that opportunities are provided for students to demonstrate learning outcomes from the syllabus. The valued attributes of a lifelong learner, Science key learning area outcomes and cross-curricular priorities should be referred to when planning activities and assessment which focus on core or discretionary learning outcomes.

When planning activities to meet the needs of learners, teachers:

- encourage students to clarify, evaluate and reconsider their understandings about natural phenomena and science concepts;
- provide opportunities for students to discuss the tentative nature of scientific knowledge and encourage reflection on how scientific ideas have changed over time;
- actively and explicitly teach students about scientific texts, language and vocabulary and allow time for students to develop competency in genre commonly used in scientific contexts;
- actively and explicitly develop in students a futures perspective as well as lifeskills and skills in literacy and numeracy;

- encourage critical literacy and numeracy approaches to the investigation of science in different historical, social and cultural contexts;
- facilitate active learning by providing both hands-on and minds-on activities and employing real-life and lifelike learning and assessment contexts.

**Cooperative learning**

Teachers who believe that learning occurs as learners discuss their work, listen to and help each other, and take responsibility for the management of tasks, provide opportunities for cooperative learning to take place.

Cooperative learning involves students working in small groups to learn with and from each other. When cooperative learning is occurring there is a division of tasks, a sharing of resources and a group goal. When students are working in groups for activities such as practical work, it does not necessarily mean that cooperative learning is occurring.

Cooperative learning needs to be carefully developed. It is built on a combination of social and learning skills. Cooperative learning develops the skills of forming and managing groups, group problem solving and metacognition.

Varied activities lend themselves to cooperative learning including those that further understanding of science concepts through practical work, outdoor studies, discussions, data collection and concept mapping. Additional information on cooperative learning can be found in Appendix 2.

**'Open' investigations**

Teachers who believe in actively engaging students in all aspects of a scientific investigation may plan experiences where students:

- decide on a problem to investigate;
- plan how they will conduct their investigation;
- gather, organise and present their data;
- communicate their conclusions.

These kinds of investigations are referred to as 'open' investigations. They are a powerful way of assisting students to understand and internalise the nature of scientific investigations. Open investigations also provide 'in context' opportunities for teachers to make judgments about students' demonstration of outcomes.

Activities that require students to undertake investigations where the problem, equipment and procedure are given are often referred to as 'closed' investigations. With this type of investigation there is less active involvement of students.

Irrespective of the degree of openness of an investigation, there are a number of strategies that can be used to assist students to understand the nature of, and become more actively engaged in, an investigation. Hackling (1998) suggests the following five strategies.

**1. A fair test mnemonic — Cows Moo Softly**
This mnemonic stands for:

**C**hange something.

**M**easure something.

Keep everything else the **S**ame.

This strategy is appropriate for introducing students to, and reinforcing their understanding of, the nature of a controlled investigation. It also assists them to design their own investigations. It requires them to recognise the various kinds of variables as they are invited to identify what is to be changed, what is to be measured and what is to be kept the same. It is an effective way of introducing the idea of a fair test and can be presented to students who have little prior experience with fair tests.

**2. Variable tables**
This is a suitable strategy to introduce when students are using the previous strategy efficiently. A table like the one below is used to introduce students to the terms 'controlled variables', 'independent variable', and 'dependent (manipulated) variable' in the context of a given problem — for example, How does the amount of light affect the growth of seedlings?

| What will I keep the same? | What will I change? | What will I measure? |
|---|---|---|
| | | |
| Controlled variables | Independent variable (IV) | Dependent variable (DV) |

**3. Writing researchable questions**
This strategy provides a structure for students to use to frame their own researchable questions. A suitable structure could be:

What happens to _____ (DV) when we change _____ (IV)?

For example, the researchable question might be: What happens to **the growth of wheat plants** (DV) when we change **the salinity of water** (IV)?

Researchable questions tend to be used with younger children, when the independent variable is discrete and there is little prior knowledge and experience of the phenomenon. When students are proficient at writing researchable questions they can be introduced to writing hypotheses.

**4. Writing testable hypotheses**
This strategy provides a structure for students to write hypotheses. Hypotheses are statements of tentative ideas to be tested, expressed in the form of a relationship between an independent and dependent variable. A suitable structure could be:

This change in _____ (IV) will cause this to happen to _____ (DV).

For example, the hypothesis might be: Increasing **the salinity of water** (IV) will **reduce** (relationship) **the growth of wheat plants** (DV).

**5. Student planning and reporting worksheets that encourage independence and reflection**

A well-designed planning and reporting format can lead students through a sequence of decision-making steps, reduce their dependence on the teacher, provide a way for them to record their thinking (including their reflections) and 'doing' throughout an investigation, and provide information for assessment purposes. Three models, increasing in detail and complexity, are included in Appendix 3. The question format of each model serves to actively engage students.

**Resources**

Activities should be based on resources that are:

- readily accessible;
- inclusive of all students;
- used only if safe to do so;
- matched to students' abilities, learning styles and cultural needs;
- able to help students develop understanding and demonstrate learning.

## Considerations for planning a unit

Planning a unit with an outcomes approach involves identifying the outcomes to be demonstrated. This step will be informed by the school program and serves as a starting point for planning activities. Part of the planning process involves designing an appropriate sequence of learning activities and identifying opportunities for gathering information about students' learning.

Units will include activities based on outcomes selected from:

- within or across strands of a key learning area;
- one or more levels within a key learning area;
- across key learning areas.

**Students' needs**

An effective unit will meet students' needs by:

- providing adequate time for reflection and critical thinking;
- supporting independence and interdependence in learning;
- presenting experiences that lead students to view science as a series of connected, rather than unconnected episodes;
- linking experiences in science to other areas of learning;
- recognising that all students will not necessarily be ready to demonstrate learning outcomes in the same way or at the same time, and possibly providing opportunities for negotiating learning and assessment;
- teaching strategies and skills for applying learnings to novel scientific applications.

**Some learning–teaching approaches**

There are a number of learning–teaching approaches to help teachers in developing units. Using these approaches, teachers sequence activities appropriately and select strategies that help students to apply learnings to novel situations. Some approaches used in science are:

- the interactive approach;
- the 5 Es instructional approach;
- Orientating, Enhancing, Synthesising.

These are discussed in Module 7 of the initial in-service materials. The relationship between these approaches and the organisation of the activities in the sourcebook modules are shown in the figure below.

| | **Learning–teaching approach** | | |
|---|---|---|---|
| **Organisation of activities in sourcebook modules** | *Interactive approach* | *5 Es instructional approach* | *Orientating, Enhancing, Synthesising* |
| Introductory | Preparation | Engage | Orientate |
| | Exploration | Explore | |
| Developmental | Student's questions | Explain | Enhance |
| | Investigation | Elaborate | |
| Culminating | Reflection | Evaluate | Synthesise |

To help students take responsibility for their own learning and assessment, it is suggested that teachers discuss with their students the main parts of the approach used.

If students are asked to engage with a number of different approaches over a short period, it is suggested that teachers discuss similarities between the approaches with their students and display these similarities on a chart so that students do not become confused.

Some teachers may choose to use only one learning–teaching approach to avoid the possibility that students may become confused.

**Syllabus requirements**

When teachers are planning a unit the following syllabus requirements should be considered:

- key learning area outcomes;
- core learning outcomes;
- core content;
- principles of assessment;
- cross-curricular priorities;
- inclusive curriculum principles.

Teachers should also be aware of:

- discretionary learning outcomes;
- the key learning area's contribution to development of the valued attributes of a lifelong learner.

**Resources**

Unit planning makes provision for appropriate use of:

- teacher and support staff expertise and interests;
- material resources;
- facilities;
- local community resources.

## Considerations for planning a program

Programs are the means by which teachers plan for demonstrations of learning outcomes over extended periods of time. The planning may involve one strand or more from one key learning area or more.

A program may cater for:

- all the students in a class, year or school level for one key learning area;
- all the students in the school for one or more of the key learning areas;
- an individual student or group of students with specific needs for one or more of the key learning areas.

**Syllabus requirements**

When planning programs in the Science key learning area, teachers should consider the following syllabus requirements.

- *Key learning area outcomes*
  The key learning area outcomes describe the contribution Science makes to the Years 1–10 curriculum and to the development of the valued attributes of lifelong learners. They will influence the selection of experiences planned for students.
- *Core learning outcomes*
  The learning outcomes selected for inclusion in the program should reflect the levels at which the students within the school or year level are working. The choice of learning outcomes included in units of work will depend on a number of factors including school requirements, teacher expertise and student needs.
- *Core content*
  During Years 1–10 students should be provided with experiences which promote learning and incorporate all of the core content. Coordinated planning between primary and secondary schools may be required if this is to happen. The core content should be contextualised to suit the needs of students and the school setting.
- *Principles of assessment*
  The program should highlight appropriate, effective and efficient assessment practices that are in keeping with the principles of assessment. These will include identification of a range of suitable assessment techniques and instruments for use when teachers develop units to cater for the different learning styles and backgrounds of students.

- *Cross-curricular priorities*
  A program should ensure that literacy, numeracy, lifeskills and a futures perspective are embedded in units wherever possible, and that students get regular contact with each of these priorities in all stages of their schooling.
- *Inclusiveness*
  A program should ensure that learning processes are accessible to all students.
- *Learner-centred approach*
  A program should encourage the use of a learner-centred approach in all units.
- *Multiple opportunities*
  The program should ensure that students have multiple opportunities to demonstrate the learning outcomes consistently and well.

**Educational setting**

Planning a program in the Science key learning area will initially require consideration of the educational setting, including:

- the location — for example, geographically isolated, urban, coastal, rural;
- staffing allocations, responsibilities and expertise;
- school organisation — for example, middle schooling approach, family groupings, vertical timetable, primary, secondary, multi-age;
- school authority policies and requirements;
- school population;
- availability of resources — for example, physical, human;
- time allocation;
- reporting requirements;
- community expectations and influences.

**Students' needs**

All programs should take into account the school population and the individual and group differences that exist within that population.

For students with disabilities, programs should provide alternative ways for demonstrating outcomes. Some students with disabilities will make similar progress to that of their peers, while others may be working at different levels. Students with disabilities can frequently participate in the same activities as others of their peer group. Planning and assessment should, where possible, be appropriate for the student's age and draw on content in the learning area which is accessible to the student.

Some students with special educational needs may not be able to demonstrate all outcomes within a level, and may find some strands more difficult than others.

Foundation Level outcomes written using the level statements should:

- be descriptive of what students know and can do;
- be written so that they can be assessed;
- be achievable;
- reflect the intent of the level statement;
- be tailored to the individual needs of each student;
- be linked to a priority goal of an individualised education plan.

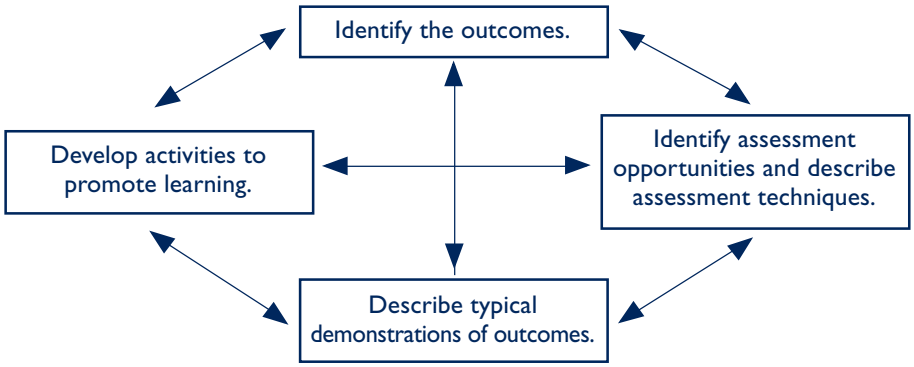
Examples of outcomes at the Foundation Level are included in Appendix 1.

## Planning assessment for demonstrations of outcomes

Assessment requires that students be able to show what they have learned — that is, they can demonstrate what they know and can do. There is an integral relationship between the experiences that promote learning and the assessment techniques that facilitate students' demonstrations of learning outcomes.

Each learning outcome describes what students should know and be able to do. The outcomes inform the assessment process and may indicate which techniques and instruments are more appropriate for their demonstration. To clarify the expectations of the assessment process, characteristics of typical demonstrations may be identified by developing criteria. Assessment items may address more than one learning outcome.

The following diagram illustrates the relationship between learning outcomes and activities. The learning outcomes are used as a starting point for planning experiences and identifying assessment opportunities. This planning process may suggest additional learning outcomes that could also be demonstrated by students as a result of particular experiences.




**Relationship between learning outcomes and planning for assessment**

As students and teachers progress through a unit, specific assessment tasks will enable students to demonstrate outcomes.

### Techniques for gathering information

Students' demonstrations of learning outcomes should be monitored through the use of a range of assessment techniques. The following techniques provide types of information which can be useful in different situations.

*Observation* is an effective technique for gaining a broad impression of students' demonstrations of learning outcomes. It includes communicating with students and monitoring progress as they work. Most observation is incidental and takes place as learners participate in planned activities. Some observations are structured to gather particular kinds of information.

*Consultation* involves teachers interacting with students, colleagues, parents, carers or paraprofessionals. The varying perspectives of these consultations help enrich teachers' understanding of students' demonstrations of learning outcomes. Information gained through consultation may confirm or conflict with teachers' impressions formed as they observe students. Sometimes consultations will reveal a need for more detailed assessment.

*Focused analysis* involves teachers in examining specific details and features of students' demonstrations of learning outcomes. Through focused analysis, teachers can identify and examine the strengths and specific needs evident in students' work. Focused analysis can employ a wide variety of oral or written tasks.

*Self-assessment* allows teachers to take students' perceptions of their own achievements into account when developing teaching, learning and assessment activities. Teachers communicate with students about the students' progress and perceptions. They use student goal setting to plan individual activities and identify whether students need additional support or explanation.

*Peer assessment* involves students in applying criteria to assess the work of others in a non-threatening but informed way. They reflect on their own work through focusing on the work of others. Students take on other classroom roles, such as that of tutor. A classroom atmosphere of negotiation, collaboration and fairness supports peer assessment.

## Classroom opportunities for gathering information

The written, oral and practical assessment forms suggested in the syllabus require careful consideration in their classroom use. A variety of forms should be used to assess an individual student's or group of students' demonstrations of learning outcomes. Frequently, learning activities will also provide opportunities for gathering information that can be used for monitoring students' learning.

To be inclusive of all students, it may be necessary to use different forms of assessment to collect information about students' demonstrations of a learning outcome.

## Assessment instruments

Teachers can record evidence of students' demonstrations of learning outcomes using assessment instruments that are manageable and easily incorporated into classroom activities. These include:

- annotated work samples;
- observation notes and anecdotal records;
- student folios;
- assignments, projects and research reports;
- checklists;
- criteria sheets;
- recordings of performances — audiotapes, videotapes, photographs;
- self- and peer-reflective writings and journals;
- test results over time;
- homework, worksheets and assignments.

## Making judgments

Evidence of demonstrations of learning outcomes can be drawn from ongoing observations 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 demonstration.

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

Teachers' professional judgment is fundamental to school-based assessment and reporting processes and should involve considered and expert decisions, made according to explicit criteria, using a range of evidence assessed against the core learning outcomes of the syllabus.

The consistency of teacher judgments is developed through processes that may involve:

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

**Shared understandings**
Where possible, teachers are encouraged to collaborate with others to develop shared understandings of tasks and consistency in making judgments about demonstrations of learning outcomes. This can be either a formal or an informal process in which teachers discuss and compare their evidence and decisions in relation to students' demonstrations of outcomes. Comparison of evidence and justification of teachers' judgments is central to accountability.

**Criteria sheets**
Criteria sheets contain the essential components, attributes, specifications, rules or principles used to judge student performance, responses or products.

**Common planning and assessment tasks**
When two or more teachers plan activities together they can reach a common understanding of expected outcomes. Where different groups of students undertake the same activities, consistent decisions regarding their demonstration of outcomes can then be made.

**Examination of students' folios**
A student folio is a collection of a student's work assembled over a period of time. It may include day-to-day tasks, work produced for assessment items, or selections of a student's best work showing effort, progress and achievement. A folio containing a complete collection of a student's work is often used to demonstrate progress. A folio containing selected items only is more commonly used for summative assessment and reporting.

**Progress maps**
Progress maps provide frameworks for monitoring student progress against described developmental continua. The concept of a progress map underlies the sequencing of the core learning outcomes in each of the strands of the syllabus. A student's progress in relation to the development of knowledge, practices and dispositions of the key learning area is plotted against the six levels used to represent the core learning outcomes.

**Moderation processes (formal and informal)**
Formal moderation processes occur when schools or school authorities involve teachers from within or across schools in comparing student work and discussing the consistency of judgments about demonstrations of learning outcomes. Informal moderation occurs any time teachers share their understandings of judgments of students' demonstrations of learning outcomes.

**Assessment in modules**
Strategies for assessment are viewed as integral to the planning process. In activities teachers identify opportunities for gathering information that will enable them to make judgments about students' demonstrations of outcomes.

**Assessment across key learning areas**
When gathering information about student learning, teachers may find opportunities to make decisions about students' demonstrations of outcomes in other key learning areas. For example, a written task using a specific genre may also be used as assessment in English. Assessment developed for integrated units of work which combine learning outcomes from more than one key learning area may provide information about student demonstration of outcomes from each of the key learning areas represented. Activities that feature cross-curricular priorities of literacy, numeracy, lifeskills and a futures perspective will often provide opportunities for this to occur.

## Reporting

In an outcomes approach, reporting occurs in terms of outcomes; however, a range of approaches for reporting is possible. While the final decision rests with schooling authorities or individual schools, teachers could report to parents or carers on students' demonstrations of all or some of the core learning outcomes or could use the level statements to guide reporting to parents or carers on student performance in strands. Students could be demonstrating outcomes at different levels in different strands.

Results of assessment need to be clearly communicated through reporting to others — students, parents, carers, other teachers and paraprofessionals — who support students' learning progress.

**Reference**
Hackling, M. 1998, *Working Scientifically: Implementing and Assessing Open Investigation Work in Science*, Education Department of Western Australia, Perth.

# Using the sourcebook modules

A module is a resource for teachers that provides learning and teaching ideas to assist students to develop and demonstrate understandings related to specified core learning outcomes. Science sourcebook modules contain activities, resource materials and information regarding assessment strategies, background and reference material to support the implementation of the Years 1–10 Science Syllabus.

The modules are not intended to be used as complete units or sequenced courses of study. Rather, they provide a selection of activities as a basis for teachers to develop customised units suited to the needs of their students. While useful in the order presented, activities in a module may be arranged in other sequences and combined with activities from other modules and sources. Teachers are encouraged to select and adapt activities and to sequence them in whatever way is most appropriate for their students. The policies of schools and school authorities will need to be considered in the adaptation and use of these activities.

In all modules, the focus is on:

- facilitating an outcomes approach to learning and teaching, with multiple opportunities for students to demonstrate the specified outcomes;
- offering a variety of ways for students to develop their conceptual understandings and practices and dispositions of 'working scientifically';
- promoting constructivist approaches to learning.

In keeping with an outcomes approach, activities in the modules provide opportunities for students to progress through the conceptual continua outlined in the syllabus. The modules, and the activities within them, are typically designed for two or three levels of learning outcomes. They allow students to demonstrate what they know and can do at the specified levels.

Activities in the Science sourcebook modules are written with particular core learning outcomes in mind. It is possible that activities could be altered to enable students to develop and demonstrate a variety of learning outcomes.

## Modules and planning

Sourcebook modules assist planning by:

- providing teachers with specific guidance and activities to support students as they develop conceptual understandings and the practices and dispositions of 'working scientifically';
- indicating how students might demonstrate what they know and can do.

Teachers may use activities from a variety of modules to prepare units appropriate for their students.

There should be a clear link between learning outcomes, planning and assessment. This involves:

- planning assessment at the same time as planning activities;
- planning how activities can be utilised for ongoing assessment;
- establishing clear expectations of student performance;
- determining how student progress will be monitored;
- providing opportunities for students to demonstrate what they know and can do;
- using assessment to inform future planning and as an opportunity to learn.

Within an outcomes approach, it is essential that the intended outcomes of a unit are clearly stated for students. At the commencement of a unit teachers need to help students understand the unit's purpose and the ways in which particular learning outcomes can be demonstrated.

Each core learning outcome contributes equally to the Science key learning area. Notionally, the amounts of time allocated to the demonstration of each outcome are equal. The actual amounts of time used for the demonstration of specified outcomes will depend on a number of factors, including:

- the overall school program;
- the needs, prior knowledge and experience of students;
- resources available.

When planning units, teachers need to consider possible learning contexts as well as the prior knowledge, experience and learning needs of students. Teachers are encouraged to adapt activities and ideas from across the range of Science sourcebook modules so that the activities are inclusive of all students and meet individual needs. Meeting these needs may require flexible pathways and special equipment in some cases. A variety of ways of demonstrating an outcome, as well as numerous opportunities to do so, should be planned. Factors related to special needs and cultural and linguistic diversity may be significant issues in the teaching–learning process. In these situations, the teacher, student and relevant advisors should jointly plan ways of ensuring activities are supportive and accessible.

While different activities may have different emphases, it is important to ensure that in creating a unit, it incorporates the cross-curricular priorities in a manner inclusive of all students.

The key features of a typical module are highlighted and explained on the following pages.

## Key features of modules

The first part of the Science sourcebook modules provides general information about the core learning outcomes and the core content incorporated in the module, as well as information on assessment.

It is intended that the assessment strategy section of each module provide teachers with an indication of the pattern of behaviour to look for when making judgments about students' demonstrations of the specified outcomes.

The list of typical demonstrations is not necessarily an exhaustive one. There are suggestions for gathering information within each activity; similar information may also be collected during activities not included in the module.

Activities in the modules are organised into three phases — **introductory**, **developmental** and **culminating**.

Introductory activities can serve a number of purposes. They may:

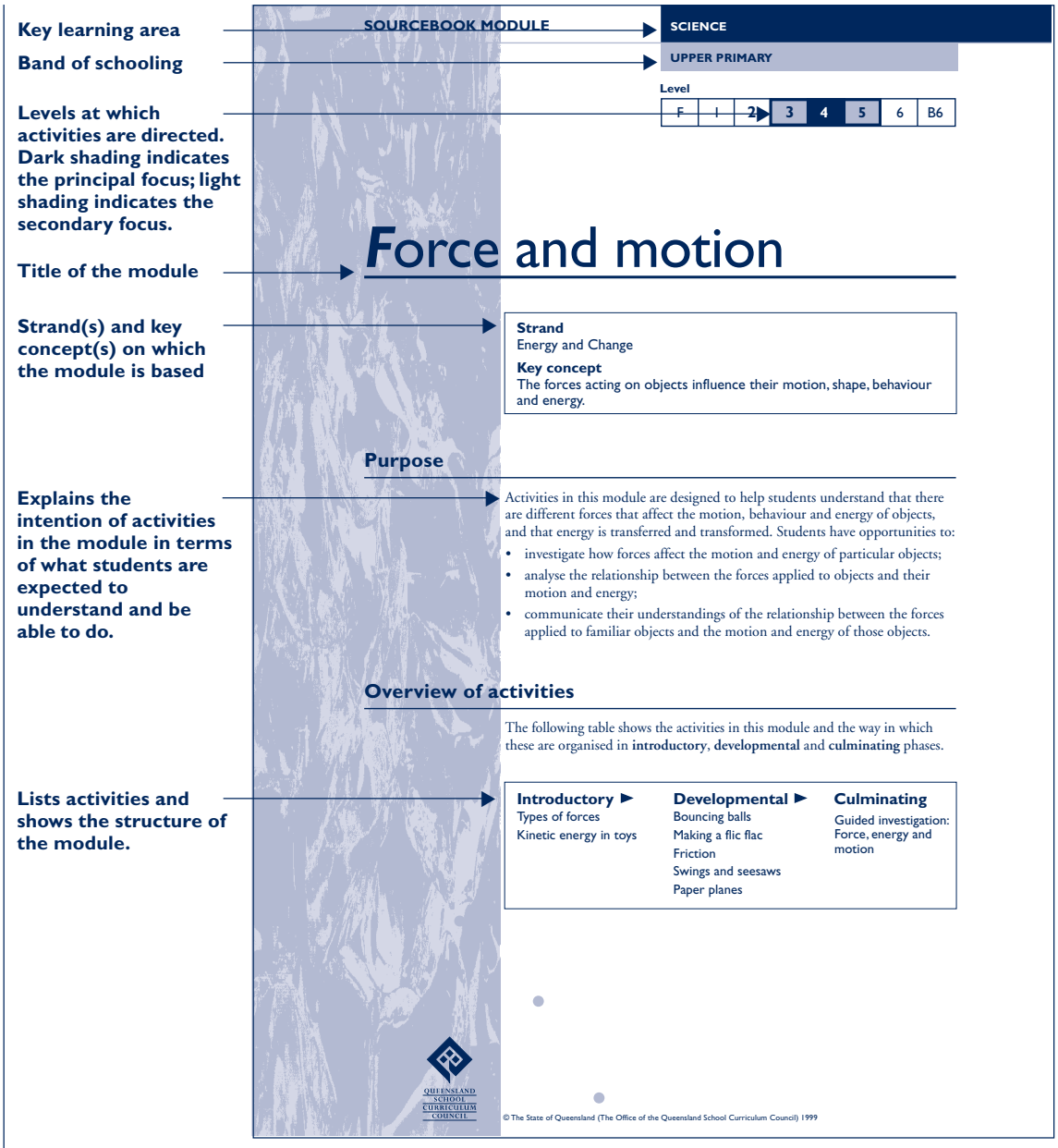
- elicit students' current knowledge and understanding in relation to the outcomes;
- arouse student interest;
- orientate students towards the intended outcome.

While it may be practical in some cases to proceed to developmental activities after just one introductory activity, it is possible that more than one will be required.

Developmental activities are intended to help students develop conceptual understandings and the practices and dispositions of 'working scientifically'. These activities also provide opportunities for students to demonstrate what they know and can do.

Culminating activities can serve a number of purposes. They may:

- complete a sequence of activities;
- draw together various parts of a unit into a cohesive whole;
- allow students further opportunity to demonstrate what they know and can do;
- provide a time and means for reflecting on the learning that has occurred and implications for future learning.


Key learning area
Band of schooling
Levels at which activities are directed. Dark shading indicates the principal focus; light shading indicates the secondary focus.
Title of the module
Strand(s) and key concept(s) on which the module is based
Explains the intention of activities in the module in terms of what students are expected to understand and be able to do.
Lists activities and shows the structure of the module.
SOURCEBOOK MODULE
SCIENCE
UPPER PRIMARY
Level
F
1
2
3
4
5
6
B6
Force and motion
Strand
Energy and Change
Key concept
The forces acting on objects influence their motion, shape, behaviour and energy.
Purpose
Activities in this module are designed to help students understand that there are different forces that affect the motion, behaviour and energy of objects, and that energy is transferred and transformed. Students have opportunities to:
• investigate how forces affect the motion and energy of particular objects;
• analyse the relationship between the forces applied to objects and their motion and energy;
• communicate their understandings of the relationship between the forces applied to familiar objects and the motion and energy of those objects.
Overview of activities
The following table shows the activities in this module and the way in which these are organised in introductory, developmental and culminating phases.
Introductory
Types of forces
Kinetic energy in toys
Developmental
Bouncing balls
Making a flic flac
Friction
Swings and seesaws
Paper planes
Culminating
Guided investigation: Force, energy and motion
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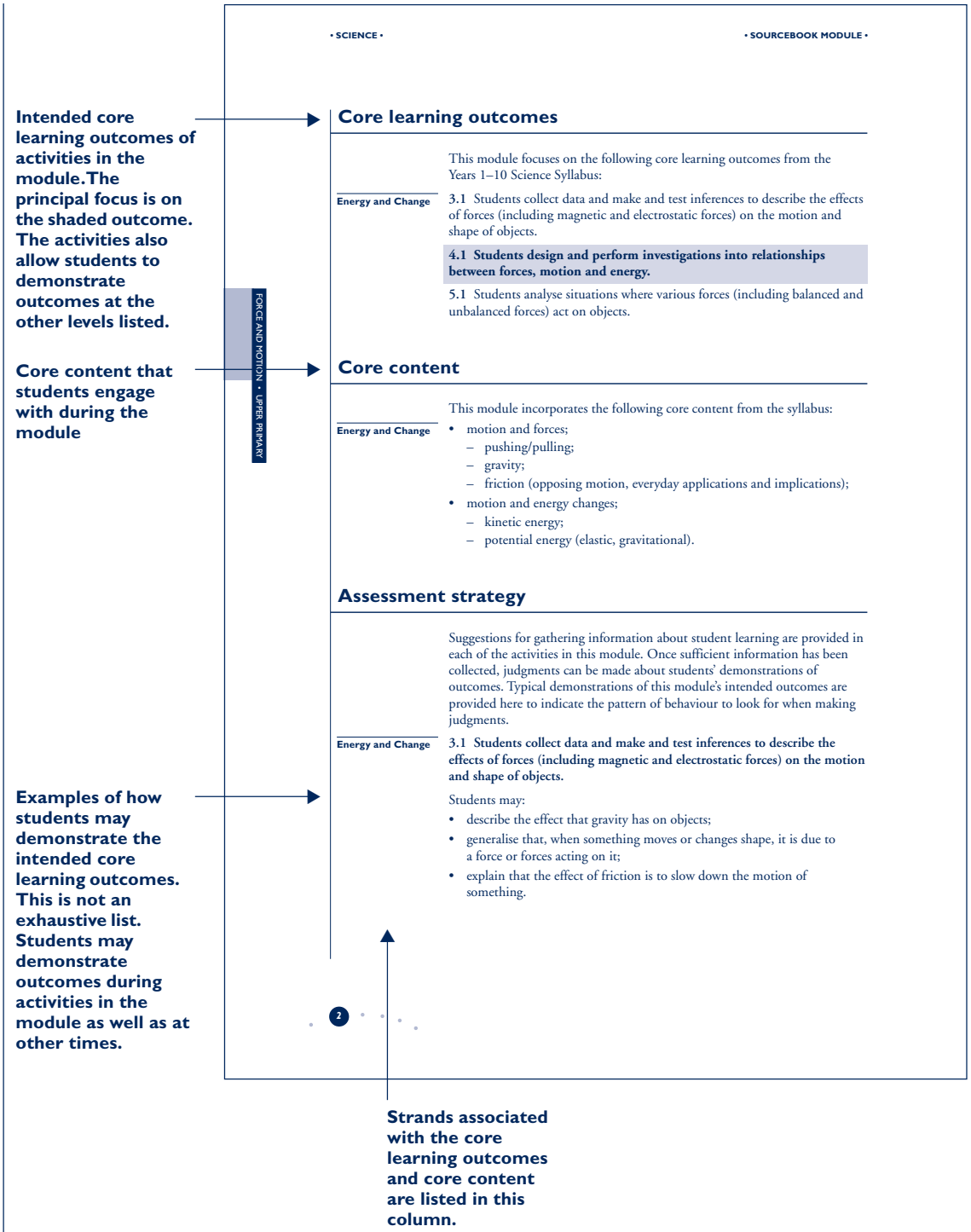

• SCIENCE •
• SOURCEBOOK MODULE •
Core learning outcomes
This module focuses on the following core learning outcomes from the Years 1–10 Science Syllabus:
Energy and Change
3.1 Students collect data and make and test inferences to describe the effects of forces (including magnetic and electrostatic forces) on the motion and shape of objects.
4.1 Students design and perform investigations into relationships between forces, motion and energy.
5.1 Students analyse situations where various forces (including balanced and unbalanced forces) act on objects.
FORCE AND MOTION • UPPER PRIMARY
Core content
This module incorporates the following core content from the syllabus:
Energy and Change
• motion and forces;
– pushing/pulling;
– gravity;
– friction (opposing motion, everyday applications and implications);
• motion and energy changes;
– kinetic energy;
– potential energy (elastic, gravitational).
Assessment strategy
Suggestions for gathering information about student learning are provided in each of the activities in this module. Once sufficient information has been collected, judgments can be made about students' demonstrations of outcomes. Typical demonstrations of this module's intended outcomes are provided here to indicate the pattern of behaviour to look for when making judgments.
Energy and Change
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.
Students may:
• describe the effect that gravity has on objects;
• generalise that, when something moves or changes shape, it is due to a force or forces acting on it;
• explain that the effect of friction is to slow down the motion of something.
2
Intended core learning outcomes of activities in the module. The principal focus is on the shaded outcome. The activities also allow students to demonstrate outcomes at the other levels listed.
Core content that students engage with during the module
Examples of how students may demonstrate the intended core learning outcomes. This is not an exhaustive list. Students may demonstrate outcomes during activities in the module as well as at other times.
Strands associated with the core learning outcomes and core content are listed in this column.

Energy and Change

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

Students may:

- explain that a force must be applied to an object before its motion can be changed;
- relate the motion (direction and speed) of an object to the forces acting on it;
- interpret that, when a force is applied to an object, energy is transferred or transformed;
- conclude that an object has energy if it has the ability to change the motion of another object;
- design and perform investigations that allow them to illustrate the relationships between the forces acting on an object, its energy and its motion.

Energy and Change

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

Students may:

- analyse the effects of applying different amounts of force to an object;
- identify the relationships between variables which affect the motion of an object;
- explain the motion of an object in terms of a number of forces acting, such as air resistance and gravity.



## Background information

**Outlines current scientific understanding about concepts introduced in the module.**

### Current scientific conceptions

#### Force

A force is an influence that produces, or tends to produce, a change in the motion of an object. When there is a push, a pull, a bend, a twist, a turn, a squeeze, a tear, a lift, a stretch, friction or resistance, at least one force is being exerted.

A force can move something, make it go faster or slower, change its direction, stop it, or change its shape. Often, an object will be affected by a number of forces at once. If these forces are balanced, the object will be held in place and will keep its shape.

When a force is applied, energy can be transferred or transformed. **Transfer of energy** refers to the shifting of energy from one object to another. For example, a bowling ball with kinetic energy (energy of movement) hits the tenpins and gives them kinetic energy. **Transformation of energy** refers to the change from one form of energy to another. For example, electrical energy is transformed to light and heat energy when you switch on a light.

**Presents some ideas and views students may have about the concepts.**



## Students' prior understandings

Students' prior understandings may differ from current scientific conceptions in a range of ways.

### Force

Some students may:

- believe that the force of an object resides within the object rather than being an external effect. This may relate to the common belief that if an object is **not moving** there are **no forces** acting on it, and if an object **is moving** there **is a force** acting on it in the direction it is moving. This belief is incorrect. For example, if an object is stationary on the ground, gravity is acting downwards and a reaction force from the ground is acting upwards. If an object such as a toy car is given a push across a flat surface, there is initially a forward force acting on it; however, once it is allowed to move freely, there is no forward force. Friction exerts a force in the opposite direction to the object's motion and is the reason it eventually stops moving.
- believe that forces can be applied only by living things. Thus, they may realise that a human can apply a force but may not consider the effects of gravity or friction.
- be aware of one or several forces being exerted on an object but may not consider all forces. For example, students may realise that gravity is acting on a ball rolling down a hill but may not consider the effect of friction acting in the direction opposite to the motion of the ball.

Resource Sheet 1

Teachers can help students build on their prior understandings by asking them to discuss and reflect on everyday situations that involve forces. (Some examples of situations are provided on Resource Sheet 1.)

### Energy

Some students may:

- use the terms 'energy transfer' and 'energy transformation' interchangeably;
- have heard about energy only in relation to food such as bread, breakfast cereals and sports drinks;
- not be aware of potential (stored) energy;
- believe that energy is associated only with living things or moving things.

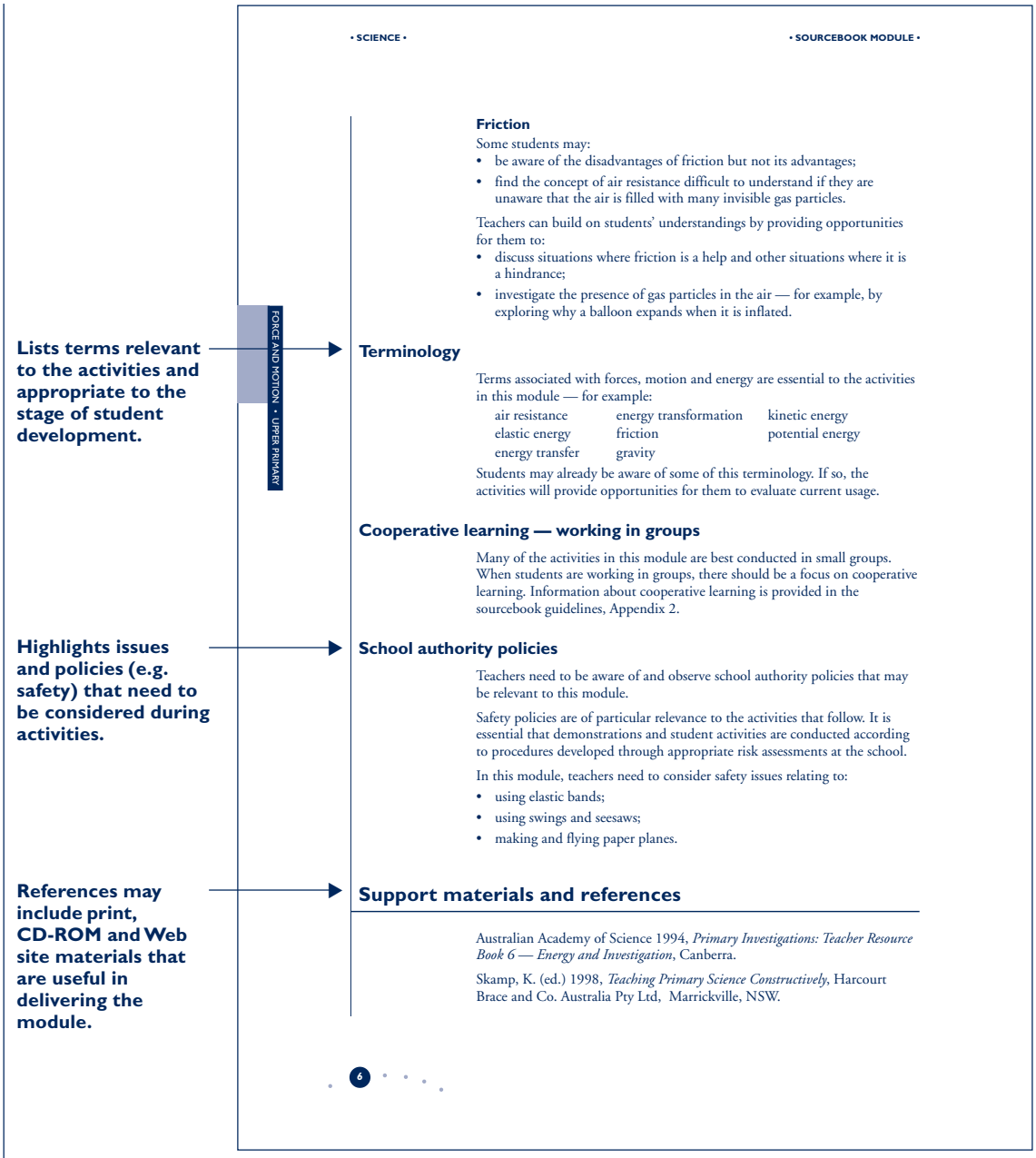
Teachers can enhance students' understandings by emphasising correct usage of the terms 'energy transfer' and 'energy transformation' and by providing opportunities for students to consider different forms of energy, including potential energy.

### Gravity

Some students may:

- believe that the moon has no gravity when, in fact, it does. However, the effects of gravity on the moon are less than those on the Earth because the moon has a smaller mass.

Teachers can help students broaden their understandings by encouraging discussion about the relative effects of gravity on the Earth and on the moon.


• SCIENCE •
• SOURCEBOOK MODULE •
Friction
Some students may:
• be aware of the disadvantages of friction but not its advantages;
• find the concept of air resistance difficult to understand if they are unaware that the air is filled with many invisible gas particles.
Teachers can build on students' understandings by providing opportunities for them to:
• discuss situations where friction is a help and other situations where it is a hindrance;
• investigate the presence of gas particles in the air — for example, by exploring why a balloon expands when it is inflated.
FORCE AND MOTION • UPPER PRIMARY
Lists terms relevant to the activities and appropriate to the stage of student development.
Terminology
Terms associated with forces, motion and energy are essential to the activities in this module — for example:
air resistance
elastic energy
energy transfer
energy transformation
friction
gravity
kinetic energy
potential energy
Students may already be aware of some of this terminology. If so, the activities will provide opportunities for them to evaluate current usage.
Cooperative learning — working in groups
Many of the activities in this module are best conducted in small groups. When students are working in groups, there should be a focus on cooperative learning. Information about cooperative learning is provided in the sourcebook guidelines, Appendix 2.
Highlights issues and policies (e.g. safety) that need to be considered during activities.
School authority policies
Teachers need to be aware of and observe school authority policies that may be relevant to this module.
Safety policies are of particular relevance to the activities that follow. It is essential that demonstrations and student activities are conducted according to procedures developed through appropriate risk assessments at the school.
In this module, teachers need to consider safety issues relating to:
• using elastic bands;
• using swings and seesaws;
• making and flying paper planes.
References may include print, CD-ROM and Web site materials that are useful in delivering the module.
Support materials and references
Australian Academy of Science 1994, *Primary Investigations: Teacher Resource Book 6 — Energy and Investigation*, Canberra.
Skamp, K. (ed.) 1998, *Teaching Primary Science Constructively*, Harcourt Brace and Co. Australia Pty Ltd, Marrickville, NSW.
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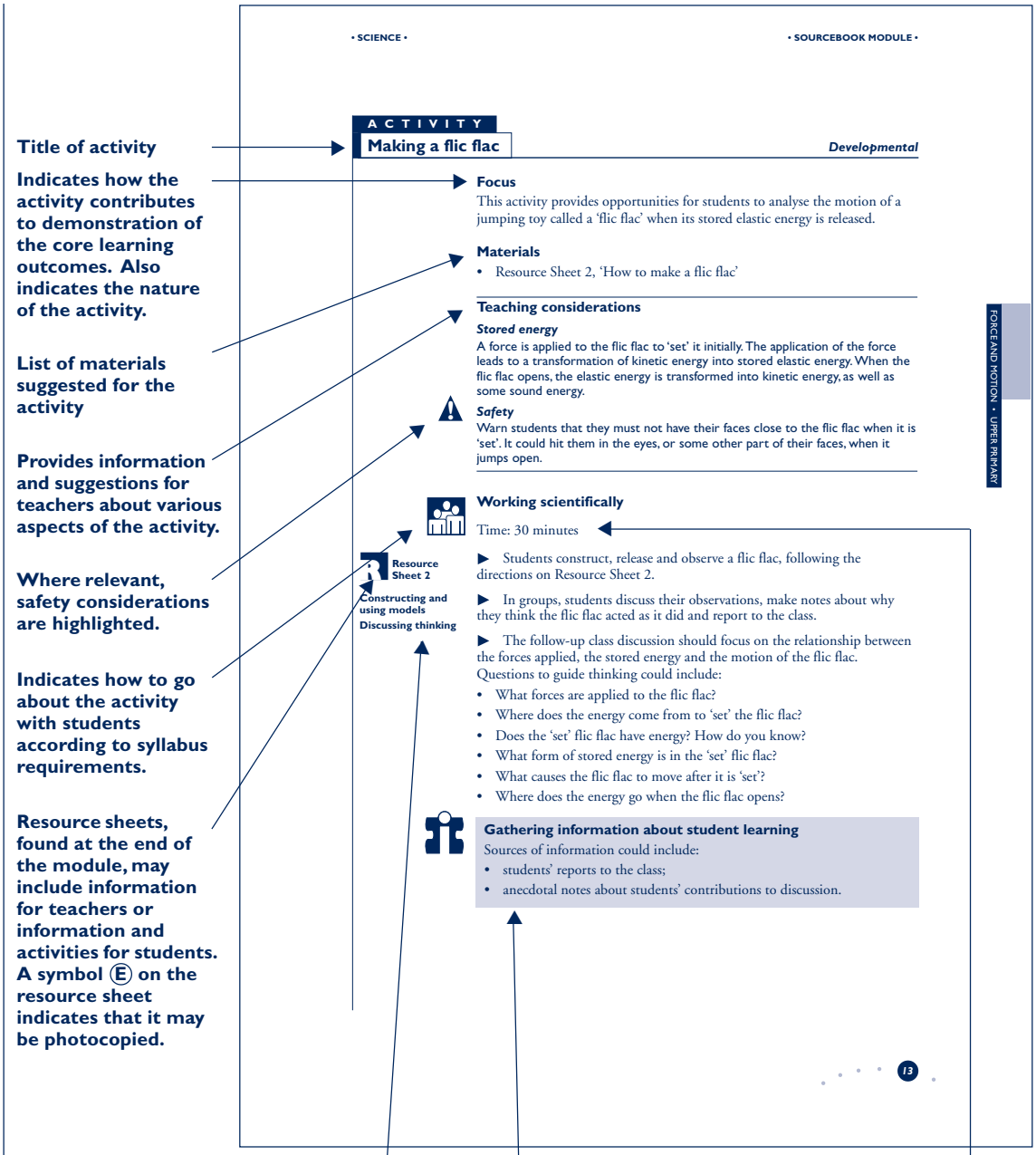

• SCIENCE •
• SOURCEBOOK MODULE •
ACTIVITY
Making a flic flac
Developmental
Focus
This activity provides opportunities for students to analyse the motion of a jumping toy called a 'flic flac' when its stored elastic energy is released.
Materials
• Resource Sheet 2, 'How to make a flic flac'
Teaching considerations
Stored energy
A force is applied to the flic flac to 'set' it initially. The application of the force leads to a transformation of kinetic energy into stored elastic energy. When the flic flac opens, the elastic energy is transformed into kinetic energy, as well as some sound energy.
Safety
Warn students that they must not have their faces close to the flic flac when it is 'set'. It could hit them in the eyes, or some other part of their faces, when it jumps open.
FORCE AND MOTION • UPPER PRIMARY
Working scientifically
Time: 30 minutes
Resource Sheet 2
Constructing and using models
Discussing thinking
▶ Students construct, release and observe a flic flac, following the directions on Resource Sheet 2.
▶ In groups, students discuss their observations, make notes about why they think the flic flac acted as it did and report to the class.
▶ The follow-up class discussion should focus on the relationship between the forces applied, the stored energy and the motion of the flic flac. Questions to guide thinking could include:
• What forces are applied to the flic flac?
• Where does the energy come from to 'set' the flic flac?
• Does the 'set' flic flac have energy? How do you know?
• What form of stored energy is in the 'set' flic flac?
• What causes the flic flac to move after it is 'set'?
• Where does the energy go when the flic flac opens?
Gathering information about student learning
Sources of information could include:
• students' reports to the class;
• anecdotal notes about students' contributions to discussion.
13
Title of activity
Indicates how the activity contributes to demonstration of the core learning outcomes. Also indicates the nature of the activity.
List of materials suggested for the activity
Provides information and suggestions for teachers about various aspects of the activity.
Where relevant, safety considerations are highlighted.
Indicates how to go about the activity with students according to syllabus requirements.
Resource sheets, found at the end of the module, may include information for teachers or information and activities for students. A symbol Ⓔ on the resource sheet indicates that it may be photocopied.
Components of 'working scientifically' that contribute to students' demonstrations of outcomes (listed in the order in which they appear in the syllabus)
Indicates the sources of information that could be used to make judgments about students' demonstrations of outcomes.
Time allocations are suggested for each of the activities in modules. Teachers may shorten or lengthen activities as necessary or divide them into smaller parts.

# Appendix 1: Examples of learning outcomes at Foundation Level

| Science and Society | Earth and Beyond | Energy and Change |
|---|---|---|
| **Key concepts**<br>*Historical and cultural factors influence the nature and direction of science which, in turn, affects the development of society.*<br>*Science as a 'way of knowing' is shaped by the ways that humans construct their understandings.*<br>*Decisions about the ways that science is applied have short- and long-term implications for the environment, communities and individuals.* | **Key concepts**<br>*The Earth, solar system and universe are dynamic systems.*<br>*Events on Earth, in the solar system and in the universe occur on different scales of time and space.*<br>*Living things use the resources of the Earth, solar system and universe to meet their needs.* | **Key concepts**<br>*The forces acting on objects influence their motion, shape, behaviour and energy.*<br>*In interactions and changes, energy is transferred and transformed but is not created or destroyed.*<br>*There are different ways of obtaining and utilising energy and these have different consequences.* |
| **Level statement**<br>*Students are developing an understanding of the ways science affects aspects of their lives. They are developing an intuitive understanding of some common natural phenomena.* | **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 are developing an understanding of the ways that things move and behave and can communicate some of these understandings.* |
| **Examples of outcomes**<br>**F.1** Students identify basic cause–effect relationships across a range of environments, e.g. because the sun has set, it is night-time.<br>Students recognise obvious weather phenomena, e.g. wind, rain, thunder, lightning.<br>Students identify changes in plants and animals (including humans), e.g. aspects of growth; ageing; life cycles.<br>**F.2** Students use their senses to identify differences between familiar objects, e.g. texture — food, fabrics, floor coverings; smells — food, flowers, body odour.<br>Students use their senses to collect information about their immediate environment, e.g. classroom, school, home, playground, shop.<br>Students participate in water-play activities to investigate, e.g. wave action in pool, pond or basin; exploring whether objects float or sink.<br>**F.3** Students recognise familiar health-care workers, e.g. physiotherapist, occupational therapist, nurse, doctor.<br>Students identify their own specialised equipment, e.g. wheelchair, glasses, communication board, hearing aid.<br>Students demonstrate healthy hygiene practices when preparing food, e.g. washing hands beforehand; cleaning preparation surfaces; cleaning utensils. | **Examples of outcomes**<br>**F.1** Students identify different aspects of a feature of the Earth, e.g. beach, garden, ocean, desert.<br>Students identify features of the sky, e.g. stars, clouds.<br>Students identify differences between the sun and the moon.<br>**F.2** Students recognise aspects of their school environment, e.g. classroom, toilet, oval.<br>Students identify aspects of their classroom, e.g. desk, table, chair, communication board.<br>Students identify different sounds, smells and sights of their immediate environment.<br>Students identify the difference between daytime and night-time.<br>**F.3** Students identify activities carried out on a beach, e.g. swimming, boating, building sand castles.<br>Students demonstrate activities appropriate to going to the shops, e.g. buying food, staying with carer, sitting appropriately in cafe.<br>Students locate places in their immediate environment according to their use, e.g. playground is for playing, lunch area for eating lunch.<br>Students identify and grow plants appropriate for a specific style of garden, e.g. vegetables, flowers. | **Examples of outcomes**<br>**F.1** Students demonstrate that pushing or pulling objects on wheels will make them move.<br>Students demonstrate that running water can make some things move.<br>Students demonstrate that blowing some things will make them move, e.g. wind, fan, mouth.<br>Students demonstrate that they can move their bodies in various ways.<br>Students show that the shape of an object may change if it is dropped or thrown.<br>**F.2** Students recognise that some objects move if pushed/pulled.<br>Students recognise that some toys need something to make them work, e.g. pushing, batteries, electricity, winding up.<br>Students recognise that light is needed at night-time to carry out various activities.<br>Students demonstrate that the more energy transformed the more movement created, e.g. pushing harder on a swing makes it go faster and higher.<br>**F.3** Students use various forms of energy to:<br>• move an object along the floor by pushing, pulling, batteries, winding up, throwing;<br>• move a boat on water by pushing, pulling, batteries, winding up, throwing;<br>• move around on playground equipment in ways such as swinging, running, walking, pushing a swing, jumping;<br>• keep warm by running, rubbing hands together, putting on a heater, lighting a fire. |

| Life and Living | Natural and Processed Materials |
|---|---|
| **Key concepts**<br>*The characteristics of an organism and its functioning are interrelated.*<br>*Evolutionary processes have given rise to a diversity of living things which can be grouped according to their characteristics.*<br>*Environments are dynamic and have living and non-living components which interact.* | **Key concepts**<br>*The properties and structure of materials are interrelated.*<br>*Patterns of interaction between materials can be identified and used to predict and control further interactions.*<br>*The uses of materials are determined by their properties, some of which can be changed.* |
| **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 are developing and can communicate an understanding that familiar materials have different properties and particular uses, and that the properties of materials may change.* |
| **Examples of outcomes**<br>**F.1** Students identify and label some living things, e.g. people, cat, dog, plants, flowers, insects.<br>Students identify the observable features of particular animals, e.g. cats have fur (that can be seen and touched), legs (that can be seen or touched); miaow (that can be heard).<br>Students identify the observable features of particular plants, e.g. rose bush — flower, petals (see, touch); perfume (smell); thorns (touch, see); leaves (touch, see); branches (touch, see).<br>Students identify features about themselves that show they are living things, e.g. they eat, grow, breathe.<br>**F.2** Students identify and label some non-living things, e.g. rock, car, road, house, sun, shirt, cup.<br>Students recognise that non-living things have particular characteristics, e.g. they do not grow, breathe, reproduce.<br>Students identify observable features that differentiate non-living things from dead animals or plants.<br>Students identify features of a non-living object (e.g. rock, car, shirt, cup) that show that it is not living.<br>**F.3** Students group various objects as living or non-living, e.g. person, cat, insect, rock, car.<br>Students communicate the observable differences between living and non-living things to show an understanding of their status.<br>Students group features of a garden according to whether they are living or non-living, e.g. trees, flowers, insects and grass are living; rocks, soil, water and garden gnomes are non-living. | **Examples of outcomes**<br>**F.1** Students group familiar materials according to an observable property, e.g. physical state (same or different, liquid or solid, wet or dry), size (same or different, big or small).<br>Students identify observable properties of a familiar material or object, e.g. they identify the taste, smell, texture and colour of a particular food.<br>Students recognise their personal belongings (e.g. bag, chair, clothing), according to observable features.<br>**F.2** Students recognise an object or material after its properties have changed, e.g. egg (raw, boiled, scrambled), writing paper (different colours, sizes, shapes), apple (red, green, tinned, dried).<br>Students observe changes that occur in materials through:<br>• dissolving, for example, sugar/salt/coffee/tablets;<br>• mixing, for example, cordial/flour in water, food colouring in playdough;<br>• burning, for example, toast, wood, marshmallows.<br>**F.3** Students can identify different familiar materials that have similar uses, e.g. you can drink from a cup, glass or mug; to keep warm you can put on a jumper or gloves, put on a heater, eat hot food and drinking warm drinks.<br>Students can identify different uses for familiar materials, e.g. paper can be used for drawing, cutting, gluing and folding; sand can be used to play with in a sandpit, in gardening and in collages.<br>Students group different familiar materials according to their use, soap, detergent and cloths are used for cleaning. |

## Appendix 2: Cooperative learning

Working effectively in teams has a number of benefits. It helps people to:

- appreciate others' views;
- develop cooperative skills;
- grow in self-confidence;
- take responsibility for actions;
- learn more effectively;
- develop trust;
- manage conflict.

When learning to work in teams, students need to be assigned to a team by the teacher and remain in that team for at least a couple of activities to allow successful partnerships to develop. Over a longer period of time it is important to vary the composition of teams to allow students to experience the full range of personal diversity within the whole work group/class. Ideally, teams should have no more than three members. This allows each member to contribute significantly to completing the team's task. It also provides members with greater opportunities to communicate effectively. The team task must also be appropriate to the developmental level of the students.

Each team member is responsible for the effective operation of the team. Team members should share leadership responsibilities. All members should be able to explain the results of their work. Rotating duties within the team helps each person develop different skills and abilities.

Team jobs can be:

- **manager** — responsible for collecting and returning equipment;
- **speaker** — seeks information from, and provides information to, other groups and the teacher when required, and shares any information obtained with all team members;
- **director** — makes sure the group understands the task and how to complete it; helps the team focus on each step to be completed; offers encouragement and support.

All team members are responsible for clearing up after an activity and getting equipment ready to be returned. The teacher can speak to all team members, not just the speaker.

Team skills students should develop include:

- moving quietly and quickly into groups;
- speaking softly and staying with the team;
- taking turns doing jobs.

Source: Adapted from Australian Academy of Science 1994, *Primary Investigations: Teacher Resource Book 6 — Energy and Investigation*, Canberra, pp. xvii–xx.

## Appendix 3: Open investigations

Ⓔ

### Science investigations: Planning and reporting worksheets, model 1

Name: _____ Class: _____

Other members of group

_____

_____

I am going to investigate

_____

_____

_____

What I think will happen

_____

_____

_____

_____

Why I think it will happen

_____

_____

_____

_____

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

What I am going to do

_____

_____

_____

_____

What I will need

_____

_____

_____

_____

How I will make it a fair test

_____

_____

_____

_____

What happened

_____

_____

_____

_____

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Was this what was expected?

Why it happened

What was difficult

How I could improve this investigation

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

### Science investigations: Planning and reporting worksheets, model 2

Name: _____ Class: _____

Other members of group

_____

_____

What are you going to investigate?

_____

_____

_____

What do you think will happen? Explain why.

_____

_____

_____

_____

_____

Which variables are you going to:
- change?

_____

_____

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

- measure?

_____

_____

- keep the same?

_____

_____

How will you make it a fair test?

_____

_____

_____

What equipment will you need?

_____

_____

_____

_____

What happened? Describe your observations and record your results.

_____

_____

_____

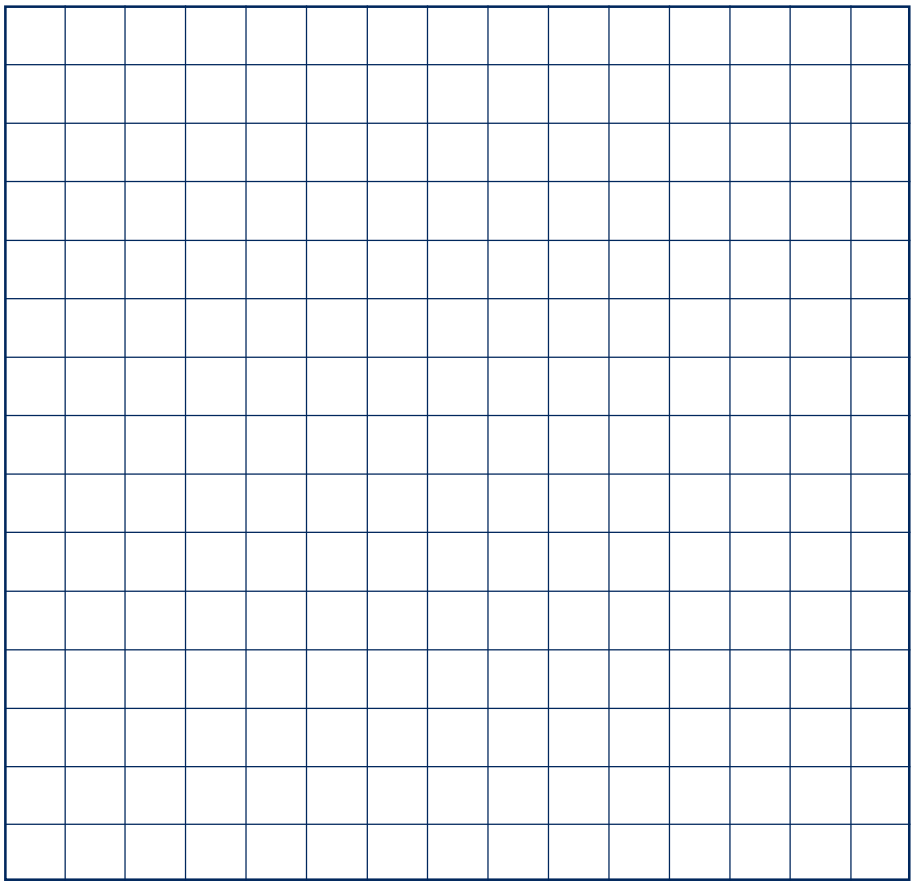
_____

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

Can your results be presented as a graph?



What do your results tell you? Are there any relationships, patterns or trends?

_____

_____

_____

Can you explain the relationships, patterns or trends in your results? Try to use some science ideas to help explain what happened.

_____

_____

_____

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

What did you find out about the problem you investigated? Was the outcome different from your prediction? Explain.

What difficulties did you experience in doing this investigation?

How could you improve this investigation (for example, fairness, accuracy)?

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

### Science investigations: Planning and reporting worksheets, model 3

Name: _____ Class: _____

Other members of group

_____

_____

**Phase one: Planning**

What is the problem you are investigating?

_____

_____

_____

What do you know about this topic from personal experience and from science?

_____

_____

_____

_____

What variables may affect the phenomenon you are investigating?

_____

_____

_____

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

Which of the variables are you going to investigate as your independent variable? (This is the variable you will change to see what effect it has on the dependent variable.)

_____

_____

How will the independent variable be changed in the investigation?

_____

_____

_____

Name the dependent variable.
(This is the variable that responds to changes in the independent variable.)

_____

_____

_____

How will you measure the dependent variable?

_____

_____

_____

What question are you investigating?

_____

_____

_____

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

OR

What hypothesis are you testing? State your hypothesis as a relationship between the independent and dependent variables.

_____

_____

_____

Predict what you think will happen. Explain why.

_____

_____

_____

_____

_____

What variables are to be controlled (kept constant) to make it a fair test?

_____

_____

_____

Describe your experimental set-up using a labelled diagram and explain how you will collect your data.

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

Are there any special safety precautions?

_____

_____

_____

_____

_____

**Phase two: Experimenting**

Carry out some preliminary trials. Describe any problems that arose.

_____

_____

_____

_____

_____

_____

How did you modify your experiment to fix the problems?

_____

_____

_____

_____

_____

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Collect and record the data you need to test your hypothesis. Draw your data table below:

Title of table:

_____

_____

How did you make sure your data were accurate?

_____

_____

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

**Phase three: Data analysis**

What is the best way to present your data? Is it appropriate to draw a graph? If so, what type of graph is most suitable?

_____

_____

Use the grid below to draw your graph.

Remember to plot the independent variable on the horizontal axis. Remember that the title of the graph should mention both the independent and dependent variables.

Title: _____

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Analyse your data. Are there any patterns or trends in your data? What is the relationship between the variables you have investigated? Is the hypothesis supported by the data?

Using science concepts, explain the patterns, trends or relationships you have identified in your data. What is your conclusion?

**Phase four: Evaluation**

What were the main sources of experimental error?

(For example: sample size and selection, measurement error, poor control of variables.)

Adapted from material published by the Education Department of Western Australia.

## Appendix 3 (cont.)

Ⓔ

How confident are you of your conclusions? How much uncertainty or error is associated with your data?

How could the design of the experiment be improved to reduce error?

What have you learned about the topic of your investigation? Was the outcome different from your prediction? Explain.

What have you learned about the methods of investigating in science?

Adapted from material published by the Education Department of Western Australia.

## Appendix 4: Students with disabilities and learning difficulties

Nine documents relating to students with disabilities and learning difficulties are included on the Queensland School Curriculum Council web site. These documents provide very general, introductory information on students with:

- intellectual impairment;
- hearing impairment;
- vision impairment;
- physical impairment;
- autistic spectrum disorder;
- speech-language impairment;
- social emotional disorder;
- multiple impairment;
- learning difficulties.

The information in these documents is organised around headings such as:

- description;
- terminology;
- population;
- disability-specific needs;
- teaching strategies;
- classroom modifications and strategies;
- safety and independence.

There is also a section that provides information on further references, resources and relevant contacts.

Specific information on individual students may be accessible through support services and structures available at a local level.

## Appendix 5: Contributors and trial schools

The valuable contributions of the following individuals, organisations and schools are gratefully acknowledged.

### Office of the Queensland School Curriculum Council

| | |
|---|---|
| Jim Tunstall | Director |
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| Mark Snartt | Principal Project Officer, Years 1–10 Science Curriculum Development Project |

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## Appendix 5 (cont.)

| | |
|---|---|
| Paul Parkinson | Science Teachers' Association of Queensland |
| Rosalie Raciti | Ministerial Advisory Council on Aboriginal and Torres Strait Islander Education |
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### Trial schools

The valuable contribution of staff and students of the following trial schools is gratefully acknowledged:

All Saints' Primary School, Boonah
All Saints Primary School, Albany Creek
Bellevue Park State School, Southport
Boondall State School
Bribie Island State School
Brisbane Adventist College
Burnside State High School, Nambour
Burnside State School, Nambour
Calvary and Logan Uniting Christian College, Springwood
Cannon Hill Anglican College
Charters Towers State High School
Coalstoun Lakes State School
Cordalba State School
Corinda State High School
Corpus Christi College, Nundah

Darling Heights State School, Toowoomba
Drayton State School, Toowoomba
East Brisbane State School
Ferny Hills State School
Fraser Coast Anglican College, Hervey Bay
Gayndah State High School
Gayndah State School
Good News Lutheran Primary School, Middle Park
Good Shepherd Lutheran College, Noosaville
Harristown State High School, Toowoomba
Holy Name Primary School, Toowoomba
Kenilworth State School
Keppel Sands State School (Cluster)
Kilcummin State School
Kimberley Park State School, Shailer Park
Kowanyama State School
Mareeba State High School
Marsden State High School, Waterford West
Middlemount State High School
Morayfield West (Minimbah) State School
Mundoo State School, Wangan
Mundubbera State School
Northern Beaches State High School, Townsville
Peak Crossing State School
Petrie Terrace State School, Paddington
Ramsay State School, Cambooya
Redbank Plains State High School
Rollingstone State School
Sacred Heart Primary School, Toowoomba
Sandgate District State High School, Deagon
The Scots PGC College, Warwick
Springsure State School
Springwood State High School
St Aidan's Anglican Girls' School, Corinda
St Francis' College, Marsden
St Hilda's School, Southport
St Joseph's School, Rockhampton
St Joseph's School, Gayndah
St Luke's Anglican School, Bundaberg
St Mary's School, Rockhampton North
St Monica's College, Cairns
St Patrick's Primary School, Bundaberg
The Willows State School, Townsville
Toogoolawah State School
Woodridge State School