Science education aims to capture and expand that childlike sense of wonder, to develop interested, informed and questioning adults.
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Science and science education

Scientific knowledge and progress

Science systematically questions, investigates, predicts and explains events in the universe. It uses logical processes, based on observation, experimentation and modelling, to gather evidence and develop explanations. These explanations are rigorously peer reviewed, resulting in scientific knowledge - an accepted, robust and soundly established body of processes, principles and facts.

Scientific knowledge is a continually and rapidly expanding set of explanations developed by communities of scientists to account for observed phenomena. Scientists assume that the universe is knowable - that it operates in ways they can discover and understand – and they set out to collect and evaluate evidence in order to discover patterns that exist.

Humans are curious about the universe and the phenomena that they encounter within it. They continually look for reasons why things are so and seek rational explanations about how things work or why they happen. In our everyday lives, people engage with aspects of the scientific process as they search for solutions to problems and seek to expand their understanding of the world.

While some scientific knowledge has built up slowly over time, some has been the result of new discoveries that lead to dramatic change in understanding. Current scientific knowledge has its origins in many different cultures and periods of history. It can never be truly value free and is influenced by factors that include societal priorities, culture, ethics, economics and politics.

Scientific progress is the result of both logical, systematic work and creative insight, guided by a respect for evidence. Serendipity, creative leaps of the imagination, inspired hunches and guesses all play a part in advancing scientific understanding. There are significant benefits, but also issues and ethical challenges associated with scientific progress and developments, and these can impact, both positively and negatively, on people, and on the natural world.

Scientific literacy

The development of scientific literacy in all students is the major goal of science education. Scientifically literate citizens can make informed and ethical decisions about the role of science and technology in shaping their lives, the priorities and directions of their society and the future of the world. Scientifically literate people understand and are interested in the world around them and contribute to informed debate on issues such as genetic engineering, energy use and production, nutrition and sustainability.

Through studying science, students learn to think rationally and logically and articulate their ideas. They learn to appreciate the need to think in terms of systems, and understand interdependencies and consequences of actions. As their scientific literacy develops, students come to think deeply and critically about claims that are made and their implications. They engage in discussions about issues that involve scientific understanding, develop a healthy intellectual scepticism and learn to appreciate that a variety of perspectives can exist on any given issue or event.
Learning through the study of science

Studying science stimulates students' natural curiosity and sense of wonder about their world, as they participate in experiences that enable them to explore, predict, clarify their ideas, ask questions, test explanations and conduct their own research. They come to appreciate the complexities of the world as they compare their current ideas and beliefs with those of scientists, and construct new understanding based on scientific thinking. They learn that scientists work in many different ways, including experimental, ecological studies, computer modelling and simulations, thought experiments (such as the work of Einstein) and epidemiological studies (e.g. Menzies Centre research).

Participating in science develops openness to new ideas, intellectual honesty and skills in critically evaluating data and preparing persuasive arguments. As students conduct scientific inquiries, they learn to question, problem solve, draw logical, evidence based conclusions, articulate ideas and work in ways that are ethical, fair and respectful. They work individually and in teams, engaging in critical and creative thinking to solve problems and clarify ideas.

Students learn to appreciate that scientific knowledge continues to grow, that they can be participants in its advancement, and that they are bound by its codes and practices – honesty, ethics, rigour and openness to review by others. Studying science teaches students the importance of precision, rigour and a regard for evidence but also shows them the importance of creative and inspired thinking.

Studying science enables students to understand its cultural significance and trace its worldwide development. They encounter the personalities, heroes, villains and characters of science, coming to appreciate that men and women from diverse cultures and times, including contemporary Australia, have contributed to current scientific understanding.

There are many opportunities and a need for students to use literacy, numeracy, thinking and ICT skills in science activities. Teachers have reported that some students, particularly boys, can show greater development of literacy skills when they are using them in the context of science.

Science and technology

Science and technology are strongly connected - much scientific knowledge is driven and made possible by technological advances and an understanding of science contributes to technological advancement.

Scientific research is not necessarily directly concerned with practical outcomes but applications of science often help to shape the world. They have transformed human existence through technological advances in diverse areas, such as health and medicine, communication technologies and food production and transport.

Studying science leads students to understand that while science values understanding the natural world for its own sake, scientists actively pursue solutions to identified problems, and technological applications of scientific knowledge can directly impact on humans, the environment and the universe.
Values, purposes and goals of the Tasmanian Curriculum

Extensive community consultation in Tasmania has led to a set of values, purposes and goals that provide a firm foundation for providing students with a quality education. How schools enact these values, purposes and goals is guided by dialogue between a school and its community. They are seen in the school’s curriculum programs, philosophy, classrooms and relationships. Science programs provide a strong basis for developing the values, purposes and goals of the Tasmanian Curriculum.

Values

Our values guide decisions about curriculum and support students, teachers, parents, carers and the community. The values are:

- connectedness – developing a sense of community through friendship, care, compassion, cooperation, acceptance, belonging and sharing
- resilience – developing self-confidence and self-respect, optimism, perseverance and wellbeing
- achievement – attaining success, pursuing excellence and being proud of personal achievement
- creativity – valuing original ideas and demonstrating enterprise and innovation
- integrity – acting honestly, ethically and consistently
- responsibility – accepting individual and collective responsibility and contributing to sustainable community development
- equity – developing tolerance, respecting difference and encouraging distinctiveness.

Purposes

Our shared purpose is that all Tasmanian students are learning to:

- learn
- live full, healthy lives
- relate, participate and care
- act ethically
- create purposeful futures
- think, know and understand.

Goals

The important goals we hold for students are ensuring that they:

- are able to reason, question, make decisions and solve complex problems
- are able to create, communicate and convey ideas clearly and confidently
- have a positive vision for themselves and their future
- are well prepared to participate actively in our democratic community and as global citizens
- can understand science and technology and make thoughtful decisions about their application.

Lifelong learning and the Science curriculum area

The Tasmanian Curriculum is designed to help students become lifelong learners. Lifelong learners are inquiring and reflective thinkers, effective communicators, self-directed and ethical people, responsible citizens and world contributors.

The Kindergarten to Year 10 Science curriculum area provides many opportunities for students to develop those attributes.
National Statements of Learning for Science

The national Statements of Learning for Science identify the elements that are common in all state and territory curriculum documents as well as what is essential for all students to learn. The core content strands, learning opportunities, standards and stages in the Tasmanian Science syllabus incorporate directly, or reflect, the Statements of Learning for Science. As the statements of learning are embedded in this syllabus, teachers using it will be covering the requirements for national consistency in curriculum outcomes.

The Statements of Learning for Science document can be accessed at:

Studying Science in Years 11 and 12

The Science curriculum prepares students for further study in science in the senior secondary years. Grade ten students who wish to study Senior Secondary 5C (or equivalent) science subjects during Year 11 benefit greatly from having undertaken extension science subjects concurrently with achieving stage fifteen during the K–10 years.

Students who achieve the upper stages of standard five should be capable of successful study of Physical Sciences Senior Secondary 5C, Biology Senior Secondary 5C, Environmental Science Senior Secondary 5C or Science of Natural Resources Senior Secondary 5C (or their equivalents) during Year 11 or 12.

Science Performance criteria

The Science performance criteria are identical to the strand names. The performance criteria are the core assessable aspects of learning. The tables in the body of this syllabus document describe the performance criteria across fifteen stages. Science as a body of knowledge is considered by its substrands. The four Science performance criteria are:

1. Science as a human endeavour
2. Scientific inquiry
3. Scientific communication
4. Science as a body of knowledge.

The Science curriculum document includes examples of activities that might be used at each standard to develop understanding around each performance criterion. These activities are organised by main idea, but teachers should bear in mind that the intent is that learning should be integrated across strands.

Cross-curricular perspectives

Information and communication technologies (ICT) in Science

In science, students use ICT to acquire, evaluate, record, manipulate, integrate and communicate data and information. They collect this data and information during their own investigations or inquiries and also access them in scientific or other texts. ICT assists students to collaborate and communicate in local and global scientific communities.
Students learn about and use ICT in science to develop their skills of problem solving, communicating and reasoning. They identify data and information needs and use ICT to locate and access data and information. They use the power of ICT to organise, manipulate and transform data and information, and develop their own interpretations and understandings. They examine and evaluate their findings and hypotheses and their original data and information for validity, accuracy, authenticity and bias. They create and communicate their findings and understandings using ICT.

A number of examples of using ICT are included in the sample learning activities in the different science strands. Many of the uses of ICT described at standard level in the English-literacy and Mathematics-numeracy documents apply equally in the context of Science.

**Thinking and scientific inquiry in the Science curriculum**

Scientific inquiry is an integral part of the Science curriculum. It encourages students to pose questions, plan and conduct investigations, collect and analyse evidence and communicate their findings. It is also concerned with evaluating investigations and claims and drawing valid conclusions. Scientific inquiry recognises that scientific explanations can change as new or different evidence becomes available.

Whilst fair testing and controlled experiments are emphasised in many scientific inquiries, students should also experience other forms of individual and collaborative investigation such as field work, the use of models and simulations, examination of second-hand data or information research.

**Literacy in the Science curriculum**

Study and participation in science provides students with many opportunities to develop their literacy skills. Students learn and apply appropriate language conventions and use science specific concepts and language to think, communicate, and participate. Students use literacy in Science to develop their personal identity, express themselves, learn to interact with others and examine relationships and issues through language. It is important that teachers use varied text forms, role-play, scenarios, inquiry and reflection to provide students with many opportunities to understand science.

Teachers can use science experiences to explicitly assist students’ literacy development, for example, by:

- assisting them to make meaning from the text forms they encounter e.g. scientific reports, documentaries, newspaper articles
- modelling how to construct different text forms e.g. formal science report, Microsoft PowerPoint®, flow chart, column graph
- discussing the uses and purposes of different text forms and the advantages and disadvantages of using particular text forms for science
- assisting students to reflect on the effectiveness of their selected communication methods.

**Numeracy in the Science curriculum**

Study and participation in Science provides students with many focused opportunities to develop numeracy skills. As students learn to think, communicate and participate in science, they are developing numeracy understanding, knowledge and skills. This helps them to become confident problems solvers, critical thinkers, effective communicators, lifelong learners and active participants in Australian society. Students use numeracy in science to measure, calculate, graph, model, create and interpret data including statistics, problem solve and make inferences in relation to the systems that operate in the natural and constructed world, including changes in the environment, and the long term future of the planet.
Science strands

The content, processes, skills and concepts of the Science curriculum are organised into four strands, Science as a human endeavour, Scientific inquiry, Scientific communication and Science as a body of knowledge. These are described below. The Science as a body of knowledge strand is divided to four substrands. The strands (and substrands) are interrelated and contain significant areas of overlap. It is not intended that they be taught separately.

In the body of the document, each strand and substrand is considered through two or three main ideas, which represent important scientific understandings and processes. It is not intended that each of these main ideas be addressed separately.

1. Science as a human endeavour

This strand recognises that science is a human endeavour with a distinctive worldview that values evidence and logical argument, and that past, present and future scientific research has implications for society and the environment. It highlights the need for decision making based on scientific evidence, ethical considerations and being able to see system consequences, including for sustainability.

It focuses on the ways science influences society through its way of thinking and worldview as well as the way societal challenges or social priorities influence the development of scientific research. It acknowledges that science has advanced through the work of different people from different cultures over time and explores how scientists think and work in different contexts.

2. Scientific inquiry

This strand focuses on the way in which scientists investigate and explain the world. Students use scientific inquiry processes to make observations, wonder why, pose questions, predict, plan and conduct investigations, collect and analyse evidence, evaluate, draw valid conclusions and communicate their findings. They participate in investigations which include fair testing, controlled experiments, fieldwork, models and simulations, and examine existing data and information. They learn to incorporate creativity, insight, imagination and hunches into their work in a balanced way.

Students reflect on their investigations by questioning and evaluating data, drawing conclusions, identifying problems that occurred and avenues for further research, and considering the implications of
their findings. They recognise that scientific explanations may be revised as new or different evidence is collected from investigations.

The investigations that students participate in are informed by, and explore the concepts outlined in, the *Science as a body of knowledge* strand.

3. **Scientific communication**

This strand recognises that students must acquire, critically examine and communicate scientific information, and use ICT appropriately. Students use a variety of methods to collect, manage, evaluate and present information, with consideration of their purposes and audience. They understand that scientific texts are constructed from particular viewpoints and for particular purposes.

Students collect and comprehend information from written, spoken and visual texts (including electronic texts) and their own hands-on investigations. They manipulate information into forms such as tables, charts, diagrams, drawings, graphs and other graphic organisers, using ICT where appropriate. They record and present their research effectively and appropriately, in forms such as experimental log books, field notes, scientific reports, posters, technical reports, magazine articles, letters, Microsoft PowerPoint® presentations, videos and debates – again, making appropriate use of ICT.

Students understand and use scientific terminology, symbols and conventions. They learn the convention of writing formal science reports in the passive voice and past tense, but recognise that this is not always the most appropriate format in which to present their scientific information.

4. **Science as a body of knowledge**

In this strand, students engage with the established body of scientific knowledge, developing their understanding of accepted core scientific processes, principles, concepts, explanations and theories drawn from across the disciplines of science. They research and refer to relevant concepts when planning, conducting and evaluating scientific investigations.

There are four knowledge substrands: Energy and force, Matter, Living things and Earth and space. It is envisaged that, in practice, many learning opportunities will be integrated across these substrands and embedded in meaningful and relevant contexts for learners. This mimics the way that real scientific research incorporates cross-discipline perspectives and input.

**Energy and force**

Students explore the effects of forces in the world. They consider a variety of energy transfers and transformations as well as the consequences of human use of energy resources.

**Matter**

Students explore the structure and properties of a variety of materials, together with the way in which those materials may change and interact. They consider how and why humans use particular materials and any consequences of this use.

**Living things**

Students consider the structure, functioning and diversity of life on Earth. They look at the interdependencies that exist and the impact and consequences of human activity on those relationships.

**Earth and space**

Students explore the features of the Earth and space and the various changes that occur there. They identify how living things, including humans, rely on resources from the Earth and space, and consider the impact and consequences of this use.
Teaching for learning

High quality teaching has a significant impact on student learning and achievement. The refined *Learning, teaching and assessment principles* provide guidance for teaching and assessment approaches that place the student firmly at the centre of the educational process.

Effective teachers:

- deeply understand the content and assessment requirements of the relevant curriculum areas
- build engaging, safe and challenging learning environments
- understand the needs of learners and know how learning best occurs
- teach for understanding and make connections across curriculum areas and to life
- have high expectations of student achievement
- express clear values and purposes for education and learning
- design motivating and rewarding learning experiences
- build independent learners
- explicitly focus on thinking skills including inquiry
- innovate in their classroom
- collaborate with their peers
- critically reflect on their own practice
- explicitly teach literacy and numeracy skills
- use a broad range of inclusive teaching strategies
- make learning relevant and personal for students
- teach and learn beyond the classroom and school
- use ICT in their teaching, assessment and professional learning
- build effective partnerships with parents and the school community
- use assessment to improve student learning
- use networks for learning, teaching and assessing
- demonstrate a personal commitment to ongoing professional learning.

Learning and teaching are at the heart of the curriculum. They are most rewarding when the key focus is on the student acquiring the understanding, skills and attributes needed to achieve their individual potential and on them establishing a commitment to lifelong learning and develop fulfilling career and life pathways.
## Learning, teaching and assessment principles

The learning, teaching and assessment principles detail key beliefs about the role of teaching and assessment in the Tasmanian Curriculum.

<table>
<thead>
<tr>
<th>Learning</th>
<th>Teaching</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>...makes meaning of the world</td>
<td>...helps students understand by acquiring knowledge and skills</td>
<td>...focuses on students demonstrating understanding in a range of curriculum areas</td>
</tr>
<tr>
<td>...is innate and lifelong</td>
<td>...is based on high expectations and enjoyment of learning</td>
<td>...improves learning and achievement</td>
</tr>
<tr>
<td>...is a personal process</td>
<td>...recognises individual differences, is inclusive and based on a broad range of teaching strategies</td>
<td>...enables students to self-assess and negotiate criteria and assessment tasks</td>
</tr>
<tr>
<td>...connects prior knowledge and experiences to new information and learning</td>
<td>...determines what students know and connects to students’ lives and futures</td>
<td>...information is based on valid processes and used to plan effective instruction</td>
</tr>
<tr>
<td>...is influenced by social interactions</td>
<td>...builds effective relationships between all those involved in the educational process</td>
<td>...is fair and inclusive of judgements from students, peers, teachers, parents, carers and others</td>
</tr>
<tr>
<td>...is affected by emotions</td>
<td>...provides a safe and challenging learning environment</td>
<td>...helps develop the wellbeing of all partners in the learning and teaching process</td>
</tr>
<tr>
<td>...is influenced by personal identity and motivation</td>
<td>...builds high expectations and confidence in students</td>
<td>...provides timely, accurate and constructive feedback to students</td>
</tr>
<tr>
<td>...depends on meaningful information and experiences</td>
<td>...involves students in setting goals and connecting what is taught to life and further learning</td>
<td>...enables students to be clear about what is being assessed and how this connects to life and further learning</td>
</tr>
<tr>
<td>...is improved when students are aware of how thinking and learning occur</td>
<td>...focuses on thinking skills in all curriculum areas</td>
<td>...encourages students to reflect on their learning including thinking skills</td>
</tr>
<tr>
<td>...enables students to demonstrate their understanding in new ways</td>
<td>...enables students to apply their learning in new ways</td>
<td>...tests students’ ability to apply their learning in new ways</td>
</tr>
</tbody>
</table>
Assessment principles and practice

The main purpose of assessment is to improve student learning. Assessment is an ongoing process of gathering and using evidence of student achievement.

Effective assessment enables:

- students to better understand their progress towards goals and become more knowledgeable and self-directed in their learning
- teachers to make more informed judgements about student progress and design more effective teaching programs
- parents and carers to better understand and support students’ learning and achievement.

Effective assessment emphasises:

- assessment for learning – teachers using evidence of student progress to inform their teaching
- assessment as learning – students reflecting on and evaluating their progress to inform future learning goals
- assessment of learning – teachers using evidence of student learning to make individual and collective judgements on student achievement against specific curriculum goals and standards.

Assessing Science

The Science curriculum provides teachers with a broad range of opportunities for students to show what they know and can do. This enables students to contribute diverse and valid evidence of their learning.

Effective assessment methods include:

- informal assessment – students and teachers making representative judgements about what they have learned on a regular basis
- formal assessment tasks – students demonstrating achievement against explicit criteria that are known prior to undertaking a learning task
- observations or anecdotal records – teachers taking informal notes while working with students
- checklists – teachers developing a snapshot of student knowledge, skills and understanding
- portfolios – students building up carefully selected collections of their work over time
- journals – students documenting their ongoing reflections about their thinking and understanding
- use of ICT to help make assessing and reporting efficient.

On-balance judgement

Teachers appraise evidence of student performances on different aspects of the Science curriculum area. Evidence of student progress is recorded across the four strands. The strands are interrelated and learning opportunities involve learning in more than one strand. Teachers should ensure that learning opportunities are provided in all four strands. A final decision about student achievement is made using an on-balance judgement. An accurate on-balance judgement considers:

- the consistency of student performance over a period of time
- clear indications of progress from first attempts to current performance
- demonstration of knowledge, processes and skills in different contexts
- the validity of the assessment task in relation to the intended outcomes
- whether there is evidence of achievement to assign a standard and stage
- relative performance on similar tasks by peers
- teacher reflection and collaboration to increase consistency and validity of judgement.
Opportunities to learn and year levels

Stages for opportunities to learn and assessment ratings

The Tasmanian Curriculum explains the scope and sequence of learning opportunities for students as they progress from Kindergarten to Year 10.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Standard 1</th>
<th>Standard 2</th>
<th>Standard 3</th>
<th>Standard 4</th>
<th>Standard 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

So that students are challenged to improve their learning, they should be provided with opportunities to learn that are in advance of their expected assessment ratings. Teachers should plan learning opportunities across a range of stages for any year group. Students can take up to a year to consolidate ideas and to demonstrate understanding following the teaching of new concepts. More able students will understand ideas quickly and for others it will take up to two years to reach the same level of understanding.

The table below provides some guidance about the range of learning opportunities required within each year group. Very few students in each year group across the state will require opportunities to learn that fall outside the range described below.

Stages for opportunities to learn

<table>
<thead>
<tr>
<th>Year level</th>
<th>Kinder–Prep</th>
<th>Years 1 and 2</th>
<th>Years 3 and 4</th>
<th>Years 5 and 6</th>
<th>Years 7 and 8</th>
<th>Years 9 and 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunities to learn</td>
<td>Stages 1 – 4</td>
<td>Stages 3 – 6</td>
<td>Stages 5 – 9</td>
<td>Stages 7 – 11</td>
<td>Stages 9 – 13</td>
<td>Stages 11 – 15</td>
</tr>
</tbody>
</table>

A summary set of assessment indicators is provided with this syllabus. Students do not have to be capable of achieving everything listed within a particular stage to be rated at that stage. The indicators of achievement are not a set of assessment criteria to be ticked off. They are indicators of the stage of understanding and an on-balance judgement should be made about whether a student’s performance is of similar difficulty to those listed. In effect, if students are deemed to be capable of achieving everything listed in a particular stage, it is most likely that they can also achieve a number of things from the next stage and may be better judged as working well within that stage. To accommodate the need for more levels for teachers to describe progress there will be two divisions within each stage – ‘proficient’ and ‘advanced’. There will be no additional support materials written to define these levels. It would be teacher judgement supported by moderation that would define the ‘proficient’ and ‘advanced’ levels within each stage. See the Assessment evidence guide for further assessment information.

It is expected that, given the opportunities to learn, as outlined in the previous table, the spread of assessment ratings would be as described in the table below. Very few students in the year groups would be expected to be assessed outside this range by the end of the year.

Stages for assessment ratings

<table>
<thead>
<tr>
<th>Year level</th>
<th>Kinder–Prep</th>
<th>Years 1 and 2</th>
<th>Years 3 and 4</th>
<th>Years 5 and 6</th>
<th>Years 7 and 8</th>
<th>Years 9 and 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment ratings</td>
<td>Stages 1 – 3</td>
<td>Stages 2 – 5</td>
<td>Stages 4 – 8</td>
<td>Stages 6 – 10</td>
<td>Stages 8 – 12</td>
<td>Stages 10 – 15</td>
</tr>
</tbody>
</table>
Developing a school Science scope and sequence

Schools are best placed to make decisions about the learning needs of their students. The Science curriculum should be implemented in ways that provide all students with engaging, challenging and personalised opportunities to learn, and which make effective use of the available resources.

It is important that schools map out the science learning that will occur at each year level to ensure coverage of the curriculum and avoid repetition of learning contexts. Whilst it may be useful to revisit an idea, such as dinosaurs, that students are familiar with or enthusiastic about, new concepts should be introduced on each subsequent occasion, for example, change, species diversity and extinction.

A balanced scope and sequence in science should cover all the strands. A scope and sequence is a curriculum plan that describes teaching content and the order in which it is taught. When planning or mapping curriculum in Science consideration should be given to integrated learning sequences which will allow for coverage of all four strands. Planning or mapping curriculum in this way assists schools and teachers to:

- help students to progress their knowledge, skills and understanding against all the performance criteria
- enable students, parents and others access to the curriculum
- create yearly plans for grades / classes
- build conceptual understanding across grades / classes
- ensure coverage of all strands
- avoid repetition of content and make learning contextual and personalised
- effectively organise time, resources and facilities.

Organisation of the Science curriculum document

The following sections of the Science curriculum document are organised by standards. For each standard the document includes:

- an overview of the standard by performance criteria
- tables showing learning opportunities at three stages for each performance criterion (with Science as a body of knowledge considered by the knowledge substrands). The tables are organised by main ideas, which carry though from stage 1 to stage 15
- possible learning contexts, which are ideas that learning sequences / units of work might be developed around (* denotes learning sequences that can be downloaded from the LTAG, # denotes a Primary Connections unit)
- sample learning activities that suggest ways in which the content might be taught – these are not prescribed activities.

The curriculum document includes a glossary of terms and list of resources to support the science teaching and learning program. The lists have been compiled in consultation with Tasmanian teachers.

The Assessment evidence guide section of the document features information to assist teachers in making assessment judgements.
# Science curriculum – layout and terminology

## Standards/Performance criteria

**Organise the content, processes, skills and concepts of Science**

## Main ideas

**Identify important science understandings and processes that run through all stages**

## Performance criteria descriptors by stages

**Identify the typical achievement expected at each stage**

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### Standard three – scientific inquiry

**Students should be provided with learning opportunities that develop their ability to:**

<table>
<thead>
<tr>
<th>Main idea</th>
<th>Stage seven</th>
<th>Stage eight</th>
<th>Stage nine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific inquiries are generated from observations, questions and predictions</td>
<td>• ask questions and make predictions, with some scientific basis, related to their everyday experience</td>
<td>• create, from their interests or experience, appropriate questions and predictions for testing</td>
<td>• pose questions that can be investigated scientifically, and explain the basis of their predictions about the outcome</td>
</tr>
<tr>
<td>Scientists plan and conduct investigations in particular ways</td>
<td>• understand that science investigations need to be fair, and, with scaffolding, (e.g. an investigation planner) work in small groups to plan and conduct simple fair investigations, that involve changing one variable and keeping everything else the same</td>
<td>• contribute to planning a variety of investigations, recognising where comparisons might be fair or unfair</td>
<td>• identify potential sources of fairness and bias in investigations as they plan and conduct them, suggesting alternative methodologies which may improve or add to an investigation</td>
</tr>
<tr>
<td>Scientists draw conclusions after considering various interpretations of their data</td>
<td>• identify sources of fairness and unfairness</td>
<td>• present data in appropriate ways and then identify patterns. Discuss and compare results with predictions and draw conclusions</td>
<td>• draw reasonable conclusions that are suggested by their data, and consider any obvious implications of their research findings</td>
</tr>
<tr>
<td>• rearrange data to allow easier identification of patterns, so that conclusions can be drawn</td>
<td>• communicate their ideas and understandings and suggest improvements to the investigation</td>
<td></td>
<td></td>
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</tbody>
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### Possible learning contexts

**Contexts** should be drawn from Science as a body of knowledge.

**Sample learning opportunities**

**Energy and force**

- working in small groups to develop a scientifically testable question for investigating the longevity of a range of battery types
- rubbing different materials (e.g. different plastics, wood, glass, metal) with different types of fabric (e.g. silk, wool, cotton) to determine which one creates the most static electricity (e.g. which picks up small pieces of paper most easily) and consider how the test can be made fair
- carrying out a variety of investigations that involve selecting suitable tools e.g. ruler to measure ramp height, measuring tape to measure how far a toy car rolls, video camera to record speed, protractor to measure the angle of a ramp
- designing an investigation into ways to improve the efficiency of a simple machine e.g. the effect of using a longer lever, moving the fulcrum, changing the size of the wheels
- identifying the relationship between the number of gear teeth and the relative motion of gears in a simple gear chain, also the relationship between direction of rotation of gears
Science
Standard one
Standard one science overview

Students working within this standard are often filled with the wonder of the world around them. They display a natural curiosity and are keen to explore, question, investigate, experiment and play with materials and objects in their immediate environment. They collect information from direct experiences and will mix things, splash in water, play with objects that float and sink, blow bubbles, feed and pat an animal, race cars and build with a wide range of materials. From those investigations they learn more about the world and gain confidence in manipulating materials.

At standard one, students' scientific literacy is rudimentary but they can participate in scaffolded scientific investigations and describe their findings and experiences.

Standard one—science as a human endeavour

Students working within standard one have an unsophisticated view of science. Some may have a relative or family friend whose work involves science and students will talk about those jobs. Students may visit a science centre or view a video of scientists at work and will later refer to that experience. For example, they may role play that they are doing an experiment or studying animals. Through participating in highly-structured scientific investigations, they come to see that their work is mimicking that of scientists.

Students working within standard one have already developed many of their own ideas about how the world works and why things happen. When they observe something new they try to fit what they experience into their current understanding of the world. For example, they may suggest that the water disappears when the tide goes out because someone took the plug out, or they may observe that a snake in the wildlife display is opening its mouth very wide and conclude that it must be yawning. Their explanations as to how and why things happen are based on their own understandings, which are often quite different from a scientist's way of explaining things and may be intermixed with fantasy ideas from story books and television. Through engaging in conversation and with information sources, students working within standard one come to understand that there are generally-held reasons as to how and why things happen. At the upper stages of standard one, students are beginning to distinguish between scientific fact and fantasy. For example, they recognise that pterodactyls were real but that dragons were not.

Students working within standard one become aware of some ways in which science and technology impact on their lives. For example, they may explain that their new car has an airbag and so is safer.

They show some responsibility in caring for a pet or their immediate environment. They are beginning to understand that things depend on other things or the environment to survive and that they can affect the quality of their environment, for example, by not throwing plastic bags away.

Standard one—scientific inquiry

At the early stages of standard one, students make simple observation statements about what they experience. For example, they may note my plant smells bad or the clouds were grey today. Moving through standard one, they begin asking questions about why things are happening, and actively seeking explanations for their observations and experiences. They start to use tools to help them observe. For example, they may use a magnifying glass to view and describe objects in more detail.

Students working within standard one participate in highly-structured, teacher-led investigations into questions such as Can you bring flowers back to life? or Which gyrocopter flies best? They recognise a relevant variable in a simple investigation and are receptive to the idea of making a test fair. For example, they may acknowledge the need to hold gyrocopters at the same height before letting them go. They use equipment such as measuring cups to help ensure that an investigation is fair.

With strategic teacher direction and questioning, students begin to contribute to the design of investigations and to predict what they think will happen. For example, they may predict which of several objects will float or which balloon will make the loudest noise when it pops. At the upper stages of standard one, students begin to contribute ideas about how to identify, design, carry out or interpret class
investigations. They try things out, varying the instructions that they are given slightly, but probably not methodically, to seek answers to questions they have come up with. For example, they may experiment with different ways of stacking blocks to build the highest possible tower or, during a trip to the beach, they may investigate whether there are crabs underneath all rocks.

Students at standard one make simple comparisons and identify similarities and differences between objects. They sort and group on the basis of either key features, such as colour, size and texture, or by personally meaningful characteristics, such as trees that grow in my garden and ones that don’t.

Students are aware that others may obtain similar or different results from their own and, with support, they can draw obvious conclusions from their data. For example, they may say: My flower only took two days to die but Susie’s took four days. They may suggest reasons for differences, such as John’s gyrocopter flew better because it had longer blades. They may suggest how they could improve what they did next time.

Students working within standard one are natural theorisers, who often have their own explanations for why and how things occur. They may offer reasons for things and suggest causes for effects they observe. For example, if the water in the fish tank has dropped over a warm weekend, they may speculate that the fish have been drinking extra water.

Standard one—scientific communication

Students working within standard one will often collect scientific information through viewing texts such as books and DVDs, even if the accompanying written or spoken text is complex. With teacher assistance, they can collect data from their own simple investigations. For example, they may use digital photos to record and communicate details of an investigation, or they may use software such as KidPix® to sequence pictures to show changes that occurred over time, or they may locate a book on a topic that the class has discussed.

Students communicate primarily through telling others about their experiences and understandings. They may tell an adult what they see, smell, hear, taste or feel. Their drawings become increasingly accurate, showing details such as shape, colour and major features. At the upper stages of standard one, students can label their drawings and write simple sentences about their science understandings and experiences. Students working within standard one begin to use science related vocabulary, and to associate certain language with the scientific process, for example, words such as investigate, experiment, observe and predict.

Standard one—science as a body of knowledge

Students working within standard one have a basic understanding of everyday scientific knowledge. Students need experiences that include opportunities to:

- use intuitive notions of forces, for example, stating that to make a ball go further it is necessary to throw it harder
- make observations about familiar forms of energy e.g. how do you make toys work? what does the wind do? what give us energy?
- investigate and compare the properties of familiar materials, noticing, for example, that some are bouncier or softer or more likely to break, and suggest why we use particular ones in particular situations e.g. rubber for gum boots
- observe and describe how some familiar materials change e.g. mixing, freezing, heating
- describe characteristics, needs and stages in the life cycle of some familiar animals
- identify some of the different groups that common animals belong to, such as fish, insects, plants
- observe and describe different features and processes, such as mountains, moon, weather types
- observe and describe cycles such as day and night or the seasons
- explain how they can care for their local environments
## Standard one–science as a human endeavour

Students should be provided with learning opportunities that develop their ability to:

### Main idea

<table>
<thead>
<tr>
<th>Scientists work, think, inquire and know in particular ways</th>
<th>Stage one</th>
<th>Stage two</th>
<th>Stage three</th>
</tr>
</thead>
<tbody>
<tr>
<td>• observe that some people like to find things out and make things</td>
<td>• understand that work or hobbies can involve science</td>
<td>• understand that scientists find out how the world works and help make useful things.</td>
<td></td>
</tr>
<tr>
<td>Applications of science have shaped and changed the world</td>
<td>• identify some things that help us e.g. scissors, computers, washing machines</td>
<td>• describe some ways in which the products of science assist people e.g. glasses to assist vision</td>
<td>• speculate what their lives would be like without the products of science</td>
</tr>
<tr>
<td>Applications of science have systems impacts</td>
<td>• recognise that we should care for living things e.g. pets have needs that have to be met</td>
<td>• recognise that they share the world with other living things, and therefore need to care for the condition of their immediate environment</td>
<td>• understand that the world is shared and that living things depend on other living things and their environment to survive</td>
</tr>
</tbody>
</table>

### Possible learning contexts

Contexts should be drawn from Science as a body of knowledge.

### Sample learning activities

#### Scientists work, think, inquire and know in particular ways

- being encouraged to ask questions about the things they notice in their lives
- talking about what significant adults who work with science do e.g. My father / mother designs bridges. My uncle / aunt has to decide which cows will give the most milk. My brother / sister has to make sure that all the food is put away and that the benches are all cleaned so that germs don’t make people sick.
- naming familiar health-care workers (e.g. physiotherapist, occupational therapist, nurse, doctor) and talking about some of the things they do and have to know about
- talking about the work of people such as gardeners, wildlife park operators and meteorologists, and discussing how they use science in their work e.g. They have to know how much fertiliser to add to make the vegetables grow. They have to decide what to feed the animals and what sort of enclosure to keep them in. They have to collect information about how much rain there has been.
- discussing how scientists find out e.g. Do they use their senses? Do they use instruments? How might instruments enhance what we are able to see? What might a magnifying glass show us compared to just using our eyes? What might be hidden from us that we haven’t learnt to see yet?
- wondering about different ways to sense the world, practising being more ‘alive’ to seeing the world
- role-playing someone who uses science e.g. vet, doctor, wildlife presenter
- mimicking being a scientist e.g. doing experiments, finding things out for themselves, inventing things

#### Applications of science have shaped and changed the world

- exploring what things help them in their lives (e.g. a fridge keeps my food cold, a stove heats it up) and selecting images from the picture libraries in Kidspiration® to show their understandings
- identifying specialised equipment that assists them or people they know e.g. wheelchair, glasses, communication board, hearing aid
- explaining healthy hygiene practices for food preparation (e.g. washing hands beforehand, cleaning, preparation of surfaces, cleaning utensils) and using Microsoft PhotoStory® to tell the story of how food should be prepared
- providing examples of applications of science in their daily lives e.g. electrical goods, food, cars, cleaning, clothing and realising that the people who invented them are scientists
• telling stories about what they do each day and how it uses some science or technology
• imagining what it might be like if there were no science products or processes in the world today
• imagining inventions that could help people or the environment and using KidPix® to draw their inventions
• drawing a picture of someone using a science application

Applications of science have systems impacts
• telling the class about their pet, what it needs to eat and what they might be doing to care for it and using Microsoft PhotoStory® or MaxShow® to create a presentation about their pet and its care
• caring for a class pet, worm farm, school pond or growing vegetables, and explaining what is important for them to survive (e.g. food, water, sun) and what happens if you interfere too much e.g. by pulling a carrot out to see if it is growing or by lifting a stone to see if the ants are still there
• discussing what it means to share a world e.g. Who are we sharing it with? What are our needs / rights, What do animals or plants need?
• exploring what different families they belong to (e.g. personal family, family of people, family of animals, family of earth dwellers, my neighbourhood family) and using Kidspiration® to create a family tree or ArtRage® to draw their family
• exploring how everyday events have causes and relationships e.g. discussing the effect of littering and considering what would happen if litter was dropped just anywhere
• discussing why it is important to be careful of other living things e.g. why not to step on insects or the plants in the garden
• exploring relationships between animals, plants and their environment e.g. bees pollinate flowers
• drawing pictures of things that are related and describing how they are related
• describing how things change and sequences of events e.g. day / night, seasons, tides
• talking about why things need the sun and using the Learning Federation object, Day sky night sky to explore changes in the sky between day and night
## Standard one—scientific inquiry

Students should be provided with learning opportunities that develop their ability to:

<table>
<thead>
<tr>
<th>Main idea</th>
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<tbody>
<tr>
<td><strong>Scientific inquiries are generated from observations, questions and predictions</strong></td>
<td>• make observation statements about the world on the basis of first hand experiences e.g. the sunset is red, the balloon made a loud pop, that plant smells like lemons, the brown rock feels smooth</td>
<td>• pose questions to find out how and why things are happening e.g. Why don’t those trees have any leaves? How did the crane get on top of that building? When will it be dark?</td>
<td>• contribute to class discussion about a question and make guess type predictions e.g. ask can you bring dead flowers back to life, then put a dead flower in soil to see</td>
</tr>
<tr>
<td><strong>Scientists plan and conduct investigations in particular ways</strong></td>
<td>• make observations about science experiences e.g. look at objects teacher has placed under a microscope, watch a bulb grow</td>
<td>• follow precise, single step directions to carry out a class investigation, when working in small groups with an adult helper</td>
<td>• participate in teacher-directed experiments involving measurement and recording of data e.g. Which toy car rolls the furthest?</td>
</tr>
<tr>
<td><strong>Scientists draw conclusions after considering various interpretation of their data</strong></td>
<td>• identify similarities and differences on the basis of familiar characteristics</td>
<td>• speculate on reasons, causes and effects e.g. my plant died because its pot was too small</td>
<td>• interpret data and draw limited conclusions, when presented with simple alternatives e.g. the magnet didn’t attract any plastic objects, the flower didn’t come back to life</td>
</tr>
</tbody>
</table>

### Possible learning contexts

Contexts should be drawn from Science as a body of knowledge.

### Sample learning activities

#### Energy and force

- banging on different surfaces / making drums and talking about the different sounds
- asking questions about things they experience e.g. Why do some toys roll further?
- identifying different forms of energy e.g. feel a ball hit you, feel the wind blow you, see a kite fly, hear a fly buzz
- investigating shadows indoors and outdoors (e.g. How do you make bigger shadows. How does my shadow change through the day?) and using the Learning Federation object, Light and shadows, to learn more about why shadows change
- investigating factors that affect motion by throwing and rolling different kinds of balls on different surfaces
- investigating science concepts though play, (e.g. using different types of boats during water play, trying to pick objects up with magnets) and making statements about what happened
- investigating, through play, how toys move and suggesting reasons for differences e.g. This car goes faster because it is bigger.
- identifying similarities and differences (e.g. The magnet attracts these metal things but not the plastic) and using Kidspiration® SuperGrouper to classify the objects they tested into groups
- comparing two gyrocopters after they have tested them and saying which one flies better
- suggesting an appropriate means of testing whether a television is broken when there is no picture when you push the remote on button e.g. check if it is plugged in, check if there are batteries in the remote

#### Matter

- observing and drawing pictures to show changes in matter e.g. ice cube melting, churning butter, setting jelly

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*NEALS*
• asking why paper towels soak water up but photocopy paper doesn’t
• making observations about the tactile properties of different materials e.g. shaving foam, wax
• using their senses to observe and describe the properties of water through play e.g. pouring, dripping
• discussing how they use their senses, describing some different sensations and identifying objects in a feely bag or when blindfolded e.g. The slime feels sticky. The water tastes salty.
• describing simple properties of various types of materials e.g. Honey is always sticky. Magnets pick things up.
• experimenting with sand sculptures to determine what makes the best mixture for the sculpture
• testing the objects a magnet attracts or repels, making predictions and collecting results
• mixing paints and observing the different colours that are formed, adding different substances to the paint and using ArtRage® to explore colour and effects
• investigating density by predicting and then trialling which familiar objects will float when placed in water
• following the teacher’s verbal directions, given one-by-one, to make slime, working with an adult helper
• grouping toys according to what they are made from (e.g. plastic, metal, wood) and using Kidspiration® Supergrouper to classify and make a record of their results
• grouping pictures of familiar objects to show things that are made and things that are natural

Living things
• looking for small animals in the schoolyard, asking questions about them, observing their behaviour and physical characteristics, using a digital still or video camera to capture images and answering questions about the animals e.g. The black caterpillar has white spots above its legs.
• monitoring changes over time e.g. changes to the trees outside the classroom, development of eggs in a nest
• observing and describing characteristics of a plant e.g. stem and leaf texture, smell, shape, size, colour, thorns
• predicting and testing whether a cut flower can be brought back to life e.g. placing a dead flower in a pot of soil, watering it over a week and taking a photo of it each day
• talking about what they have experienced on an excursion to a natural area e.g. The trees were very tall. The big black birds came very close to us.
• observing and recording changes in animals they keep over a period of time e.g. how many days it takes for mealworms or silkworms to change
• sequencing pictures of an event such as a flower opening
• observing how a fruit tree changes through the year and telling the teacher
• walking through the school grounds finding leaves, flowers and seed capsules, describing their features by using their senses e.g. rubbing, smelling
• comparing what worms look like through a magnifying glass as opposed to the naked eye
• following specific teacher instructions to test whether a seed would germinate and grow under particular conditions e.g. no water or no light
• making a collage of leaves to show that there are different types of trees in the school grounds
• working safely and ethically e.g. treating animals appropriately, using cutting instruments safely
• grouping objects to make a display for the class table using a characteristic that is scientifically relevant e.g. shells that have one part (univalves) / shells with two parts (bivalves), plants having similar and different flower shapes
• identifying similarities and differences in a row of line drawings of different birds
• suggesting why a snake in a museum display has its mouth open wide e.g. It must have been yawning.
• making a reasoned observation such as: The daffodils are coming up so it must be spring soon.

Earth and space
• making predictions, measuring and recording observations about the weather using non-standard / standard units
• using pictures with similar themes to ‘guess my rule’ e.g. kettle, oven, hot springs – steam rises
• sorting natural objects (e.g. by the colour, shape, texture) and hypothesising on how others have sorted theirs
• identifying familiar objects using only one sense e.g. feel a rock, see a mountain
• making connections that explain possible cause and effect and talking about them with others e.g. It is dark because the sun goes out at night.
### Standard one—scientific communication

**Students should be provided with learning opportunities that develop their ability to:**

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<tr>
<td><strong>Scientists consider accuracy, relevance and credibility when acquiring information</strong></td>
<td>• engage with simple scientific information from familiar sources e.g. a book showing the kinds of animals found at the beach</td>
<td>• link scientific information contained in texts with their own experiences e.g. we saw kangaroos like the ones on the DVD at the wildlife park</td>
<td>• seek out science information from various texts e.g. find a book or website on echidnas, select a science-focused beginning reader</td>
</tr>
<tr>
<td><strong>Scientists need to communicate information in a variety of ways</strong></td>
<td>• communicate their science observations and understandings through words, signs, picture symbols, actions, drawings or photos</td>
<td>• communicate their science observations and understandings with increasing detail, and increasing use of appropriate vocabulary e.g. float, sink, insect, magnetic</td>
<td>• communicate their science observations and understandings in ways that include using pictures, labels and simple sentences</td>
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<tr>
<td></td>
<td></td>
<td>• use some scientific words, such as observe, experiment and investigate</td>
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</table>

### Possible learning contexts

Contexts should be drawn from Science as a body of knowledge.

### Sample learning activities

**Scientists consider accuracy, relevance and credibility when acquiring information**

- reading and sharing a variety of books (e.g. big books, lift the flap books, picture books) to find answers to questions about animals or plants and identifying familiar environmental features in a text e.g. beach, river
- talking to a classmate about what their pet eats or about what they found at the beach
- asking adults about changes in their local environment
- using the chapter menu (if in pictures) of a DVD or CD ROM to locate information about particular habitats
- collecting information from texts in response to adult or peer prompting e.g. *Which animal has sharp teeth?*
- making a group collage to illustrate the seasonal behaviour of living things or to illustrate ‘rough’ and ‘smooth’
- recording personal experiences of water use through pictorial representation
- measuring and recording daily temperature changes and writing simple sentences or drawing pictures to record the weather each day
- drawing pictures to show the things that they do at different times over a 24 hour period
- finding pictures of things that interest them in books, magazines, catalogues, posters, websites, television, DVD
- sorting DVDs from books and imaginative texts from information texts and talking about the differences between information and imaginative texts
- with adult assistance, saving the photos that they have created and / or sorted

**Scientists need to communicate information in a variety of ways**

- drawing about and contributing to a group discussion on which objects floated and which sank in their investigation
- making a chart to show objects that are and are not attracted to a magnet e.g. stick pictures on a table the teacher has drawn up
- making a pictograph to show how many paperclips different magnets picked up e.g. stick paperclips on to a chart with pictures of the different types of magnet on it (drawn up by the teacher)
- drawing a flow chart to show steps in a process e.g. record steps in jelly making
- recounting what happens when a toy is wound up and released and telling a friend how to make a toy work by adding batteries
• making measurements e.g. how long it takes for containers of hot water (similar size and shape) to cool when covered with different materials
• using words like float and sink when telling the teacher what they saw in an investigation about water
• sorting and labelling objects into sets (e.g. paper / glass / wood / metal) and justifying their groupings
• making a poster showing substances that are and are not soluble e.g. using ArtRage®
• drawing a picture of what happens to an iceblock left out of the freezer
• using KidPix® software to show the things they used to make a cake
• using their senses to make observations and describing them to the class e.g. The object in the feely bag is hard and round and slippery.
• interpreting a simple graph made by the class using MaxCount® e.g. stacked dot plot of which colour jelly people thought smelt best
• grouping pictures of living things (e.g. plants / animals, legs / no legs) and justifying the groupings
• using appropriate terms to identify the major parts of a plant or animal e.g. kangaroo’s pouch, elephant’s trunk
• drawing a picture of a flower showing its colour
• drawing and / or labelling a big picture of a tree and telling an adult what the different parts are
• drawing a big picture of their body with major / significant body parts such as eyes and ears shown and then verbally naming the parts
• drawing a picture of a Tasmanian devil showing its black colour, four legs and sharp teeth
• drawing or painting pictures of things they see on an excursion showing details of colour and shape e.g. they may draw a picture of a crab showing that it has a red carapace and eight legs
• writing simple sentences about a visit to a wildlife park where they observed a variety of living things
• making leaf rubbings and prints to closely observe the patterns of leaves
• using modelling clay to make a model of an insect and explaining its features
• telling a class visitor what classroom fish need for healthy living
• making charts that show what different things need to survive (students can glue pictures under chart headings)
• writing simple descriptions and conclusions (e.g. The caterpillar made a cocoon. It will be a butterfly soon.) and using the Learning Federation object, Part of a pattern, to learn more
• describing how to care for animals or plants at home or in the classroom
• explaining the features of an animal that they have painted
• drawing a simple life cycle e.g. mealworm life cycle
• arranging pictures to represent the life cycle of an insect or of a plant that they have observed
• marking growth of a plant, animal or themselves on a growth chart
• reporting to a group about where particular animals were found at the beach
• painting a picture (e.g. using ArtRage®) to communicate their understanding of day / night e.g. What is in the sky? What are people doing?
• talking about seeing the moon in the day time
• constructing and explaining the components of a model town or environment
• using hoops to construct a Venn Diagram to group objects such as toys, shells and then using a digital camera or the Venn Diagram in Kidspiration® SuperGrouper to capture their work
• demonstrating their understanding of ideas such as colour, size, time by reorganising ideas using software that they are familiar with e.g. KidPix®, Kidspiration®, Microsoft Photostory®
• showing an increase in the vocabulary that they use to explain and describe familiar science-related situations
• using science terms such as observe and experiment to describe what they are doing when investigating
Students should be provided with learning opportunities that develop their ability to:

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<tbody>
<tr>
<td><strong>The behaviour of objects is determined by the forces that act on them</strong></td>
<td>• understand that it is possible to change things by applying a force e.g. dropping / throwing / hitting / pushing / heating</td>
<td>• make observations about the ways that objects of different shapes and sizes move e.g. the soccer ball rolls further, the square block doesn’t roll, some objects roll and some slide</td>
<td>• make observations about the way that different types of objects behave in different situations (when different forces act on them) e.g. Do they float or sink if placed in water? Is it as easy to ride a bike on sand as on concrete?</td>
</tr>
<tr>
<td><strong>Energy can be transferred and transformed</strong></td>
<td>• make a variety of different objects move e.g. push a toy car, wind a key, take the lid off a jack-in-the-box, throw a toy glider or ball, pour water over a waterwheel, push a swing, blow bubbles, squeeze a water squirter, suck through a straw</td>
<td>• make observations that show that the more energy that is used on an object the more movement is created e.g. if you throw a ball harder, it goes further, if you blow harder, the toy windmill turns faster</td>
<td>• make observations about some effects of energy in their everyday lives e.g. rubbing hands together makes them warmer, the kite moves in the wind, running around makes you feel hot, plucking guitar strings makes a musical sound, putting a sausage on the barbeque cooks it</td>
</tr>
<tr>
<td><strong>Humans use energy and this raises ethical and sustainability issues</strong></td>
<td>• describe how to make different kinds of toys work e.g. put batteries in them, plug into a power point, push them, throw them</td>
<td>• explain some ways in which energy affects them personally e.g. sun warms, flames burn, electricity makes the computer work</td>
<td>• identify the energy source used by some common objects e.g. electricity makes the television work, the batteries make a torch work, petrol makes the car go, food gives us energy</td>
</tr>
</tbody>
</table>

Possible learning contexts

On the move, What makes this toy work? What are some ways of heating and cooling things? How do we predict if something will float or sink? How does energy affect us? (* denotes a Primary Connections unit)

Sample learning activities

The behaviour of objects is determined by the forces that act on them

• dropping balls of playdough and investigating how their shape changes
• engaging in play that lets them see how easy or difficult it is to move different kinds of similar objects e.g. throwing different balls, rolling different toy cars, sailing different toy boats
• investigating the effect that throwing a ball with different forces has to show that throwing it harder makes it go further
• applying different forces to an object to see the effect and how this affects how far something moves e.g. pushing a swing
• explaining that they made the toy car go further by pushing it really hard
• investigating how easily or quickly different size boats sail e.g. yachts made from polystyrene, wood, milk cartons
• predicting, investigating and recording which objects in a collection will float and which will sink
• investigating how far a toy car will travel on different types of surfaces
• talking about their experiences of walking on different kinds of surfaces e.g. gravel, ice, mud, sand
• use the Learning Federation object, Let’s make it go, to examine what powers some everyday objects

Energy can be transferred and transformed
• describing some of the forms of energy that different appliances emit e.g. heaters, toasters, kettles make things hot / radios, televisions, electronic toys make sound / torches, lamps, the sun, computers, candles make light
• listing as many appliances / objects as they can that emit a particular form of energy e.g. light, heat, sound
• looking at books that show how different things move (e.g. sails, wheels) and using Microsoft ClipArt® animations or searching for animations in Google Images® to show how different things move
• demonstrating how to make some different kinds of toys work e.g. blow a windmill, push a vehicle with wheels, run water over a water wheel
• moving boats on water by pushing, pulling, blowing, batteries, winding up
• identifying that the stove or oven is hot and that the fridge is cold
• investigating and talking about some of the ways in which everyday things or their parts move e.g. musical instruments, wheeled toys, fanned paper, water toys, rubber band powered planes
• sorting toys according to how they move (e.g. spin, roll, fly) and experimenting with alternative movements e.g. Can you make a rolling toy spin? Which toys move best?
• constructing and investigating moving objects using commercially produced or consumable materials e.g. make a car from Lego®, make a kite from paper
• moving their own body in different ways (e.g. walking, jumping, skipping, running, rolling, crawling) and talking about which takes the most effort / energy
• discussing some of the ways in which energy transfers can be dangerous e.g. a candle or the stove can burn you, a hammer could fall on your toe
• investigating and explaining how they believe various everyday things work e.g. musical instruments, elastic bands, windmills, marbles, wheeled toys, mirrors, dismantled machines such as a VCR, tape recorder, torches
• making, exploring and using toys or models that use energy and explaining their own ideas about how they work, including:
  - energy creating movement e.g. wind energy for a pinwheel or sailing boat, simple catapult
  - stored energy e.g. pop-up card, batteries, springs
  - light energy e.g. colours, mirrors and reflections, torches
  - sound energy e.g. musical instruments
• using the Learning Federation object, Mixing colours, to investigate the effect of mixing different primary colours

Humans use energy and this raises ethical and sustainability issues
• listening to a story that talks about how people have obtained the energy that they needed in the past e.g. candles for light, outside fires for heat
• talking about ways in which people keep warm e.g. fire, heater, extra clothes, jumping up and down, rubbing hands together
• describing some of the things in their house which need electricity to make them operate
• explaining some of the ways in which energy is important in their everyday lives e.g. we need light to see at night, heat to keep us warm
• telling an adult a way of keeping an icy-pole cold on a hot day e.g. put it in the fridge, put it in an Eski, put your hand around the stick not the ice part
• identifying the type of energy that different things in the classroom need to make them work e.g. lights and television need electricity, the bike needs someone to push it, the calculator needs batteries
• discussing that people need food to give them energy to do things such as run, shout, push a bike, blow a trumpet
• talking about the term ‘energy’ and what it means to them
• drawing and talking about a collection of household appliances to clarify ideas about how and why they are used
### Main idea

**The chemical and physical properties of materials are determined by their structure**

- identify a variety of familiar materials e.g. paper, wood, plastic, metal
- describe observable properties of a variety of familiar materials e.g. the play dough is blue and squishy, the rose is spiky and smells nice, the teddy is soft

**Materials react and change in a variety of ways**

- talk about what things look like after they have watched them change e.g. ice-cream melting
- observe, describe and record some of the familiar changes that occur in materials e.g. dissolving (sugar in tea), heating / burning (bread to toast to charcoal), mixing (flour and eggs to pancakes), evaporating (boiling water to steam), condensation on windows, melting, cooking eggs, freezing
- describe some ways in which the properties of materials may be changed, and how they change e.g. wetting paper makes it tear easily, cooking eggs makes their yolks hard, leaving metal in the rain can make it go rusty

**Humans use materials and this raises ethical and sustainability issues**

- understand that familiar materials and objects are suited to particular purposes e.g. paper for writing / cutting / gluing / folding, towel for drying, glue stick for sticking paper
- communicate appropriate choices of objects and materials for familiar activities e.g. clothing suited to wet weather, toys suited to the bath or pool
- explain why common materials are used in particular situations e.g. clothing, sunscreen, glass for windows, packaging materials

### Possible learning contexts

What are some different ways that things change? What dissolves? What’s it made of? What happens to different things when you change the temperature? What makes a good chair?*, Does it matter what it’s made of?* (* denotes LTAG learning sequence)

### Sample learning activities

**Structure and properties of materials**

- sorting toys into groups based on the material they are made from (e.g. paper, glass, wood, plastic) and using *Kidspiration® SuperGrouper* to make a record of their findings
- sorting objects on the basis of obvious physical attributes e.g. big / small, wet / dry, colour, music /speech, hard / soft
- identifying, describing and categorising objects using feely bags
- playing ‘guess my object’, describing the characteristics of your object (which must be in the room) to a partner
- describing an object in terms of its shape, colour, texture, size and smell, so that a classmate can recognise it
- sorting familiar materials into groups on the basis of less obvious characteristics e.g. texture, runny or hard
- testing and sorting floaters and sinkers into groups and describing their observations orally or pictorially
- investigating the properties of a range of everyday materials such as fabric, metals, plastic and glass
• predicting, with reasons, and recording whether a range of objects have a particular characteristic e.g. will float or sink, will absorb water, will roll
• grouping plastics, metals, wood, powders etc. according to properties such as hardness, flexibility, solubility or lustre
• using KidPix® to draw a set of objects with a common characteristic

Materials react and change in a variety of ways
• drawing a picture to show what happens when ice or ice-cream melts
• suggesting ways to make an iceblock melt
• predicting and observing changes from liquid to solid e.g. make jelly, freeze a drink bottle
• investigating how things change when water is added e.g. pour water on sand, add articles made of different materials such as fabric, wood and plastic to discover which things get wet or stay dry
• discussing changes they observed during cooking e.g. mixing ingredients, baking in oven, making bread, setting of jelly whilst making frog in a pond
• baking bread or making flavoured iceblocks to show how materials change as conditions change
• drying flowers
• investigating how things kept in a fridge stay fresher longer than if left in a warm room e.g. using their senses to monitor the changes in milk that is refrigerated compared with milk that is left in a warm room
• investigating how to stop an iceblock from melting, or how to keep fish and chips warm
• investigating how some changes can be reversed e.g. melting and resetting chocolate or ice
• predicting and experimenting with dissolving common products in water (e.g. sugar, coffee, jelly crystals, sand, soil, rocks) and recording the change that occurs (e.g. colour, smell, solubility)
• using past experiences to suggest ways to change materials e.g. suggests baking to change biscuit dough into biscuit, mixing paints to make new colours

Humans use materials and this raises ethical and sustainability issues
• sorting different familiar materials according to their use e.g. clothes for wearing / keeping warm, furniture for sitting on or for storage, food for eating
• making objects using a variety of materials including paper, plastic, fabric and wood
• applying their knowledge of properties to choose suitable materials to make an identified object e.g. model boat (could consider shape, how waterproof) or house (could consider stronger card being needed for sides), jumper for Teddy
• identifying different objects that could be used for the same purpose e.g. What could we drink out of? What could we mix things in? What could we make a shirt out of? What could we carry our teddies in?
• reading about how people prepare and spin wool to make clothing
• designing and drawing a lunchbox that will keep their lunch cool, explaining why they selected particular materials and shapes
• reporting on why and how people in particular occupations use the materials that they do
• making popcorn to observe and describe a way that heat promotes change
• describing how they made modelling clay or foil float or sink, and giving their own explanations of why that worked
• exploring condensation by writing in the condensation on a window or breathing on a cold mirror and offering explanations for what is happening
Standard one—science as a body of knowledge—living things

Students should be provided with learning opportunities that develop their ability to:

<table>
<thead>
<tr>
<th>Main idea</th>
<th>Stage one</th>
<th>Stage two</th>
<th>Stage three</th>
</tr>
</thead>
<tbody>
<tr>
<td>The structure and characteristics of living things affect their behaviour and functioning</td>
<td>• understand that living things have certain needs to keep them alive e.g. food, water, air, shelter</td>
<td>• describe the function of common body parts, and how they help organisms obtain their needs e.g. eyes for seeing, nose for smelling, legs for moving</td>
<td>• understand that living things have different characteristics at different times of their lives e.g. frog life cycle, changes with age</td>
</tr>
<tr>
<td>A diverse range of living things have evolved on the Earth</td>
<td>• understand that there are different groups of living things e.g. plants, flowers, insects, frogs</td>
<td>• describe some of the ways in which things in the world can be grouped e.g. plant / animal</td>
<td>• group living things in different ways e.g. fur / no fur, legs / no legs, leaves / needles</td>
</tr>
<tr>
<td>Humans interact with ecosystems, and this raises ethical and sustainability issues</td>
<td>• understand that different familiar environments have different characteristics e.g. beaches have sand, bush has lots of trees</td>
<td>• describe the kinds of living things that are likely to be found in common environments</td>
<td>• describe how living things rely on their non-living environment and how humans may impact on this relationship e.g. moving rocks means that crabs have nothing to protect them from the sun and birds</td>
</tr>
</tbody>
</table>

Possible learning contexts

How does my garden grow?*, Hidden treasures?*, My body: a good sensory detective?, Pets: a matter of care*, What do animals need to survive? Why don’t caterpillars and tadpoles get old? How can I tell if something is a plant or animal? Why do crabs live at the beach? (* denotes LTAG learning sequence)

Sample learning activities

The structure and characteristics of living things affect their behaviour and functioning

• understanding that living things have needs e.g. the bean plant needs water, the goldfish needs food
• growing plants with and without water
• recognising and investigating the basic needs of living things e.g. predicts and tests whether a seed would germinate if it has no sun, lists requirements for looking after a pet
• showing appropriate body features in drawings made using ArtRage® e.g. two eyes, one nose, one mouth, two ears
• using simple models and toys that involve putting a person or animal back together
• engaging in action games related to body parts e.g. Head and shoulders, knees and toes, Simon says
• making flip books to create animals with different characteristics
• observing, identifying and comparing parts of common plants and animals e.g. hoof, snout, petal, paw, fin, wing, leaf, seed, stem
• comparing the main structures of plants and animals and identifying their functions e.g. legs for running, roots for staying in the ground, eyes and ears for collecting information, flowers to attract insects
• discussing and trialling how they would cope if the use of a particular body part was limited e.g. blindfolded, write / draw with non-preferred hand
• using photos to make a timeline from birth to present day showing how they / a classmate / their teacher / a pop star has changed
• keeping a journal of drawings / photos / transcribed descriptions to show the stages of growth in a plant or animal they have cared for (e.g. sunflower seed, silkworm, mealworm) using MaxWrite®
• describe the different stages in the life cycle of some animals that they are familiar with e.g. moths and butterflies
• placing pictures of eggs, tadpoles and frogs in the correct life cycle order
• growing a sunflower in the classroom, making daily observations and keeping a photographic record of its growth e.g. marks on a stick
• matching adult and juvenile photos e.g. horse / foal, frog / tadpole, seed / gum tree

A diverse range of living things have evolved on the Earth
• making a collage that shows different groups of living things
• choosing the animals which are birds from a range of pictures
• listening to stories or watching DVDs about different living things
• looking through books that have pictures of familiar and unfamiliar living things
• making a class display of plants
• sorting and naming pictures of different kinds of living things e.g. fish, birds, flowers
• playing celebrity heads, where they are different kinds of animals
• reading Who or what am I? type books and guessing what the animal is
• identifying from a picture book an animal they have seen on the TV or at the wildlife park
• grouping photos of things from the playground in different ways, e.g. leaves / needles, legs / no legs
• use the Learning Federation object, Garden detective: Australian garden, to identify and group insects

Humans interact with ecosystems, and this raises ethical and sustainability issues
• going on an excursion to the beach, taking digital photos and later describing what the beach was like (e.g. it has sand, water, shells) and making a record of their observations using Microsoft PhotoStory®
• drawing pictures of some living things they have seen on an excursion e.g. people, sheep, cows, kangaroo, tree
• placing animal cut-outs in the correct environment on a poster e.g. fish in water
• viewing books / DVDs / websites that show the animals that live in a particular environment e.g. coral reef, Antarctica
• making a model of a common environment that includes living things that would normally be found there e.g. a desert model may include camels and palm trees, a river model may include fish, platypuses, yabbies
• discussing what different kinds of living things need to have in their environment e.g. food, water, shelter, air
• discussing how to care for a class pet and how to act near it
• designing and constructing a model showing what a particular living thing needs to have in its environment e.g. a home for a mini beast, a zoo enclosure, a Tasmanian devil
• using the Learning Federation object, Where do frogs lay their eggs? to explore natural and made environments where frogs might live
### Main idea

**Earth and space have characteristic features and patterns of activity**

- Stage one: identify a variety of features of the Earth and sky e.g. mountain, beach, garden, river, sun, moon, star, clouds
- Stage two: share their ideas about some easily observable patterns of their physical environment e.g. weather, day and night, seasonal change, changes to the moon
- Stage three: use terms that identify and describe various familiar and non-familiar features of the Earth e.g. soil, rocks, oceans, dams, tides, icebergs, clouds, glaciers, deserts

**Earth and space systems continue to be shaped by the changes they experience**

- Stage one: identify obvious changes that occur on the Earth e.g. day and night, rain and sun
- Stage two: describe obvious events and identify basic cause and effect relationships that occur on the Earth and in the sky e.g. it is night-time because the sun has set, the trees don’t have any leaves because it is autumn
- Stage three: explore and describe short and longer term patterns of events that occur on the Earth and in the sky e.g. seasons, soil erosion, drought, flood, changes in the moon’s appearance, movement of the sun, tides

**Humans use the Earth and this raises ethical and sustainability issues**

- Stage one: describe some of the activities that occur in familiar environments e.g. playing in the park, building sand castles at the beach, picking flowers in the garden, making things in factories
- Stage two: discuss some of the ways in which they make use of the Earth and take care of it e.g. pick up rubbish in their playground, plant trees to give shade
- Stage three: explain some ways in which they can care for their immediate environment and why this is important e.g. by taking responsibility for the plants and shrubs in an area near their classroom, recycling paper in their classroom

### Possible learning contexts

*Weather in my world*, How has our river changed? What’s in the sky? How does the moon change? How do we know the season is changing? What happens to the sun and moon whilst I am sleeping? How can we group different rocks? Why should I care for my environment? (*denotes a Primary Connections unit)

### Sample learning activities

**Earth and space have characteristic features and patterns of activity**

- telling an adult about the night sky or drawing a picture showing features of the sky (e.g. sun, moon) after exploring the Learning federation object, *Day sky night sky*
- identifying various natural features and phenomena in pictures e.g. mountains, rivers, rainbows
- taking sample bottles of soils from different locations
- accessing information sources (e.g. books, DVDs) about features of the Earth e.g. mountains, oceans, deserts
- identifying common features of the day and night sky (e.g. clouds, sun, different shapes of the moon, stars) and discussing their personal activities at different times
- identifying differences between the sun and the moon
- observing and describing a beach environment, particularly tidal changes
- discussing and investigating how human or animal lifestyles are affected by weather or environmental conditions e.g. *People wear coats and use umbrellas when it is raining, Crabs hide under rocks when the tide is out.*
- sharing a big book that describes different natural environments and how people live in /use them
- choosing clothing suitable for particular weather / environments and explaining why they are suitable e.g. explaining what Teddy would wear to the beach on a hot day in summer
• collecting an assortment of natural and manufactured objects on a nature walk and sorting them in different ways e.g. natural things / manufactured things, rocks / shells / plant parts
• building a town in a sandpit, including some of the features observed in the local area e.g. roads, hills, river, and describing and naming the features to an adult
• creating landscapes of natural features or environments e.g. in sand, as a class collage, by computer graphics
• use the Learning Federation object, *Soil types*, to examine the properties of sand, loam and clay and see which is best for building a sand castle

**Earth and space systems continue to be shaped by the changes they experience**
• telling an adult how day is different from night
• painting and explaining pictures that communicate their understanding of day and night, including relevant features and corresponding activities
• investigating differences between day and night through direct observation and discussion
• observing and recording daily weather conditions for a month e.g. using pictures, photos, symbols, writing
• collecting data on local weather patterns, representing it electronically and relating it to activities in daily life, showing how their life and that of others is affected e.g. wearing a hat and sunscreen outside
• comparing their own daily weather reports with those in newspapers, on television, the internet and the radio
• talking about seasonal change in relation to events such as seasonal holidays, different people’s birthdays
• drawing, or cutting from magazines, a series of pictures to show changes over a period of time e.g. one day, one year
• observing and describing changes that occur at regular and irregular intervals e.g. tides, waves, lightning and thunder, leaves falling to the ground, amount of sun in a room, rainbows, sunsets, mist and fog
• constructing a simple sundial and using it to tell the time
• making connections between daily activities and the position of the sun through activities such as listening to stories from diverse cultures and historical times e.g. when people eat / work
• naming and identifying features of the different seasons e.g. what the weather is like, what plants they see
• identifying and reporting on a range of local environmental changes over the different seasons e.g. river flow, length of daytime, plants in flower

**Humans use the Earth and this raises ethical and sustainability issues**
• matching a range of events to their daily activities e.g. *When the tide is out you have to walk further to swim. When it is raining you play inside. When it is night you go to sleep.*
• observing and participating in activities carried out in different natural environments and conditions e.g. flying kites in the wind, throwing rocks in rivers, planting / watering / digging in the garden
• learning routines for caring for the natural environment e.g. putting rubbish in bins, using water wisely, using recycling containers
• participating in activities to take care of their environment e.g. litter clean-ups, tree planting
• investigating and participating in ways that people use resources from the natural environment e.g. water for drinking and washing / trees for wood, paper and shade / plants for food / collecting shells, feathers, rocks or leaves
• identifying ways that natural phenomena affect their lives e.g. wind dries clothes, ‘sails’ boats, blows trees down, messes up your hair / rain makes the garden grow, makes it muddy outside, makes you wet
• observing and discussing some ways in which humans affect natural environments e.g. cutting grass, building houses, making roads
• working together to compile a list of the many ways that we use water
• identifying differences between natural and built features and / or objects e.g. drawing a natural environment and adding cut out pictures of manufactured objects such as seats and cars
• listening to someone who has lived in the area for many years talk about how the local environment has changed as they have grown up and how this has affected their activities
• discussing how and why people change environments to suit their needs e.g. dams, farms
• comparing old and recent photos of their home or school area and commenting on changes that have occurred
Science
Standard two
Standard two science overview

Students working within standard two recognise applications of science in their everyday life. They understand that scientists investigate in order to try to explain their observations. Students working within standard two question why things are as they are and, with teacher guidance, carry out investigations to explore a variety of scientific phenomena. They develop their understanding of the scientific inquiry process as they work through standard two.

Standard two—science as a human endeavour

Students working within standard two are more aware of the place of scientists in the world of work, particularly in their own community. For example, they may recognise that police collect evidence to solve crimes, or that research boats are collecting information about how many whales are in the ocean. They are becoming more aware of the difference between fact and fiction, and are beginning to understand that science values finding out about the world through fair, logical and evidenced-based investigations.

Students working within standard two recognise scientific aspects of their everyday activities. For example, they might state that they were working like scientists because they tried growing plants in the dark and in the light. They recognise some applications of science that they encounter in their everyday activities. For example, they might comment that their shoes have soles that make them grip better.

Students working within this standard largely see the world from their own perspective. Through class discussion, they can be led to consider community interests and needs, and develop awareness that they have a shared responsibility for the quality of their immediate environment and for conserving resources. They begin to understand that products and actions can have positive or negative impacts on the environment and identify some simple systems. For example, they may explain why a paper recycling program is operating in their school or investigate the use of water and then suggest ways to conserve water in the broader community. They take shared responsibility in caring for their immediate environment and conserving resources.

Standard two—scientific inquiry

At standard two, students still need considerable teacher support when conducting scientific inquiries.

Students observe and question numerous aspects of the world around them. For example, a class garden on the window sill may lead them to ask questions about how plants grow. With teacher support and prompting they are able to turn their questions into ones suitable for investigation.

At standard two, students participate in teacher-guided inquiries. They are able to follow a short sequence of steps provided by the teacher, to conduct an investigation. For example, they may use a recipe that the teacher provides to make slime and then try changing quantities to see if they can produce better slime. At the upper stages of standard two, students can collaborate to design their own simple inquiries into everyday situations. For example, they may ask What do plants need to grow? Students working within this standard have an intuitive understanding of fairness and know that repeating a test more than once increases the accuracy of their conclusions. If they are prompted by being given a range of options, they can identify a change that would make an investigation fairer.

Students follow teacher directions to record and present data. They use a variety of equipment to make measurements, using different units, which may include informal units of measurement, for different purposes. They master a number of new tools and skills that allow them to collect a wider variety of data. For example, they may use a class microscope to view sugar crystals or a hair, or they may use leads and a meter in electricity investigations.

Students working within standard two make predictions about what might happen in their investigations. At the early stages of the standard their predictions are primarily guesses. As they move through the standard their science ideas and experience grow and they give more plausible reasons for their predictions, even
though their suggestions may be incorrect. For example, they may suggest that when we add an extra battery to our circuit, the globe will be brighter because if one battery makes weak light more batteries will make the light strong.

Standard two students collect and classify, using increasingly scientific characteristics. For example, they may group animals on the basis of their habitat or body covering rather than colour or size. They are able to organise and interpret their data, initially through the teacher providing templates and asking leading questions. For example, when collecting data on schoolyard biodiversity they come to understand that on a pictograph the column with the most pictures shows the most common organism.

They draw conclusions that are straightforward and largely result from class discussion. Their justification may be a statement of what they observed. For example, they may report that the car with the thinner wheels was best because it went the furthest. At the upper stages of standard two they attempt to explain their results and they know that different interpretations of data are possible. For example, they may recognise that one group of students investigating how to clean water could conclude that Method X is best because that water was the clearest and had the fewer bits floating in it, whereas another group could say that the water may look clear but can still contain germs, so it is not really the cleanest.

Students compare their results with those of their class mates and with their predictions, noting that some people obtained different or better results than others. Moving through standard two, students come to understand that some variation in results is to be expected. For example, they note that some seeds die while others grow even in the same spot on the window sill with the same conditions. At the upper stages of standard two they suggest reasons why such variation might occur.

At the upper stages of standard two, students can be prompted to identify what went well in their investigation and where difficulties and sources of unfairness were encountered, and to suggest how and why they would do things differently in future. For example, when making a film canister rocket they may suggest changing the fins and nose cones to improve its flight. When prompted, they recognise possible sources of bias in data. For example, when viewing an advertisement comparing detergents they recognise that Detergent A seems to be best but that the dishes it was used on may not have been as dirty to begin with, so it may not really be better.

**Standard two—scientific communication**

At standard two, students collect information from a range of texts and through their own investigations. They begin to select texts that will answer their science questions. At the upper end of standard two, with teacher guidance, they begin to show an awareness that information can be presented in a way that influences a reader/viewer’s thinking.

Students begin to collect information and record their data and findings in a more formal way. For example, they can keep a journal of their investigations, initially using a teacher template, or take regular photos and organise them on a computer. They include labels on their diagrams / pictures to highlight important aspects of an object, using scientific language that is appropriate to contexts they have studied. For example, they may label the head, thorax and abdomen on a diagram of an insect.

Students working within standard two share and begin to more clearly communicate their observations, results, ideas and understandings. They are beginning to use a variety of presentation forms to communicate the results of their investigations, using scientific terminology appropriately. Presentation methods may include graphic organisers, spoken presentations, formal scientific reports, and reports in other styles, such as a letter, media report, Microsoft PowerPoint® presentation, art work or drama presentation.

**Standard two—science as a body of knowledge**

Students working within standard two make some connections between science concepts and what they see in the world around them. They are amassing ideas and understandings about how things work.
Standard two–science as a human endeavour

Students should be provided with learning opportunities that develop their ability to:

<table>
<thead>
<tr>
<th>Main idea</th>
<th>Stage four</th>
<th>Stage five</th>
<th>Stage six</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientists work, think, inquire and know in particular ways</td>
<td>• understand that scientists investigate the world in a particular way</td>
<td>• understand that science values investigations that are based on evidence</td>
<td>• understand that science values investigations that are fair, and are based on evidence and logical reasoning</td>
</tr>
<tr>
<td>Applications of science have shaped and changed the world</td>
<td>• describe the work of a particular scientist and explain why it is useful</td>
<td>• describe some of the ways that applications of science are used in their community e.g. obtaining clean drinking water</td>
<td>• explore how they are engaging in science in their interests and activities within and beyond school</td>
</tr>
<tr>
<td>Applications of science have systems impacts</td>
<td>• identify some things that might have a positive or negative impact on the world, and understand that they should be responsible and caring in things that they do</td>
<td>• recognise some of the ways they both rely and impact on their immediate environment and identify ways to be more responsible for sustainability in their home or school</td>
<td>• demonstrate their shared responsibility for the quality of their immediate environments and in conserving resources, understanding that they are part of a system</td>
</tr>
</tbody>
</table>

Possible learning contexts

Contexts should be drawn from Science as a body of knowledge, Is necessity the mother of all inventions?* (* denotes LTAG learning sequence)

Sample learning activities

Scientists work, think, inquire and know in particular ways

• looking at a text and discussing what might be fantasy or fiction and what might be fact answering questions such as: Where do facts come from? How can we check—senses, observation, experiment, expert, text? How might we class things that we ‘know’ to be fact or fiction?
• considering how a science investigation might be different from a history investigation — Is it what we are looking at or how we do it? What do scientists value? (evidence, logical reasoning)
• watching examples from television shows to help explain how scientists conduct experiments
• exploring some of the different instruments scientists might use to find things out (e.g. microscope or digital microscope) and looking at what instruments they are using in their experiments
• seeing themselves as scientists when conducting investigations and being able to describe why it is science e.g. It is science because I asked a question, collected evidence and made a conclusion or because I used predict / observe / explain
• role playing a particular scientist or telling a story as if they were a scientist e.g. A day in the life of a scientist
• developing a class science code of practice e.g. be fair, be observant, be careful, be accurate, be logical, be honest

Applications of science have shaped and changed the world

• interviewing a person in their family and asking them what applications of science they are using in their day and using a digital camera to capture the interview
• looking at what science and / or technology people are using in different jobs (e.g. police, fire fighter, farmer, doctor, builder, baker, shopkeeper) and discussing whether the person would be able to do their job without it
• exploring the ways different applications of science are used in the community e.g. transport, food, medicine
Applications of science have systems impacts

- exploring some interconnections between people, plants, animals and the environment (e.g. on a farm) and using Kidspiration® to organise their findings
- identifying activities that might conserve resources (e.g. turning off lights, walking to school, composting, wearing jumpers when cold) and those that might be wasteful (e.g. too much packaging, wasting water, heating rooms that are not used, throwing out food) including by using the Learning Federation objects, Water uses and Water matters
- discussing the ways that they might have an impact on their immediate environment e.g. by drawing a chart showing all the things they use or take into their bodies (inputs such as air, water, food, clothing, toys) and all the things that they throw away or expel from their bodies (outputs such as CO₂, rubbish)
- identifying activities that have positive and negative impacts e.g. Cutting down trees lets us make paper and houses but takes away habitat for animals and birds. or Using cars provides us with transport but causes pollution and use of resources.
- imagining inventions that might help the environment and discussing whether they are practical or not
- caring for a class pet or class garden, being aware of how the things they do can affect it and describing what is needed to look after it
- interpreting their experiences of the natural environment using narrative, drama and myth, or by keeping a class journal or class blog
- listening to local indigenous storytellers to learn about indigenous ways of knowing about the natural world
- discussing what ‘sustainable’ means and discussing questions such as: How do we know if we are consuming more than can be replenished? What are we wasting? What things do we do at home that might be sustainable and what do we do that might be wasteful? How could we start changing the ways that we do things?
- discussing what is means to ‘Refuse, Reduce, Reuse and Recycle’
- finding creative ways to reuse something that would have been thrown away
- exploring the different ways that people, plants, animals and the environment are interrelated in their neighbourhood
- exploring, describing or role playing how parts of a simple system work e.g. How do the parts of a plant work together? How do the parts of a toaster work together?
- exploring the PMI (plus, minus, interesting) aspects of different technologies e.g. a PMI for damming a river
Standard two–scientific inquiry

Students should be provided with learning opportunities that develop their ability to:

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Scientific inquiries are generated from observations, questions and predictions</strong></td>
<td>• ask questions (e.g. How? What will happen if?) and, with teacher prompting, modify them so that they can be investigated through scientific inquiry</td>
<td>• suggest questions that could be investigated using a scientific approach and make reasoned (but not necessarily scientifically-based) predictions about what the answers will be e.g. Which iceblock will melt the quickest?</td>
<td>• work in small groups to develop a scientifically testable question on a class topic related to their interests and experiences</td>
</tr>
<tr>
<td><strong>Scientists plan and conduct investigations in particular ways</strong></td>
<td>• participate in teacher-guided investigations, following a short sequence of steps provided by the teacher to conduct a scientific investigation, including collecting, and recording data</td>
<td>• contribute to class discussion about why the teacher has suggested a particular method to investigate their questions</td>
<td>• plan and carry out investigations, that involve a small number of steps, using appropriate equipment, and following suggestions to collect, record and present data</td>
</tr>
<tr>
<td><strong>Scientists draw conclusions after considering various interpretation s of their data</strong></td>
<td>• interpret their data and draw simple conclusions if led through the process by teacher questioning</td>
<td>• recognise obvious patterns and trends in their data, draw simple conclusions based on them and suggest reasons why their results are not the same as those of others e.g. The plants that got more water grew better.</td>
<td>• compare their results with their initial ideas</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• share findings, talk about the way in which the investigation could be changed and begin to consider fairness of tests</td>
</tr>
</tbody>
</table>

Possible learning contexts

Contexts should be drawn from Science as a body of knowledge

Sample learning activities

**Energy and force**
- asking – *What will happen if we change the surface the toy car is rolling on?*
- following teacher directions to make a windmill and then investigating how changing the size and shape of the blades affects how fast it turns or how much weight it can lift
- following class discussion, working in small groups to design a simple fair investigation e.g. to see which of a range of toy cars rolls farthest down a slope or to see how the type of surface affects how far the car rolls
- comparing their results with those of other students and suggesting possible reasons for discrepancies e.g. *My group got a lower temperature because our thermometer was in the shade.*
- suggesting how and why they would change their investigation in the future e.g. *We would make all of our helicopters out of the same coloured paper because we think that the red paper flies better.*
- identifying a relevant variable in an investigation e.g. need to release parachutes from the same height

**Matter**
- making predictions about and investigating the insulating properties of different fabrics
- predicting and following teacher directions to investigate how materials change over time or in different conditions e.g. *What happens to bread left in a cupboard / on the window sill, in the sun / buried? What happens to paper / plastic / food scraps / cans / glass bottles when they are left outside over an extended period of time?*
• participating in a Predict, Observe, Explain activity by making simple predictions (e.g. what will happen when sultanas are put in a glass of lemonade?), following teacher directions to carry out the investigation and explain their results, suggesting some ways that they could collect additional data e.g. putting jelly beans in the lemonade to see if they do the same as the sultanas
• contributing to a class discussion about ways to make their investigation fairer e.g. stirring a solution the same number of times
• following a sequence of steps provided by the teacher to investigate how the ink from different felt pens separates out and drawing simple conclusions, such as Dark colours separated more.
• following teacher instructions to find out which kind of paper towel is the ‘best’
• following teacher instructions to determine what happens when the ingredients are changed in a recipe e.g. use plain flour instead of self-raising flour
• conducting simple investigations, developed by the class, to test the effectiveness of materials for different purposes e.g. cleaning materials
• collecting a range of school ground litter, sorting it into groups suggested by the teacher (e.g. recyclable, biodegradable, non-recyclable) and suggesting why they have found more of certain types
• investigating how changing conditions changes a particular effect e.g. how temperature affects how fast an iceblock melts, how the amount of bicarbonate of soda added to vinegar affects the flight of a film canister rocket
• working in small groups to investigate factors that affect the rate of melting of common materials e.g. ice blocks, ice-cream, butter
• watching the teacher demonstrate that a lump of modelling clay can be made into a boat, and then investigating how changing the shape of a modelling clay boat changes how many marbles it can hold, making sure that they use the same amount of modelling clay each time and dropping the marbles in the same way
• talking about their results in a way that shows an intuitive idea of fairness—Trixie’s glue was better because she used more flour in her glue and we ran out.
• suggesting their slime did not work properly because they added too much water
• understanding that a different interpretation may be possible in an experiment e.g. The water looks clean because it is clear but it might still contain things we cannot see, so it is not really clean.

Living things
• asking questions about an investigation they are carrying out e.g. How can we measure this insect?
• recording data from an investigation as a stacked dot plot or tally marks or digital photographs of stages and using MaxCount® to create a graph
• observing a plant bulb with a magnifier, discussing what it is and predicting what it will do and why, planting the bulb and keeping a record of how it changes over time, discussing what the bulb needs as it is growing, then testing this e.g. by placing one bulb in a cupboard, not watering one
• visiting the same area (quadrat) each month and collecting or photographing the kinds of plants that are flowering there and organising the results as a series of photos or simple table
• carefully measuring amounts used in an investigation e.g. give each plant one cup of water
• growing beans, collecting data (such as date, photo, height, what you can see, what has changed, what you think will happen next and why) in a journal, then varying a condition (e.g. amount of water, soil type, size of pot), predicting and recording what will happen and using Microsoft PhotoStory® to show progress and final results
• investigating whether different types of seeds grow at different rates, following a class discussion about what seeds need to grow

Earth and space
• setting up a worm farm and proposing questions they might investigate about it
• observing and presenting different ‘phases’ of the moon using pictorial representation, as directed by their teacher
• collecting data about daily weather for a week each month or term and comparing daily and seasonal changes e.g. uses a class thermometer to measure the temperature at different times of the day, reads downloaded information from the Bureau of Meteorology website
• investigating turbidity in a waterway and how it affects the animals present and then using the Learning Federation object, Waterways, to learn more about different waterways
• investigating how a local area changes following a bushfire
• investigating patterns and movements of clouds and associating the patterns with different weather conditions
Standard two–scientific communication

Students should be provided with learning opportunities that develop their ability to:

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<tbody>
<tr>
<td>Scientists consider accuracy, relevance and credibility when acquiring information</td>
<td>• follow teacher directions to collect and record scientific information e.g. record experimental findings in the appropriate place on a template, locate a text about volcanoes and tell the class two interesting things about them</td>
<td>• use a range of simple texts to help find information e.g. collect information from the web, books and a DVD for a report on Antarctica</td>
<td>• be aware that information on scientific issues can be presented to influence the reader’s thinking in particular ways e.g. a book might lead you to think that taking water from a river is bad</td>
</tr>
<tr>
<td>Scientists need to communicate information in a variety of ways</td>
<td>• organise science information with teacher guidance e.g. keep a science journal set up by a teacher, using short sentences, drawings and pictographs</td>
<td>• organise science information with teacher guidance but showing increasing independence and use of scientific language and conventions e.g. report headings, labelled diagrams, use vocabulary such as solid, liquid, gas</td>
<td>• use, and select from, a range of appropriate methods (e.g. PowerPoint, graphic organisers, tables, posters, reports) to communicate scientific observations, results, ideas and understandings, using scientific language relevant to contexts they have studied e.g. thorax, abdomen, friction, properties</td>
</tr>
</tbody>
</table>

Possible learning contexts

Contexts should be drawn from Science as a body of knowledge.

Sample learning activities

Scientists consider accuracy, relevance and credibility when acquiring information

• using templates to record information in tables and lists e.g. recording their findings on how far different toys travelled in a table provided by the teacher
• using titles, contents pages, catalogues, simple indexes, dictionaries, the web, television programs, people with expertise to collect information about different types of energy or different bridge shapes and designs
• making and recording observations in an experiment to see which ball is the most bouncy
• predicting and recording which surface has the least friction in an investigation
• talking to classmates about where people need to sit on the seesaw to make it balance
• sorting objects into recyclable and non-recyclable on the basis of the material they are made from and using Kidspiration® to make a record of their results
• recording predictions about what will happen to food that is being cooked
• recording on a table which wrapping helps keep food the freshest for longest
• taking digital images of different foods decomposing and researching food preservation
• deciding whether the material in an information book on animals will help with their research on the thylacine
• using a digital, still or movie camera to capture images for their report about keeping silkworms
• using simple library catalogues, search engines and directories designed for children, online forums, DVDs, CD ROMs, posters to collect information on crabs
• preparing questions to ask a visiting expert about how major internal organs help us to live
• observing and recording the life cycle of an animal and comparing their findings to information in the Learning federation object, Part of a pattern
• reading and writing stories about animals that hibernate in cold weather
• labelling the parts of a flowering plant on a diagram
• keeping a diary about the growth of a plant over a period of time
• deciding what questions to ask the school gardener about the trees growing in the gully and using an MP3 player or digital video to record the interview
• interpreting labelled diagrams of a waterway e.g. using the Learning Federation objects Waterways and Water use
• identifying a range of information sources that would allow them to collect information about the moon e.g. books, posters, internet
• considering if the information in a book on space is likely to be current and comparing it with information on the internet
• using teachers and librarians to find information about glaciers and icebergs
• using a list of websites bookmarked by the teacher to find out about local plant and animal species
• keeping a science journal about what is happening in their investigation of a local creek

Scientists need to communicate information in a variety of ways
• organising predictions on a chart about which materials are magnetic e.g. metal, water, plastics and paper
• making a poster sorting things that use the same energy source e.g. electricity for electrical appliances
• writing captions for a poster about the temperature of different coloured objects placed in the sun
• drawing and labelling diagrams that show what happened in an investigation e.g. This is what happened when we put the vinegar and the bicarbonate of soda together … or When we put Alka-Seltzer in water …
• conducting an investigation on the conditions that affect the rate of melting of common materials (e.g. ice blocks) and communicating the results by using a poster or multimedia product or dramatic play
• recording results on a table / spreadsheet after classifying materials into categories (e.g. recyclable / non-recyclable / recycled) using MaxCount®
• creating a column graph to show the different ways in which people use water in their homes, providing a heading and labels on the axes e.g. using MaxCount®
• designing a poster or Microsoft PowerPoint® or MaxShow® presentation on ways that we can reduce water consumption
• drawing different minibeasts that they have found in the school grounds after using a digital microscope to observe and video their movements
• making plaster casts of animal tracks
• constructing a papier-mâché model of an animal that they have researched, showing its main features
• compiling class lists of the features of different plants, grouping like features and describing the features used
• making a collage or drawing a diagram of human body parts on a body outline to show the position of the major organs, with simple explanations about the major organs
• showing features of plants in a diagram e.g. leaves, stems, roots, tendrils, flowers, fruit
• drawing a mind map to show their ideas and their own observations about penguins e.g. using Kidspiration®
• predicting, ordering, measuring, recording and describing changes when growing a seed or keeping an animal which undergoes rapid change e.g. as a bar graph, on a timeline, life cycles, using digital photographs
• writing poems about differences between seasons and using ArtRage® to illustrate the poems
• mapping the position of particular types of areas in the playground e.g. shady, windy
• drawing chalk lines on a netball court to show the position of a shadow from a stick
• using labelled diagrams and accompanying short text to explain erosion and weathering
• sorting information, clustering similar ideas and headings or key questions to organise information
• saving and retrieving their report on their investigation
• making systematic observations and measurements
• using class data to construct a bar chart, describing simple patterns that they see in their data e.g. using MaxCount®
• reporting on observations and experiments, using science-specific language to record what went well and where difficulties were encountered
• describing how seeing data in a visual rather than numerical form allowed them to make new interpretations about the types of litter in the school yard
• Using the drawing tools of Microsoft Word® to make a map of the school yard and describing problems they had
### Standard two—science as a body of knowledge—energy and force

**Students should be provided with learning opportunities that develop their ability to:**

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<tbody>
<tr>
<td>The behaviour of objects is determined by the forces that act on them</td>
<td>• describe and record some of the different ways that forces (pushes and pulls), including gravity, change the shape and motion of objects e.g. how pushes and pulls make different toys move, that gravity makes things fall</td>
<td>• investigate and record how the properties of an object can determine the effect of the forces that act on it e.g. magnets pick up some objects and not others, some balls are more bouncy than others</td>
<td>• investigate and record ways in which pushes and pulls (forces) act in everyday situations to make things stop, move or change shape e.g. brakes on a bike or car, friction on different surfaces</td>
</tr>
</tbody>
</table>

| Energy can be transferred and transformed | • describe and record some of the different ways in which energy may affect objects e.g. heat energy melts ice, light helps make plants grow, people need warm clothes in the snow | • describe how the properties of an object affect how it absorbs and/or emits energy e.g. different coloured objects heat up differently, different length strings affect the sound of a musical note | • explore a number of different forms of energy (e.g. heat, sound) and the way they are used in their everyday lives, using intuitive ideas of energy being needed to get things done |

| Humans use energy and this raises ethical and sustainability issues | • describe and record some of the ways in which electrical, light, heat, sound and movement energies are used in their homes and at school | • describe and record some of the ways that energy is used in their community, and how that energy is obtained | • identify some of the different ways that various people get electricity e.g. hydro, solar, coal, wind |

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**Possible learning contexts**

*Push-pull power*[^1], Where do we get energy from? What is force? What do magnets do, How can we make music? What colour car should you buy to be cool? Why is that balloon sticking to the wall? How can you see around corners? ([^1]denotes a Primary Connections unit)

**Sample learning activities**

**The behaviour of objects is determined by the forces that act on them**

- identifying everyday forces as push or pull forces
- suggesting ways that you can use a push force to make something move
- identifying contexts in which they use pushes and pulls in their classroom
- exploring the size of the push or pull needed to move different sized objects
- posing questions to explore rolling, sliding, spinning, falling, flying and speeding up, as those motions are changed by forces due to the wind, magnets, motors, pulls, pushes and gravity
- talking about the force called gravity, and how it means that people don’t fall off the Earth
- watching a video about space and then discussing and describing some ways in which life is different for astronauts
- making a modelling clay boat and investigating how changing its shape affects the number of marbles that it can carry
- looking at the types of footwear that are designed for different activities e.g. running, rock climbing, skating, football, skiing
- predicting the outcome and then sliding objects with different surface coverings down inclined planes (slopes) to see which has the least friction (slides down quickest)
- investigating some electrostatic forces such as the effects of static electricity e.g. making balloons stick to walls

[^1]: denoted a Primary Connections unit
• talking about *attraction* and *repulsion* when exploring magnets, including considering what happens when north and south poles are brought together
• exploring toys that rely on centre of gravity (e.g. balancing figures), making their own toy and investigating the effect of varying the amount of weight used and its position from the balancing point
• investigating where people need to sit in order to balance a seesaw
• observing what happens to the shape of water / rain droplets as they fall

**Energy can be transferred and transformed**
• exploring how magnets move things e.g. *How close does the magnet need to be to attract?*
• exploring the effects of sunlight on various objects e.g. magazines, paintings, fruit, plants, chocolate, ice
• predicting, measuring and recording the differences in temperature in the sun and the shade
• discussing what it feels like to walk on different surfaces in bare feet on a hot day e.g. bitumen, grass, sand
• drying a wet cloth in different places around the school to establish the most suitable drying conditions
• investigating the best way to stop an ice cube sitting on their desk from melting
• measuring the temperature of different coloured cans left in the sun to find out what colours heat up the most in order to investigate questions such as: *What colour should you paint your house to keep it coolest? Why is black plastic used for solar hot water systems?*
• discussing why people use various insulating devices, and how those devices affect heat transfer e.g. stubby holders, wetsuits
• making musical instruments to explore how sound is produced e.g. make a bottle orchestra by filling bottles with different amounts of water and either tapping or blowing across them, make a string orchestra, by plucking strings of different lengths and materials, make drums from different types of containers and materials
• sorting pictures of home appliances into energy source groups e.g. batteries, wind, springs, fossil fuels, solar
• finding examples of different forms of energy e.g. wind power, solar power, electricity, gas
• locating things in the classroom that use electricity, are hand powered, use a battery etc
• posing questions about, investigating, modifying, comparing and sharing ideas about simple devices
• investigating sounds made through the vibration of materials e.g. string, rubber bands, rulers
• varying movement e.g. changes the wing shape of a plane so it will fly further, makes a parachute fall more slowly, investigating how a paper helicopter falls under different conditions
• exploring reflections from flat and curved mirrors and from mirrors placed together, and surveying the uses of different kinds of mirrors in their homes and other places
• assembling a simple gearing system and looking at the effect of turning one of the gears
• use the Learning Federation object, *Energy from the sun*, to explore how changing the properties of a solar cooker affects the temperature it reaches
• use the Learning Federation object, *Sound*, to explore the effect of changing characteristics of musical instruments
• exploring the Learning Federation *Light and reflection* series of objects to learn about properties of light energy

**Humans use energy and this raises ethical and sustainability issues**
• identifying the sun as the main source of heat and light energy for all things on Earth
• identifying sources of energy and describing the ways in which energy is used in daily life e.g. food to eat, electricity for cooking, batteries for toys, fires for warmth, springs in toys
• collecting data electronically to compare their own and others’ ideas on how energy use at school or home can be reduced and why energy conservation may be important
• investigating how people stay warm or cool in extreme environments e.g. deserts, Antarctica
• talking about food as a form of energy and considering the amount of energy that we get from different types of food and drink e.g. water versus a soft drink
• identifying and describing some of the ways in which energy is obtained in their own and other communities e.g. hydro, coal, solar, gas, wind, nuclear
• beginning to distinguish between renewable and non-renewable energy sources
• comparing energy use in their home e.g. graph the number of electrical appliances of different types
• acting responsibly in relation to energy use e.g. class appoints light monitors, turns computers off at power points
• listening to the Learning Federation object, *I think . . . for sale* where students discuss who owns the wind
**Standard two—science as a body of knowledge—matter**

Students should be provided with learning opportunities that develop their ability to:

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<tbody>
<tr>
<td>The chemical and physical properties of materials are determined by their structure</td>
<td>• explore some less obvious properties of common materials and the changes that they undergo e.g. do they dissolve, how runny are they, density of liquids, evaporation, melting, condensation</td>
<td>• classify materials as solids, liquids or gases on the basis of their observable properties</td>
<td>• examine and compare the observable properties of common materials that a variety of everyday products are made from e.g. compare the ingredients in a cake</td>
</tr>
<tr>
<td>Materials react and change in a variety of ways</td>
<td>• investigate and describe differences in the observable changes that materials undergo as a result of everyday processes e.g. some fabrics fade more, you can dissolve more of some substances</td>
<td>• plan investigations to explore how conditions affect the properties of some common materials e.g. how temperature affects the speed at which iceblocks melt</td>
<td>• observe, describe and investigate how changing a variety of familiar materials changes their properties e.g. adding salt to ice, heating air makes it rise</td>
</tr>
<tr>
<td>Humans use materials and this raises ethical and sustainability issues</td>
<td>• investigate a property of a common material e.g. absorbency of paper towel</td>
<td>• investigate the properties of a common material e.g. elasticity, absorbency, strength of a piece of Lycra®</td>
<td>• investigate whether the properties of a material suit it to particular purposes e.g. packaging materials, clothes, bike helmet</td>
</tr>
</tbody>
</table>

**Possible learning contexts**

What materials do different people use – and why? How much drinking chocolate can you dissolve in your milk? What chemistry is happening in your kitchen? How do we decide if something is solid or liquid? What makes the perfect bubble? Which paper should I choose?

**Sample learning activities**

Structure and properties of materials

- grouping familiar and unfamiliar items using a property they have identified e.g. texture, transparency, flexibility
- sorting recyclable objects such as paper, metals, glass and plastics on the basis of their origin
- discussing and using appropriate adjectives (e.g. hard, runny, wet, smelly) when describing properties of materials
- investigating and communicating differences in the properties of similar types of materials e.g. Which glass is it easiest to see through? Which plastic can you drop without it breaking?
- working in small groups to devise a set of questions to ask an expert (e.g. baker, builder, gardener, engineer) about the materials that they use in their work e.g. taste, whether it preserves, whether it is poisonous
- planning and setting up a ‘fair test’ to investigate, for example, the biodegradability of different materials found in the school yard e.g. paper, plastic, straw, food scraps, ice cream sticks
- classifying materials as solids, liquids and gases and justifying their choices
- identifying materials, (e.g. water, honey, ice cream, glass) as solid, liquid, or gas and developing their own definitions e.g. liquid won’t stay in a pile on the bench
- investigating and discussing properties of materials e.g. air takes up space in a balloon, air moves, water takes the shape of its container
- exploring the behaviour of air through such pneumatic devices and natural objects as balloons, tyres, lungs and vacuum cleaners
- sorting and classifying common materials using a classification tree e.g. using Kidspiration®
• using a simple classification tree diagram to classify common materials
• use the Learning Federation object, *Kitchen chemistry: experiment and mystery level 1*, to test the physical properties of some kitchen substances

**Materials react and change in a variety of ways**

• investigating which materials change and which do not change under certain conditions, for example, by
  - heating, cooling, freezing e.g. popping corn, melting wax
  - mixing e.g. adding water
  - being left in the sun, in a cupboard or buried
  - composting e.g. paper, plastic, food scraps, tin can
  - changing the ingredients in a recipe e.g. substituting plain flour for self raising flour
• predicting changes that will occur in food during the storage, preparation and cooking process e.g. colour change, decay
• drawing and labelling pictures to show what happens to water when you heat it from ice through to steam
• observing and discussing changes to and from solid / liquid / gas states, and in smell and colour, while heating, melting, freezing and cooling materials
• investigating what happens when different amounts of bicarbonate of soda are added to different amounts of vinegar or other liquids
• investigating and researching changes caused through heating and cooling e.g. popping corn
• investigating the effect of adding salt to a piece of string placed on top of an iceblock

**Humans use materials and this raises ethical and sustainability issues**

• conducting simple investigations to test the effectiveness of materials for different purposes, participating in class analysis of results and drawing their own conclusions e.g. materials that: keep us dry, stop an ice cube from melting, keep things warm, keep food fresh, are attracted to a magnet
• designing an investigation to explore properties of common materials, explaining why they have particular uses
• predicting and devising an investigation to test the effectiveness of materials for different purposes (e.g. food wrappings for keeping foods fresh) and suggesting ways the investigation could be improved
• exploring which shapes let them build the strongest bridge
• investigating the effectiveness of different packaging materials in keeping food fresh e.g. paper, plastic wrap, cloth, alfoil
• building model boats or planes with different materials and talking about the kinds of materials and forms of construction
• modifying properties by devising investigations that change variables e.g. the detergent to water ratio in bubble mixtures, the materials from which bubble makers are made
• using a teacher-provided fair test to investigate the effect of varying the proportion of ingredients in common processes e.g. water cordial, making plaster, play dough, biscuits, bread
Students should be provided with learning opportunities that develop their ability to:

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<tr>
<td>The structure and characteristics of living things affect their behaviour and functioning</td>
<td>• describe some of the external and internal characteristics of living things and say what their function is e.g. the heart pumps blood</td>
<td>• recognise that there is a relationship between the characteristics of a living thing and how it survives e.g. teeth for eating meat or grass, gills or lungs for breathing in water or air, claws for catching prey, wings for flying</td>
<td>• observe the characteristics that a living thing has and use these to draw conclusions about its way of life e.g. What sort of environment does it live in? How does it reproduce? How does it feed?</td>
</tr>
<tr>
<td>A diverse range of living things have evolved on the Earth</td>
<td>• understand that groups of living things all have their own particular features e.g. fish have gills, plants have leaves, carnivores have sharp, pointy teeth, birds have feathers</td>
<td>• understand that there are many different kinds of living things, and distinguish between living and non-living things using basic criteria e.g. need for food and water, need to sense their environment</td>
<td>• describe some of the changes that take place as living things grow while realising that offspring are similar to their parents</td>
</tr>
<tr>
<td>Humans interact with ecosystems, and this raises ethical and sustainability issues</td>
<td>• understand that the type of non-living environment determines the kinds of living things found there e.g. aquatic, terrestrial, arid, city, agricultural</td>
<td>• describe and explain some of the ways in which plants or animals, including people, respond to normal environmental changes e.g. hibernation, bird migration, plants grown in sun and shade</td>
<td>• explain that the basic needs of living things must be met for survival in an environment, and consider how humans have impacted on the living things in a local area</td>
</tr>
</tbody>
</table>

Possible learning contexts

Plants in action®, What affects the chain?® Garbage in the gutter, death in the sea . . .* Who survives?® Why don’t kangaroos live in Antarctica? What’s inside me? Alligator or crocodile, tortoise or turtle, . . . Is our schoolyard really a zoo! (® denotes LTAG learning sequence, ® denotes a Primary Connections unit)

Sample learning activities

The structure and characteristics of living things affect their behaviour and functioning
- discussing the functions of various internal and external parts of living things e.g. bones, gills, beaks, roots, flowers
- drawing a body outline and drawing in and labelling all the body organs that they know and then using ArtRage®, or KidPix® to make an electronic record
- identifying and comparing features of living things (e.g. leaf shapes, types of teeth that Tasmanian devils have) and discussing how they are used e.g. sharp teeth for eating meat
- making a list of the needs of various living things e.g. fish need water, ants need to live in groups
- observing an unfamiliar animal and suggesting how its features aid its survival
- observing a living thing closely (e.g. using a digital microscope), recording its characteristics (e.g. antennae, location of legs) and suggesting why it has the features it does e.g. spots so that it can hide better, a long tongue to catch insects
- posing questions about, researching and describing the features, habitat and life cycle of a group of living things
A diverse range of living things have evolved on the Earth

- using KidPix® or Kidspiration® software to sort animals or plants into groups, and then explaining their classification system
- sorting pictures or models of living things into groups and explaining the basis of their classification system
- explaining different ways of groupings animals e.g. by considering growth, reproduction, food sources, specific physical features, body coverings, teeth, limbs and body parts
- identifying particular living things by their characteristics e.g. penguins are black and white, have flippers and don’t fly, wattle trees have green leaves and yellow flowers
- selecting two plants from the school garden each day over two weeks and making a list of the characteristics of each plant, then looking at the final list and identifying similarities and differences
- discussing what makes something a plant
- observing and identifying similar and different features and posing and investigating questions about living things e.g. What features are common to all mammals / insects / arachnids / eucalypts?
- grouping familiar and unfamiliar things into living or non-living, plant or animal when given some information about them e.g. puffballs, sponge, rock, water, seeds, animal scat (dropping)
- sharing stories and making observations that allow them to compare a range of life cycles, including humans, to demonstrate that living things change over time and that they reproduce, grow and die
- discussing if they think certain objects are alive or not and why e.g. alive because they eat, breathe, grow, move
- sorting a list of familiar and less familiar objects into living and non-living
- explaining why fire is a non-living thing whereas a plant is a living thing even though fire moves and plants don’t move as much
- considering the ways in which offspring may be similar to and different from their parents and families
- comparing adult and young from a variety of species and identifying similarities
- using the Learning Federation object, Animal search, to classify animals as fish, amphibian, reptile or mammal

Humans interact with ecosystems, and this raises ethical and sustainability issues

- investigating the features of familiar living things that let them survive in a particular environment and not in others e.g. fish have gills, so they will only be in aquatic environments, parrots need holes to nest in, so they are only found where there are suitable trees
- predicting the types of living things that will be found in particular environments e.g. aquatic environments will have fish, trees will have birds
- carrying out a detailed investigation of a local environment and then discussing the different plants, animals and non-living things that they observed
- comparing posters that show different environments and exploring the difference between the plants, animals and people in each
- explaining why some animals hibernate and others don’t
- considering why animals don’t live in certain places e.g. Why do wombats live in burrows rather than trees?
- listening to a visiting expert talk about shearwater (muttonbird) migration
- reading about the hibernation of an unfamiliar animal e.g. squirrels, brown bears
- discussing ways in which living things depend on the Earth and are affected by changes in the Earth
- investigating ways in which living things fill their needs from their environment e.g. wombats get shelter by building a burrow, so they need suitable soil types
- investigating the relationships that exists between living things in a familiar area e.g. constructs a food chain, observes that a schoolyard tree hosts many life forms
- suggesting how environmental change will impact on the diversity of plants and animals in a familiar area and using MaxShow® or Microsoft PhotoStory® to create a presentation for parents e.g. removal of trees will reduce nesting sites, construction of a small pond will provide a habitat for frogs
### Students should be provided with learning opportunities that develop their ability to:

<table>
<thead>
<tr>
<th>Main idea</th>
<th>Stage four</th>
<th>Stage five</th>
<th>Stage six</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth and space have characteristic features and patterns of activity</td>
<td>• identify and describe the characteristics of various landforms and patterns of movement e.g. volcanoes, earthquakes, canyons, geysers, coral reefs, ocean currents</td>
<td>• describe some of the ways in which easily observable conditions vary in their local area e.g. weather, rock types, water flow in creeks</td>
<td>• describe some of the ways in which easily observable conditions vary across the Earth e.g. weather, landforms</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>• explore the relationship between distance and the apparent size of objects e.g. a large object looks smaller as you move away from it</td>
</tr>
<tr>
<td>Earth and space systems continue to be shaped by the changes they experience</td>
<td>• understand that the Earth is very old, and that the animals, plants and landscapes have changed over time e.g. dinosaurs, coastal erosion</td>
<td>• identify and consider the impact of various types of change on the Earth’s animals, plants and landscapes e.g. day / night, drought, bushfire, storms, tsunami</td>
<td>• observe and describe changes on Earth and in space (e.g. day / night, weather, soil erosion, phases of the moon) and recognise that some changes are more predictable than others</td>
</tr>
<tr>
<td>Humans use the Earth and this raises ethical and sustainability issues</td>
<td>• understand that there are essential materials and energy sources that allow us to live on the Earth e.g. energy from the sun, wood, coal, oil, stone, minerals, water</td>
<td>• describe some of the ways in which their own community uses and is dependent on resources from the Earth e.g. rivers and oceans, dams, air, land, electricity, mining</td>
<td>• examine how they and other living things depend on the Earth and are affected by changes at the Earth’s surface</td>
</tr>
</tbody>
</table>

### Possible learning contexts

*Water works*, *Spinning in space*, *A drop in the ocean*, *How do we depend on the earth? How do we know it’s a desert? Where did the dinosaurs live and why did they go? How have environments changed in my local area?* (* denotes LTAG learning sequence, # denotes a Primary Connections unit)

### Sample learning activities

**Earth and space have characteristic features and patterns of activity**
- collecting local rocks, soils and other natural objects and sorting them using properties such as shape, colour, grain, texture and size, and then returning them to their points of collection
- comparing and describing rocks from different areas
- identifying and sharing information about features of their natural and built local environment that affect living things, including themselves
- studying and investigating the differences between some soil types e.g. texture, capacity to retain water, how well plants grow in each type
- speaking to an expert who has visited significant landforms or patterns e.g. volcanoes, Antarctica, meteorology
- creating a photo collage of local landforms such as rivers, lakes, beaches, mountains
- creating a model from modelling clay, papier-mâché or other materials to show a particular landform or pattern
- considering when and where objects are visible in the sky e.g. sun, moon, stars, Venus (evening star), Southern Cross, Iron Pot / Orion
- reading books that show the star patterns that diverse cultures have seen in the skies
- exploring the relationship between distance and perceived size by tracing around objects such as trees / houses as viewed through a window and comparing their tracings to the actual object
• working in groups or in teams to design and make instruments to measure aspects of weather (e.g. wind speed, rainfall) following class discussion and teacher modelling of possibilities
• investigating patterns and movement of clouds and associating them with different weather conditions e.g. grey clouds mean that it is going to rain
• viewing Finding Nemo and then finding out more about the East Australian Current
• using Google Earth® to locate significant features of the Earth

Earth and space systems continue to be shaped by the changes they experience
• making a model of a prehistoric landscape to show that animals and plants were different in past ages
• sharing information from books or the internet about what the Earth used to be like
• observing the moon each night for a month, drawing a picture of what it looks like each day / night and comparing their findings with their initial ideas and predictions
• observing times for sunrise and / or sunset at different times of year
• keeping a record of how the tide changes over the course of a day / a week / a month and noting the impact that this has e.g. Boats are aground at low tide. There isn’t much beach to walk on when the tide is extra high.
• investigating how a local area changes following a bushfire
• discussing the impact that a sudden irregular change has had on their local area e.g. hailstorm
• making a model that allows them to investigate environmental change that may occur as a result of erosion and weathering e.g. place sand into a container and wash it away with different rates of water flow then look at the effect of adding vegetation
• demonstrating the relationship between the sun and Earth e.g. using role-play to show how day and night occur
• monitoring some effects of the Earth’s rotation e.g. temperature changes from day to night and over seasons
• making observations of the shadows cast by the sun at different times of day
• identifying and describing how the apparent position of the sun changes in the sky during the course of the day and discussing the effect this has on temperature and activities e.g. We do sport in the morning, before it gets too hot.
• investigating how and explaining why shadows change shape and size during the day
• observing the patterns of behaviour of particular living things at different times of the day and night and in different seasons e.g. compares the eating and sleeping patterns of nocturnal animals to their own

Humans use the Earth and this raises ethical and sustainability issues
• using information from books, posters, the internet and CD ROMs to research and discuss the relationship between people and their environment e.g. clothing used in different climates and landscapes
• talking about how diverse cultural groups manage their lives with respect to the effects of the daily and seasonal positions of the sun e.g. in very hot areas, people stay indoors during the hottest part of the day
• discussing how changing environments can have benefits and disadvantages e.g. chopping down trees makes paper but creates a loss of habitat for birds
• listing things that they and their families use in everyday life, identifying what they are made of and finding out how they are obtained from the Earth
• maintaining online contact with students from a different culture / environment and comparing how they obtain and use resources from the Earth e.g. water, power, what their houses are like
• researching changes in and uses of soils e.g. interviewing a community member about practices that degrade or improve soils, builds a composting system, helping to maintain a worm farm
• discussing ways in which living things depend on the Earth and are affected by changes to the Earth e.g. animals living in a rock pool, a local endangered species
• communicating, through dramatic play, the way they live in their environments, identifying problems and devising ways they can contribute to the care of environments for a better future and using digital video to record the play
• posing questions about, and taking action on, an issue at home or school that has implications for the use of natural resources or environments
• brainstorming, in groups, the recreational uses of water and then preparing a class mural showing the uses and using Kidspiration® to make an individual record
• investigating responsible use of water resources through discussion and by questioning community members
• investigating where our water comes from (e.g. excursion to water catchment area) and using the Learning Federation objects, Water use and Water matters to consider human use of water further
Science
Standard three
Standard three—science overview

Students working at standard three understand the place and methods of science and scientists, and tend to see themselves as scientific investigators. They engage with a wide range of science texts and have a working knowledge of many science concepts and terms. They are able to identify obvious advantages and disadvantages of scientific developments.

Standard three students move from working on teacher structured investigations to conducting their own guided inquires, either independently or in groups. They are able to identify testable questions, understand the idea of a fair test and are beginning to operate more independently, being aware of the need to work safely and ethically.

Standard three—science as a human endeavour

Students working within standard three are aware that the world around them generally works in an ordered and predictable way. They understand that scientists value investigations and arguments based on fair testing, evidence, accuracy and logical reasoning. They begin to realise that scientists also use creativity, imagination and hunches when coming up with new ideas and inventions, and that some inventions come about through serendipity. They begin to identify different types of investigations and different ways that scientists work, realising that investigations have ethical considerations.

Students are developing an understanding that scientific knowledge can change over time. For example, they may be aware that people once thought that the world was flat but that this view changed as more evidence was collected. They investigate significant inventions that have changed the way people live.

Students working within standard three use their scientific understandings to make sense of day-to-day experiences and issues. In their investigations, they might examine products of scientific work, such as sunscreen or hair gel, and comment on their effectiveness and why or how they came to be developed. They are able to describe how people in a range of occupations and cultures use science in their work and leisure.

At standard three, students consider appropriate ethical issues that are relevant to them, incorporating a scientific perspective. For example, they may consider whether a dam should be built on a river. Students identify and understand some of the relationships within simple systems. They can explore the consequences of human activity for the sustainability of their local natural, built or social environments and investigate how their own actions can contribute to sustainable resource use. For example, they may conduct an energy audit at home as a part of an investigation into how community use of energy is contributing to wider energy use concerns. They understand some ways to take local action on an issue.

Standard three—scientific inquiry

Students working within standard three conduct scientific inquiries into questions and predictions that they generate based on their own interests and experience of the world. As they move through standard three, the process of refining questions changes from being teacher initiated to being student initiated. Students base their thinking on an increasing base of science knowledge.

Students are able to explain the importance of fair testing although they may not use it as a matter of course. They use terms such as variable and control and can list variables that are likely to influence their investigations. They become aware of the need to check, and repeat observations and measurements if required, and can identify some sources of fairness or unfairness in their own and others’ investigations.

At standard three, students conduct scientific investigations in a variety of ways. They may make detailed observations, construct models, conduct fair tests and carry out ecological studies. They make a significant contribution towards designing investigations based on familiar experiences. For example, they may design an investigation about which basketball shoe will provide the best grip or which bread lasts the longest.
before going mouldy or what food their pet prefers. Moving through standard three students become more
ordered in their approach to scientific inquiry and take individual responsibility for careful, safe work habits.

Students understand that if obvious problems occur in their investigation, they should try alternatives. For
example they may report that One of the guinea pigs in our investigation is eating most of the food so we need to
separate them so that we can be sure that all the animals do like to eat bananas and are not just eating them
because that is the food that is left over. Moving through this standard, students increasingly understand that
each investigation is part of an ongoing process of refinement and improvement.

Students are increasingly able to rearrange their data, to make it easier to identify patterns, regularly using
graphs to display results. They correctly interpret data presented in table or graphical format and
independently draw straightforward conclusions. At the upper stages, students make links between their
investigations and scientific knowledge acquired as part of class discussion or individual research.

They understand that the results of scientific investigations are seldom exactly the same and that this is not
necessarily due to any error being made. They begin to make logical deductions or inferences. For example,
they may find dead fish whilst conducting an ecological study of a stream and decide that there are
chemicals in the water that killed the fish.

Students reflect, with assistance from their teacher, considering how well their method worked in practice.
Moving through standard three, they can be assisted to develop a list of criteria suitable for evaluating an
investigation, and can then use the list to reflect on their own investigation. Students consider some
implications of their findings, such as how food should be stored to stop it going mouldy.

**Standard three–scientific communication**

Students working within standard three are becoming more aware of the need to collect and communicate
information in ways that mimic those used by scientists. They use ICT to assist with their work, as a matter
of course. This is likely to include using electronic information sources, calculators, simple data loggers and
common software, such as the Microsoft Office® products.

Students collect information from first-hand investigations, library research, the internet and experts,
becoming aware of the need to check that the information source is likely to be accurate, for example, by
checking the date a book was published. They use Google searches to locate particular information.

Students' scientific communications are becoming increasingly complex and they use written and spoken
modes of communication confidently. They can report their results to a wider audience using a range of
presentation styles and using basic scientific terminology and conventions. They are familiar with the
scientific report style.

They use accessible texts to compare their ideas and the results of their investigations with those that are
generally accepted by scientists. At stage nine, they recognise that data may be manipulated to benefit
certain people or groups. For example, a media article may only report some information.

**Standard three–science as a body of knowledge**

Students working within standard three readily identify some of the science that occurs in the world
around them, including examples of the scientific inquiry process. They are able to seek out the scientific
concepts that are relevant to their observations and questions.
Standard three—science as a human endeavour

**Students should be provided with learning opportunities that develop their ability to:**

<table>
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<tr>
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<th>Stage eight</th>
<th>Stage nine</th>
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<tbody>
<tr>
<td><strong>Scientists work, think, inquire and know in particular ways</strong></td>
<td>• describe some of the ways that people think and work scientifically e.g. ideas, hunches, imagination, problem solving, investigations, theorising, decision making, serendipity, trial and error</td>
<td>• identify and explain some different ways that people think and work scientifically to carry out investigations (e.g. experiment, ecological study, health study) and realise that many investigations have ethical considerations</td>
<td>• realise that scientific ideas are modified over time by a community of scientists as new perspectives and evidence are taken into account e.g. flat earth, is Pluto a planet?</td>
</tr>
<tr>
<td><strong>Applications of science have shaped and changed the world</strong></td>
<td>• recognise products of science and that they may have both positive and negative outcomes for society e.g. cars</td>
<td>• describe how some products used in work and leisure have changed over time e.g. planes, refrigeration</td>
<td>• explain some ways that scientific developments influence and are influenced by history and community needs e.g. vaccines, sewage treatment, water recycling</td>
</tr>
<tr>
<td><strong>Applications of science have systems impacts</strong></td>
<td>• identify some of the relationships in simple natural and/or constructed systems e.g. food chains</td>
<td>• explore the consequences of human activity for the sustainability of a familiar system, including investigating how their actions contribute to sustainability of resources and local environments</td>
<td>• explore some of the relationships within and between local natural, constructed or social systems; and identify different perspectives in making responsible choices e.g. consider the likely effect of a new development on the local ecosystem</td>
</tr>
</tbody>
</table>

**Possible learning contexts**

Contexts should be drawn from Science as a body of knowledge.

**Sample learning activities**

**Scientists work, think, inquire and know in particular ways**

- looking at how scientists might work (e.g. questioning, imagining, observing, experimenting, hunches, problem solving, decision making, sharing findings, debating, retesting) and considering questions such as: How do the scientists know they are right? How do they come up with new ideas or inventions? How do they work together? What might it be like to be a scientist?
- interviewing a scientist, reading a scientist’s blog or emailing a question to a scientist
- discussing how indigenous people undertake science and how this might be different from western science e.g. listen to traditional Aboriginal and Torres Strait Islander stories that incorporate scientific knowledge about particular environments, such as the appearance and behaviour of specific plants and animals e.g. Yellow-Eye
- exploring the heroes and villains of science e.g. scientists who created something of great benefit versus scientists who might have stolen other people’s ideas, created products or conducted experiments that were harmful
- considering questions such as: Are scientists democratic? What happens if scientists cheat? Do they have a code of practice?
- considering how to weigh up the long term benefits of research on animals against animal rights
- working in small groups to research different types of contemporary scientists, considering questions such as Where do they work? What do they do? What instruments do they use? What is similar and what is different? Do scientists have a common way of thinking and investigating? What do they value? How do they check that they are right? How do they know they are fair? How do they come up with ideas? Does science create ‘truth’? How are decisions made?
• discussing different types of investigations and how ethical they might be e.g. some scientists just observe nature without interfering, whilst others need to interfere to collect evidence (such as by cutting fish open to see what they eat), others experiment in the laboratory by changing the conditions to find out what might be happening (such as by feeding fish different food to see if they grow faster)

• developing a class code of practice for being a scientist, which could include scientific processes, thinking dispositions (e.g. be persistent, creative, accurate, open, flexible, honest), ethical considerations and good questions to reflect on e.g. Is this the best way?

• exploring scientific discoveries that challenged what scientists and society believed to be true, considering issues such as: Why didn’t people accept the evidence before? What were the controversies? How did the new ideas come to be accepted? (could role play different characters)

Applications of science have shaped and changed the world

• exploring the ways different applications of science (e.g. medicine, transport) are used in the community and affect the ways we live, describing how an aspect of science has changed over time and how it might have affected society

• making a radio show about how scientists work, think, inquire and know by using a MP3 to record the voices, then using the recording to make a podcast for a nominated audience to listen to

• imagining what the world might be like without a particular technology e.g. without cars, would we need roads?

• exploring inventions, considering question such as: What is the weirdest, most clever, most used, most significant, most horrible or most useless invention? What inventions saved the world? What are some inventions from other cultures? What inventions have used ideas from nature or have come about accidentally? and using Kahootz® to create and design their own invention

• rating inventions against categories such as how good they are for individuals / society / the environment

• looking at something personal that they rely on and tracing how it was developed and why e.g. sunscreen, hairdryer, music, TV, computer, bra, hairspray or hair gel, fridge, cosmetics

• exploring ideas from other cultures about cosmology, technology and significant earth events e.g. Aboriginal Dreamtime, Navajo Indian cosmology, Vedic stories of submarine and aircraft 10 000 years ago, naming of stars and constellations, cosmology of the Egyptian pyramids

• analysing the historical aspects of a particular science event by constructing a timeline of significant developments and / or writing an information report e.g. space exploration

Applications of science have systems impacts

• exploring the different ways that people, plants, animals and the environment are interrelated in the local neighbourhood e.g. What is the uniqueness of the local ecosystem? How would new developments impacted on the ecosystem? How can such ecosystems be protected?

• exploring practices for sustainability that indigenous cultures have developed

• exploring, describing or role playing how simple systems work (e.g. living system such as food chains, digestive system, a mechanical system such as a toy, a production line such as making sandwiches, then moving to more complex systems such as sewage treatment. How do the processes work together? Chart the sequence of steps.

• exploring different products and the resources that they use (e.g. energy, paper, water, food) considering: How are they produced? What industries are needed to produce them? How do they support employment? Is their production sustainable? What would the world be like if they couldn’t be made any more?

• deciding on criteria and a rating system for determining if something is a sustainable practice

• identifying some issues with environmental implications (e.g. litter on a beach, polluted water or air), charting the implications and discussing why the issues exist, then looking at the perspectives of different stakeholders and discussing ethical issues, possible solutions and any new problems the solutions might cause

• examining ways that common household materials can be reduced, reused and recycled (e.g. bottles, cans, plastic bags, paper, cardboard, food scraps) and taking personal action to make a change in their household

• drawing and labelling a flow chart to show how recycling works, designing and setting up a recycling system and evaluating its effectiveness

• simulating making and launching a planet with different physical / chemical / biological conditions into orbit and seeing if it can support life, visit http://www.scienceyear.com/wired/, then select Planet 10 / World Builder

• visiting a local industry to see how it uses scientific processes and production lines, then drawing a flow chart for the industry, from raw resources through to use of the product in the community
### Students should be provided with learning opportunities that develop their ability to:

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<td><strong>Scientific inquiries are generated from observations, questions and predictions</strong></td>
<td>• ask questions and make predictions, with some scientific basis, related to their everyday experience</td>
<td>• create, from their interests or experience, appropriate questions and predictions for testing</td>
<td>• pose questions that can be investigated scientifically, and explain the basis of their predictions about the outcome</td>
</tr>
<tr>
<td><strong>Scientists plan and conduct investigations in particular ways</strong></td>
<td>• understand that science investigations need to be fair, and, with scaffolding, (e.g. an investigation planner) work in small groups to plan and conduct simple fair investigations, that involve changing one variable and keeping everything else the same</td>
<td>• contribute to planning a variety of investigations, recognising where comparisons might be fair or unfair</td>
<td>• identify potential sources of fairness and bias in investigations as they plan and conduct them, suggesting alternative methodologies which may improve or add to an investigation</td>
</tr>
<tr>
<td><strong>Scientists draw conclusions after considering various interpretation of their data</strong></td>
<td>• identify sources of fairness and unfairness</td>
<td>• present data in appropriate ways and then identify patterns. Discuss and compare results with predictions and draw conclusions</td>
<td>• draw reasonable conclusions that are suggested by their data, and consider any obvious implications of their research findings</td>
</tr>
</tbody>
</table>

### Possible learning contexts

Contexts should be drawn from Science as a body of knowledge.

### Sample learning activities

#### Energy and force
- working in small groups to develop a scientifically testable question for investigating the longevity of a range of battery types
- rubbing different materials (e.g. different plastics, wood, glass, metal) with different types of fabric (e.g. silk, wool, cotton) to determine which one creates the most static electricity (e.g. which picks up small pieces of paper most easily) and consider how the test can be made fair
- carrying out a variety of investigations that involve selecting suitable tools e.g. ruler to measure ramp height, measuring tape to measure how far a toy car rolls, video camera to record speed, protractor to measure the angle of a ramp
- designing an investigation into ways to improve the efficiency of a simple machine e.g. the effect of using a longer lever, moving the fulcrum, changing the size of the wheels
- identifying the relationship between the number of gear teeth and the relative motion of gears in a simple gear chain, also the relationship between direction of rotation of gears
- identifying clear sources of bias in an investigation e.g. their rocket went further but they had a bigger film canister
Matter

- identifying and posing scientifically investigable questions in response to the learning that they are participating in e.g. when investigating types of bread, ask What makes bread rise?
- contributing to class discussion on how to refine questions (e.g. Which is the best paper towel?) to one that can be scientifically tested e.g. Which paper towel soaks up the most water? or Which is the strongest paper towel?
- predicting the effect of varying the ingredients in common processes (e.g. fresh pineapple to jelly, using baking powder as well as self raising flour in scones) and commenting on whether this should be common practice
- devising their own fair test to decide which is the best paper towel e.g. using sheets of three different paper towels, dip each into water, squeeze the water out of the paper towel, measure how much came out of each piece and conclude that the paper towel from which most water was squeezed is the best
- making a significant contribution, in a group, to design a fair investigation that compares the properties of different materials e.g. Which colour can absorb the most heat? Which type of fabric keeps the hot water bottle warmest? Which things found in the kitchen are the most soluble? How long do different types of food keep?
- devising and carrying out a fair test to show how temperature affects the evaporation of water
- planning a fair method for a simple investigation that the teacher suggests e.g. When the teacher suggests investigating which is the best laundry detergent, students suggest spilling the same amount of the same kind of tomato sauce on identical white t-shirts and washing them in each kind of detergent
- investigating how quickly different metals rust and recommending which ones are suited for particular purposes e.g. roofing material, sinks, cars, toaster, cutlery, kitchen utensils, electrical wiring
- investigating a particular product to determine which is best e.g. sticky tape, glue removers, string
- trialling the effectiveness of different types of paper for constructing paper planes
- commenting on the water quality in a local creek including whether it is safe to drink it or swim there

Living things

- viewing a video where scientists try to determine if an octopus can learn to navigate a maze and then designing an investigation to test whether a goldfish can remember a maze
- following whole class discussion on what plants need to grow, deciding on one variable and planning and conducting a fair test, (e.g. one plant with no water, one plant with 10mL a day, one plant with 20mL a day etc.) then discussing the fairness of the test and repeating the test
- investigating making compost under different conditions
- investigating the effect of temperature on yeast growth
- comparing their own plans for an investigation (e.g. What colour surface do snails prefer?) with those of others in the class and improving their plans based on the comparisons
- modifying the method that they have designed when problems come to light e.g. One guinea pig won’t let other guinea pigs near the food, so I will test their feeding preferences one at a time.

Earth and space

- designing and conducting an investigation to collect information about the weather using simple instruments (e.g. thermometer, rain gauge) and online sites and discussing emerging patterns with others
- investigating whether the height from which an object is dropped affects the size of the crater that is formed
- investigating the effect of wind on dunes, suggesting and testing ways of stabilising the sand (e.g. use a hairdryer and sandbox and try putting vegetation in the model) and linking their results to actions that could be taken in a local area
- carrying out a study of a local stream, considering a range of factors, such as turbidity, flow, pollution, pH, macro-invertebrates and making recommendations for changes / improvements that are needed in the local area
- investigating the water-holding capacity of a range of soil types (e.g. sand, clay, loam, compost) hypothesising on the effect that would have on the growth of plants
- examining the nature of rocks, analysing their possible uses (e.g. soft rocks can write on pavers) and their origins (e.g. crystals are igneous)
- investigating the weather in local communities (e.g. designing and making or researching instruments that show aspects of weather such as wind speed and direction, rainfall, temperature, air pressure) and using the information to predict the weather the next day
- investigating the question Do different types of water vary in salinity? examining the results that other groups have obtained and identifying whether the pattern or trend in the data is the same as their own results
### Standard three–scientific communication

*Students should be provided with learning opportunities that develop their ability to:*

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<td><strong>Scientists consider accuracy, relevance and credibility when acquiring information</strong></td>
<td>• collect information relevant to their science investigations in ways that mimic those used by scientists e.g. library research, internet, poster, experiment</td>
<td>• collect information relevant to their science investigations from a variety of sources, using simple strategies (e.g. check the author) to assess its accuracy, relevance and credibility</td>
<td>• purposefully collect, select and organise information to answer particular science questions, being aware that data may be selectively presented to suit various groups’ needs</td>
</tr>
<tr>
<td><strong>Scientists need to communicate information in a variety of ways</strong></td>
<td>• present results of their investigations in ways that mimic those used by scientists, such as a report, an oral presentation or a poster</td>
<td>• be aware that they can present the results of their science investigations in a variety of ways (e.g. report, PowerPoint, poster, talk, role play, video, mind map, photo essay) and select appropriate ones, showing an awareness that some are more effective than others</td>
<td>• compose texts that present the results of their science investigations clearly and logically, including the use of lists, tables, diagrams and pictures where appropriate</td>
</tr>
</tbody>
</table>

### Possible learning contexts

Contexts should be drawn from Science as a body of knowledge.

### Sample learning activities

**Scientists consider accuracy, relevance and credibility when acquiring information**

- refining questions for an inquiry about forces, then brainstorming sources of information and identifying appropriate search terms for a web search
- researching the history of batteries, using the internet, books, interviews
- researching and presenting a report on the inventor of a common object and their invention e.g. television
- brainstorming the uses of water
- interviewing an expert or visiting a local recycling plant to find out what happens to objects after they are placed in the recycling bins
- framing questions and using a variety of resources, including web search, CD ROMs and video to find out about food preservation
- drawing the shapes of different trees to compare and group them
- maintaining an accurate record or journal of features or behaviours of a living thing using a method that they have devised e.g. record the feeding preferences of guinea pigs when they are offered a number of different foods
- comparing the results of their own investigations with the results of scientists, using the internet or books as a source of information e.g. What do books tell us about which flowers you can make dye from?
- examining the ways in which argument texts present a point of view on an issue e.g. water use in the community
- researching how beans grow and what they need to survive
- beginning to ask questions to determine the currency, relevance, credibility, accuracy of information on issues such as the devil facial tumour disease
- researching the history of the thylacine to find out why it may have become extinct
- drawing a map and plotting the distribution of an endangered species such as the giant freshwater lobster
Scientists need to communicate information in a variety of ways

- using Microsoft PowerPoint® or PhotoStory® to compile a list of instructions for making and using a siphon and an explanation of how it works
- using a variety of graphic organisers (e.g. mind maps, concept maps, flow diagrams, graphs, maps) to show their understanding about materials and how they are used e.g. using Inspiration®
- using appropriate software to compile a report on a fair test they have carried out on insulating materials
- drawing a simple diagram that represents the water cycle and role playing the experiences of a water drop
- investigating the recycling numbers on various plastic containers and explaining what they mean
- presenting a report on the effectiveness of different stain removers, using the headings Aim, Method, Results, Discussion, Conclusion
- constructing a model volcano to show its structure
- making a podcast or video to present their opinion about a proposed processing plant during a debate
- preparing and presenting a report on the process of soil erosion or making a video clip about it
- developing a video or producing a pamphlet using Microsoft Publisher® to show parents about the class’s involvement in a local environmental project
- interpreting symbolic information on maps and diagrams e.g. pictographs, simple keys, grid references
- composing a chant or rap suggesting possible solutions to the problems faced by an endangered native species
- discussing and debating a conservation /environmental issue such as the effect of feral animals on the environment
- developing a large wall chart about the habitats of some common Australian animals and plants
- describing the functions of a feature of an animal through the use of a multimedia presentation e.g. the shell of a snail provides protection and shelter
- representing collected data as a simple but accurately drawn and labelled bar graph e.g. using Microsoft Excel®
- comparing present environments with those of the past, using art works, visits to natural environments, maps, electronic images, photographs etc. and discuss changes that have taken place
- representing energy transfer chain findings in diagrams, multimedia presentations or posters
- using drawings, graphs, science journals to communicate their findings from experiments about yeast
- discussing different ways of representing data (e.g. graphs, tables, photo stories) and adjusting information for a specific audience e.g. children in the Years P-2
- constructing a mind map about objects in our solar system
- using ICT programs such as Hyperstudio® or Inspiration® to demonstrate an understanding of the seasons
- investigating and developing an argument about the effect that the introduction of exotic species to an ecosystem can have on its nature and viability and communicating the argument confidently, using online and offline modes
- comparing their conclusions and justifications with those of others e.g. reporting on ways in which science is used in tackling a problem that they have investigated e.g. air or water pollution
- presenting investigative findings and considered position on the effects of common materials on environments to a school assembly
### Students should be provided with learning opportunities that develop their ability to:

<table>
<thead>
<tr>
<th><strong>Main idea</strong></th>
<th><strong>Stage seven</strong></th>
<th><strong>Stage eight</strong></th>
<th><strong>Stage nine</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The behaviour of objects is determined by the forces that act on them</strong></td>
<td>• describe some of the ways in which people apply forces for specific purposes e.g. pulleys for lifting, levers for moving things, hammering in nails, bows and arrows, screwdriver, playing musical instruments</td>
<td>• compare the effects of large and small forces on the motion and / or shape of an object</td>
<td>• investigate and describe some of the relationships that exist between force, motion and energy e.g. pendulums, throwing a ball, levers, pulleys</td>
</tr>
<tr>
<td><strong>Energy can be transferred and transformed</strong></td>
<td>• identify ways in which energy can be stored (e.g. batteries, rubber bands, springs, water in dams) and how it is then used e.g. to make a torch work, to operate a toy, to make air particles vibrate</td>
<td>• investigate how some different forms of energy (e.g. heat, sound, light, electricity) are transferred e.g. electrical energy via the wires in an electrical circuit</td>
<td>• investigate and explain how living things use different energy transfers e.g. the chemical energy in food allows bodies to function, movement of water downhill allows electricity to be generated, vibrating air particles allow sounds to be heard</td>
</tr>
<tr>
<td><strong>Humans use energy and this raises ethical and sustainability issues</strong></td>
<td>• suggest practical ways in which to reduce their energy usage (e.g. turn lights and television off) and suggest why that is desirable e.g. it would be cheaper, if everyone did it we wouldn’t need to worry about not having enough water in dams</td>
<td>• investigate how some different forms of energy are used in their community and research the sources of those forms of energy</td>
<td>• investigate various ways of obtaining and using energy more efficiently e.g. insulation, type and amount of food that living things eat</td>
</tr>
</tbody>
</table>

### Possible learning contexts

How do simple machines make life easier? What’s the electricity doing in your circuit? Could and should our school go solar? How are sounds created? How do explorers survive in extreme environments? It’s electrifying*

* (denotes a Primary Connections unit)

### Sample learning activities

**The behaviour of objects is determined by the forces that act on them**

- investigating and discussing some ways in which people use tools to make doing things easier
- investigating simple machines and identifying how they are commonly grouped (inclined plane / ramp, lever, pulley, wheel and axle, screw), how they make work easier because they require smaller forces and which machine is best for doing particular jobs
- identifying, investigating and recording how simple devices (e.g. playground equipment, toys, balls, scissors, stairs, ramps, doors) move or operate, using terminology that includes levers, pulleys, gears and wheels
- investigating how different size forces affect the movement of a toy plane or ball e.g. by drawing a rubber band back by different amounts and then measuring how far the object moves
- investigating the effect that changing the slope (increasing the force) of a ramp has on an object rolled down it
- investigating the force that different shapes can withstand and determine the weight they can hold e.g. make different types of bridges from skewers, icy pole sticks, spaghetti
• discussing the different forces that act in different situations and researching how humans overcome them when exploring different environments e.g. deep ocean divers experience large external pressures of water pushing against them, so they need submersible vehicles with thick walls; astronauts experience very small external pressures, so they need suits that insulate them from the external environment, to stop them from exploding
• talking about how a larger force is needed to move a larger car, so the car needs more energy (fuel)
• predicting, testing, analysing and reporting on how the swing of a pendulum is affected by the length of the string and the weight of the pendulum
• use the Learning Federation object, Pulleys, to explore lifting problems

Energy can be transferred and transformed
• discussing how different forms of energy can be classified e.g. movement, chemical, light, sound, mechanical, electrical, magnetic, elastic
• investigating and describing easily observable characteristics of some energy forms e.g. light rays travel in straight lines and bounce off mirrors, sound travels better through solids than through air
• investigating how we hear sound better when it moves through a solid rather than the air e.g. stethoscope, putting ear to the ground
• designing and modifying a string or tube telephone (e.g. change string material, thickness, length, tube diameter) to investigate the way in which sound is transmitted
• investigating the energy processes involved in hearing e.g. a sound is created → air particles vibrate → ear drum vibrates → sound travels through ear bones → sets up vibration in hairs of different length inside the ear → each hair sends an electrical signal to the brain → the brain puts each pitch together to create the whole sound. Model the ear by using different musical instruments or devices to represent each stage.
• exploring how changing the shape and size of a sound cannon affects its effectiveness at blowing a candle out
• investigating heat transfer through experiments such as the ability of different metals to transfer heat energy by using butter to stick small beads to one end of a piece of metal and then heating the other end (e.g. by standing it in a container of hot water) or using a thermometer to measure the effectiveness of different insulations in keeping a container of liquid hot or cold
• investigating the effect that magnetic and non-magnetic objects have on compasses placed nearby and discussing how sailors and bushwalkers use the Earth’s magnetic field to help them to navigate
• designing, making and comparing the accuracy of different timing devices e.g. candle clock, water clock
• constructing a variety of simple electric circuits and seeing which materials are suitable
• setting up a chain of dominoes or Mousetrap game and talking about how the energy is transferred
• analysing devices to identify energy sources, energy receivers and chains of energy transfer e.g. sun → food → human → bike pedal → chain → back wheel, or water in dam → turbine → electricity → television → light and sound and heat

Humans use energy and this raises ethical and sustainability issues
• investigating patterns of energy use in the home and school and suggesting ways of reducing wastage
• comparing current energy use with energy use in the past e.g. survey parents and grandparents
• visiting sites where electricity is or used to be generated and transferred for their community e.g. a nearby dam
• investigating alternative uses and sources of energy in the past, present and future, and taking part in activities such as designing, making and testing the effectiveness of models of windmills
• researching the sources of a range of forms of energy and how they are transferred and used e.g. wind power
• identifying and discussing how people use alternative energy sources at home, in the workplace and in recreational activities e.g. windsurfing, solar power to heat a swimming pool
• recognising that different human activities require different amounts of energy
• comparing the energy content of different foods (by reading packaging labels and advertising materials) and considering what the effect of eating different types of food is likely to be
• investigating the effects of building design on energy use at home and school (e.g. verandahs, two-storey buildings, curtains, landscaping) or solving problems associated with energy use within the context of design and technology e.g. designing ways to light dark corners and to improve the acoustics in rooms
Students should be provided with learning opportunities that develop their ability to:

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<tr>
<td>The chemical and physical properties of materials are determined by their structure</td>
<td>• investigate how changing the manner in which parts are assembled can change the properties of the final product e.g. some shapes are more streamlined, some shapes are stronger</td>
<td>• explore the properties of an object in relation to the properties of the materials that it is made from e.g. eggs and sugar compared with meringue, sand and cement compared with concrete</td>
<td>• explore some of the relationships that exist between materials’ properties and how they behave e.g. foods that contain starch turn purple when you add iodine, things that are made from animal or plant matter will decay in a compost bin</td>
</tr>
<tr>
<td>Materials react and change in a variety of ways</td>
<td>• investigate and describe temporary and more permanent changes that materials can undergo e.g. whipped cream, boiled eggs, ice, wax, garden waste, metal corrosion</td>
<td>• investigate different types of changes materials can undergo e.g. tanning leather so that it lasts and is more pleasant to wear, refining ores to obtain metal, dyeing with different mordants</td>
<td>• identify patterns in the types of change that take place in materials e.g. some metals rust / others do not, foods deteriorate faster at higher temperatures, liquids evaporate / solids do not</td>
</tr>
<tr>
<td>Humans use materials and this raises ethical and sustainability issues</td>
<td>• describe some of the ways common materials (e.g. water, wood, metals, fabrics) are used, and why those materials are used in preference to others</td>
<td>• examine how the selection of material for a specific purpose depends on the selection criteria as well as the properties of the materials being considered e.g. cost, can it be recycled?</td>
<td>• investigate how effectively some manufactured materials meet their purpose and consider the potential impact their use may have on the environment e.g. biodegradability of plastics</td>
</tr>
</tbody>
</table>

Possible learning contexts
Captivating chemistry*. How will we identify the mystery powder? Which running shoe should I buy? Whose spaghetti bridge is strongest? What’s the lifecycle of a tin can? How well can packaging protect an egg? (* denotes LTAG learning sequence)

Sample learning activities
Structure and properties of materials
• designing and conducting fair investigations to compare the properties of common materials, such as:
  - strength of threads, sticky tapes, glues, plastic bags, rubber bands, papers, woods
  - flexibility of paper, rubber, wire
  - solubility of common kitchen substances like salt, sugar, flour and bi-carb soda in a range of solutions like water, vinegar and milk
  - bouncing ability of rubber, balls
  - absorbency of kitchen towels and fabrics
  - stretchability of different fabrics
  - cleaning power of different soaps or detergents
• describing the visible structure of materials using adjectives such as grainy, porous, fibrous, powdery and spongy
• investigating the ways in which a mixture’s properties compare with the part’s properties e.g. a cake or a meringue with egg and sugar, a mud brick with dirt and water
• investigating and describing a property (e.g. texture) of the components of materials before and after they are combined e.g. sand, cement, water, gravel components and the resulting concrete

• using magnifiers, microscopes or digital microscopes to investigate the visible structure of common materials, (e.g. the fibres that make up fabrics) and to sort materials according to particle size and shape (e.g. sugar, salt and flour)

• comparing properties of different forms of the same edible material, (e.g. breakfast cereals, wholemeal and white flour, oranges and orange juice) and discussing which is better for health and why

• researching and classifying the raw materials used in the component parts of everyday objects e.g. parts of a car

Materials react and change in a variety of ways

• investigating and describing reversible and irreversible changes e.g. water to ice, cream to whipped cream, raw egg to fried egg

• predicting, contributing ideas to designing and conducting experiments to show how different conditions can affect change e.g. dissolving sugar in cold and hot water, stirring salt into water for various amounts of time

• designing and conducting investigations into the effect of external environmental factors on common materials e.g. heat on colours, wind drying out moisture, light bleaching colour, iron nails kept in different conditions

• investigating simple ways to separate substances through a range of methods (e.g. evaporation to get salt from seawater, filtration to remove dirt from water) and discussing whether the changes are reversible or not

• observing and describing the changes that different foodstuffs undergo e.g. making bakers’ toast (honeycomb), churning cream to make butter

• investigating the factors affecting rates of processes e.g. temperature on yeast growth, dehydration on food spoiling

Humans use materials and this raises ethical and sustainability issues

• relating the properties of common materials to their use e.g. why Lycra® is used for swimsuits, why waterproof material is used for raincoats

• finding out about how various materials and scientific processes are used in paid and unpaid work, by interviewing people (e.g. a vet, home-carer, national park ranger, plant nursery worker, canteen manager, groundsperson) to find out why and how they use specific materials and processes, and what alternatives there are

• asking people what different types of chemicals / materials they have in their cupboards and why they have them e.g. cleaning products, fuels

• researching how certain materials (e.g. dairy products, timber, iron ore) are processed or different products are made

• investigating and experimenting with different types of food preservation (e.g. making jam, freezing, drying) and considering how those processes have affected human activity and the environment

• working in teams to investigate ways of combining different substances to produce useful materials (e.g. self-raising flour, concrete) and considering how those processes are used in their homes and in workplaces

• developing and justifying a set of rules for safe handling, storage and disposal of materials at home, at school, and in business, industry and the community and using Microsoft PowerPoint® or PhotoStory® to communicate these

• using books, CD Roms and the internet to research different inventions, the materials they use, how they are made and their impacts on humans and the environment

• investigating the properties of household products, (e.g. properties and uses of detergents and their effects on the environment) discussing the ethical positions of using and disposing of materials, considering alternatives and the implications for their personal use and creating a pamphlet for parents using Microsoft Publisher®

• investigating the packaging of common items (e.g. food or toys), considering the properties of materials used, the benefit to the customer or the producer, the costs, the resources being used and waste created

• raising questions about and investigating the suitability of materials for construction of everyday objects e.g. spaghetti bridges, paper planes from different types of paper, storage of food in plastic, paper or glass

• comparing the advantages and disadvantages, including environmental impacts, of using materials for a particular purpose e.g. chlorine or salt in swimming pools, bleach, CFCs
### Standard three—science as a body of knowledge—living things

Students should be provided with learning opportunities that develop their ability to:

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<td><strong>The structure and characteristics of living things affect their behaviour and functioning</strong></td>
<td>• pose questions and seek explanations about the internal and external features of living things in order to better understand how they survive e.g. What happens to food in the stomach? What affects plant growth?</td>
<td>• describe the relationship between the structures of living things and the functions those structures perform e.g. ears are shaped to catch sound waves, Venus fly traps have specialised leaves to catch insects</td>
<td>• explore ways in which the health and survival of organisms is dependent on their environment e.g. diet, disease, climate</td>
</tr>
<tr>
<td><strong>A diverse range of living things have evolved on the Earth</strong></td>
<td>• identify and describe various features of a variety of objects and explain whether they should be classified as living, non-living or once living</td>
<td>• use observable characteristics to sort familiar and unfamiliar living things into groups</td>
<td>• investigate and classify closely-related living things on the basis of easily observable characteristics e.g. blue whale / sperm whale / killer whale, eastern rosella / green rosella / rainbow lorikeet</td>
</tr>
<tr>
<td><strong>Humans interact with ecosystems, and this raises ethical and sustainability issues</strong></td>
<td>• describe some of the interactions that occur between living things, including humans e.g. predator / prey, parasite / host</td>
<td>• explore ways in which living things interact with each other and the non-living parts of their environment e.g. water, soil</td>
<td>• explore ways in which humans have impacted on the living things in a particular ecosystem e.g. introduced species, hunting, habitat change, animal migration patterns</td>
</tr>
</tbody>
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**Possible learning contexts**

*Marvellous microorganisms*, Why are shorebirds at risk?*, Is it worth fighting for?* Why is my ear the shape it is? What adaptations are needed to survive in Antarctica? How will the Tasmanian devil survive? What are some threats to survival in the Tasmanian bush? How do you know if you are talking to a kangaroo or wallaby? (* denotes LTAG learning sequence, # denotes a Primary Connections unit)

**Sample learning activities**

The structure and characteristics of living things affect their behaviour and functioning

- posing questions about, investigating and describing the function of some internal and / or external features of living things and how those features enable them to survive e.g. sonic guidance of bats helps them navigate at night, leaf shape and colour, camouflage
- identifying, labelling and sharing ideas about the features of particular living things that help them to survive e.g. thorns, woody seeds, hard shells, birds’ beaks
- visiting a museum and describing the features of living things they observe e.g. thylacine has striped fur, the Tasmanian devil has really strong jaws
- recognising and investigating a variety of relationships that exist between living things e.g. clown fish are able to survive in sea anemones, mistletoes are parasitic and attach themselves to other plants, cuckoos lay their eggs in other birds’ nests
- investigating and describing features of plants or animals that help to ensure survival into the next generation e.g. winged seeds
- reporting how features of plants and / or animals aid in their survival e.g. fat leaves for storing water, beak shape for eating seed
• working collaboratively or in teams to research online how and why some species have become extinct or endangered e.g. dinosaurs, thylacine
• designing the ultimate animal to survive in a specified environment and justify your design e.g. consider diet, reproduction, predators, climate, interesting features
• identifying examples of features that aid the survival of animals or plants in their particular environments

A diverse range of living things have evolved on the Earth
• deciding if objects are best classified as living or once living or non-living and explaining how they decided
• researching how scientists classify living things and what you need to know about living things in order to classify them
• exploring the ways in which scientists decide if an organism has the potential for life or was once alive e.g. investigates seed germination
• identifying the features used in plant and animal classification and giving examples of members of different groups, predicting the type of environment that an unfamiliar animal would be found in by observing its features and suggesting the function that they perform
• researching some groups of living things, including common Australian plants and animals, to find out why they are grouped together e.g. reptiles, parrots, monotremes, eucalypts
• comparing life cycles and reproductive processes of different living organisms e.g. ferns, fungi, amphibians, mammals, birds
• using a key to identify specimens they have collected from different locations e.g. identify water invertebrates as being crustaceans or insects or worms
• identify ways in which more closely related living things can be distinguished using easily observable characteristics e.g. species of whales or parrots

Humans interact with ecosystems, and this raises ethical and sustainability issues
• researching some of the effects that introduced species can have on an environment e.g. rabbits, foxes, blackberries in Australia, rabbits and cats on Macquarie Island, Northern Pacific Seastars in Tasmania
• recognising and investigating a variety of relationships between living things, including parasitic relationships (e.g. mistletoe) and symbiotic relationships (e.g. native birds) with particular types of plants
• appreciating that living things depend on each other and on environments for survival and exploring the effects of humans and introduced species on environments through interactive simulations and software programs
• investigating the impact of natural environmental change on plant and animal existence e.g. seed germination following bushfire or floods, frogs and fish burrowing in times of drought
• analysing a proposed environmental change and writing a letter, email or blog detailing its potential impact
• creating a poster or Microsoft PowerPoint® presentation analysing the impact of a feral animal
• writing a letter to the premier persuading him that the government needs to eradicate rabbits from Macquarie Island
• designing a game based on the positive and negative effects of living things in a specified environment e.g. use Kahootz® to design and play the game
• describing the biodiversity of various habitats and identifying food chains that exist there e.g. wetlands, dry sclerophyll forest, Antarctic ocean
• developing knowledge, skills and language to describe and report on the unique features of Australian biodiversity through a study of local environments
• investigating the positive and negative impacts that humans may have on their environment e.g. land clearing, construction of marinas, reservoirs and dams
• summarising information from an invited guest speaking on an environmental topic (e.g. Waterwatch, Parks and Wildlife Service) and suggesting what action needs to occur e.g. a detailed survey of an area, provision of nesting boxes
• using a ‘futures wheel’ to explore the implications of reduction in diversity, and planning and carrying out actions to support ecological diversity by constructing and situating nesting boxes
• researching animal migration patterns e.g. the Swift Parrot, whales
• surveying the shorebirds in their local area, investigating their migration routes and identifying any threats to their survival, e.g. shearwaters
• use the Learning Federation object, Who’s for dinner, to examine a billabong food web
### Standard three—science as a body of knowledge—earth and space

**Students should be provided with learning opportunities that develop their ability to:**

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<tbody>
<tr>
<td>Earth and space have characteristic features and patterns of activity</td>
<td>• describe some of the ways in which humans explore the Earth and Solar System e.g. use submersibles to collect information about deep ocean vents, use telescopes or space probes to collect information about other planets, collect fossils to see what the Earth used to be like</td>
<td>• research current information from space exploration about other planets and objects in the solar system and compare the regular and predictable motions of various objects in the solar system e.g. by modelling</td>
<td>• identify and describe the conditions that sustain life on Earth and compare them with conditions on other planets</td>
</tr>
<tr>
<td>Earth and space systems continue to be shaped by the changes they experience</td>
<td>• describe some of the ways in which the Earth has changed in the past and how it continues to change and categorise those changes e.g. regular / irregular, sudden / gradual, natural / result of human activity</td>
<td>• suggest causes and effects of some of the changes which occur at the surface of the Earth or in the atmosphere e.g. pollution</td>
<td>• investigate some interactions between systems of Earth (atmosphere, oceans Earth’s surface) and / or space e.g. weather, water cycle, erosion, rock formation, changing course of rivers, meteor impacts</td>
</tr>
<tr>
<td>Humans use the Earth and this raises ethical and sustainability issues</td>
<td>• describe the importance of the Earth’s characteristics in allowing living things to survive, and how changes to these characteristics may affect living things e.g. air and water pollution</td>
<td>• investigate how different Earth resources are used in the community for a variety of purposes e.g. forestry, mining, fishing, power production</td>
<td>• investigate a local environmental issue and explain the reasons for the community’s involvement e.g. Landcare projects, water quality, recycling, Clean up Australia, reduced plastic bag use</td>
</tr>
</tbody>
</table>

### Possible learning contexts

Where do rocks come from? How do we explore away from the surface of the Earth? What makes the Earth move and change? How can plastics be a problem for the Earth? What cycles are important on Earth? Understanding healthy waterways

### Sample learning activities

**Earth and space have characteristic features and patterns of activity**

- making telescopes, periscopes, Cartesian divers, models of volcanoes
- viewing video footage of submersibles exploring deep sea trenches, undersea volcanoes and mountains
- role-playing information about the solar system (e.g. order of planets, relative size, distances apart, properties) or using Kahootz® to create a solar system simulation
- discussing a range of astronomical features e.g. stars, constellations, comets
- comparing details of the moon visible to the eye with those seen through binoculars
- viewing video clips of astronauts carrying out various activities (e.g. dropping things, jumping on the moon, throwing balls, using the toilet) and identifying similarities and differences between activity on Earth and in zero gravity environments, and then hypothesising about what activity would be like on other planets
- participating in sessions run by local astronomers to find out about different aspects of the solar systems
• questioning and exploring ideas about the characteristics of the Earth that are favourable to life, comparing the Earth with other planets, considering the prospect of life on other planets
• investigating the factors that affect life on Earth and comparing them with other planets e.g. making a terrarium
• suggesting what they would need in order to migrate to, and survive on, another planet
• use the Learning Federation object, The wonders of our universe, to explore Earth's place in the universe

Earth and space systems continue to be shaped by the changes they experience
• observing and collecting information about the impact of environmental changes, such as those due to periodic changes (e.g. day and night, seasonal changes, tides), steady changes (e.g. a shifting coastline, the weathering of buildings), violent changes (e.g. storm damage, flooding), irregular changes (e.g. drought, bushfires)
• keeping a record of how the size and direction of shadows changes at different times of the day and make connections between the length / position of the shadows and the apparent position of the sun
• investigating shadows at different times of the year e.g. using a digital camera to photograph a schoolyard feature at the same time of the day every month
• monitoring and describing changing weather conditions e.g. describing cloud patterns, comparing wind speeds, accessing the Bureau of Meteorology website
• modelling the formation of different types of rocks by making rocky road, baker's toast or similar
• discussing and analysing the effects of a current issue that highlights sudden environmental change e.g. bushfire, flooding, sand dune erosion due to a king tide, drought, storm, tsunami
• using electronic sources of information to compare their present environments with images or descriptions from 20, 60 or 150 years ago and discussing the changes that have occurred
• drawing a simple diagram to show the water cycle e.g. use Google Sketchup® to create a diagram
• making a model ecosystem in a terrarium and observing how frequently it requires water
• expressing their ideas about changes that occur in their local environment and considering the implications for sustainable environments
• using websites, databases, DVDs and CD ROMs to identify and report on patterns of global air and ocean movements, and exploring how that data is used in weather forecasting
• posing questions about the nature of rocks and their origins
• exploring the ways in which people depend on soils, the mistakes made in the treatment of soils, and the steps they take to conserve them
• simulating the effects of wind and water erosion by constructing model environments e.g. use Kahootz®
• investigating the characteristics of the different seasons and what causes the changes observed e.g. rainfall, temperature, length of day, equinox, solstice
• using soil probes to measure soil temperature and moisture content during a seasonal change

Humans use the Earth and this raises ethical and sustainability issues
• discussing the steps people take to reduce the risk of degradation of natural environments (e.g. bushfires, soil erosion) and explaining why this is important
• investigating the impact that seasonal and environmental change may have on living things (e.g. hibernation, deciduous trees, salmon migration) and the behaviour and adaptations that living things may display in response to environmental change e.g. following floods in Central Australia, many wildflower species bloom
• researching natural materials that they and their communities need and how this use can be sustainable e.g. water, forests, minerals
• writing a report about our use of natural materials and identifying possible environmental impacts
• discussing the pros and cons of mining operations and envisaging a sustainable future
• identifying changes that occur in their local environment and considering any implications for sustainability
• discussing situations where people have altered landscapes for activities such as farming or housing and considering long-term implications of those alterations
• researching the exploration for, and use of, minerals and the management of mineral resources
• collecting data and presenting findings showing how the evaporation rates of water are affected by temperature and making links to water restriction regulations
• using Google Earth® to view different areas
Standard four–science overview

Students working within standard four have developed an understanding of scientific concepts and scientific inquiry and apply this understanding in their own investigations. They appreciate that science and its processes have applications in everyday life and are developing an awareness of the importance of scientific literacy in making decisions that influence individual and community wellbeing.

Standard four–science as a human endeavour

Students working within standard four have acquired a significant understanding of a scientific world view. They are practised in the process of evidence collection and interpretation and recognise that scientists see valid evidence as allowing them to more confidently predict how the world works. They appreciate that science values openness to new ideas, intellectual honesty and willingness to change when proved wrong. However, they are also beginning to understand that science knowledge and practice is not value-free and scientific integrity and rigour can be influenced by culture, religious beliefs or personal passions.

Students recognise examples of explanations that would not be accepted by the scientific community (e.g. horoscopes) and can articulate the difference between the way scientists work and approaches used by non-scientists.

Students are beginning to appreciate the contribution different cultures have made to scientific knowledge. They consider reasons why different cultures may have different views in relation to scientific practice and how this has informed the way different cultures live or have lived, for example, indigenous perspectives or that of Chinese medicine. They explore how and why scientific ideas have changed over time (e.g. Earth is not the centre of the universe, causes of disease).

Students are able to suggest investigations and questions that arise from media articles and advertisements, considering and responding to various ethical and social issues. They examine the impact of applications of past and present science and technology research on themselves, society and the environment. Moving through standard four, students use their scientific understandings to identify some system relationships when predicting consequences and suggesting solutions to relevant issues.

At standard four, students investigate and consider current and possible future impacts that their communities may have on the sustainability of their natural, built or social environments and can see the connections between local and global environmental and resource issues. For example, students may debate issues that arise from the construction of a new processing plant.

Standard four–scientific inquiry

Students working within standard four confidently design and carry out straightforward scientific inquiries to answer their questions. They make reasoned predictions about the possible outcomes of straightforward investigations, basing their predictions on the scientific concepts that they have encountered.

Students are developing a clear understanding of the concepts underlying the scientific process, including variables, controls and hypotheses. They recognise that conditions must be the same for a fair comparison and, as a matter of course, run several trials and average the results. They understand the concept of a variable and can identify the variable to be changed (the independent variable), the variable to be measured (the dependent variable) and the factors that need to be kept constant. At the early stages of standard four, students are likely to frame their investigations as a question, such as Will fertiliser make my beans grow faster? but moving through the standard, they recognise that scientists generally frame their investigations as hypotheses (for example, Plants will grow faster if fertiliser is added), and that a good hypothesis must be testable.

They recognise that equipment varies in its accuracy and that their own skills in making measurements can impact on the data they collect. For example, they may recognise that a measuring cylinder will be more accurate than a beaker for measuring liquids, or that different types of balances vary in their accuracy.
Students consistently rearrange and analyse their data appropriately, and discuss and summarise patterns in it, drawing reasonable conclusions. They recognise that they need to question data that appears to be anomalous. Students working within standard four compare their results with those of others for the same investigation, suggest plausible reasons for any differences and offer reasonable suggestions about how to improve their investigations or conduct further ones. They reassess their understanding in the light of new data or reconsideration of existing data.

At the upper end of standard four, students can conduct and interpret more complex investigations, such as those that involve multiple data sets.

Students clearly explain how their conclusions are linked to their data, and link their results and conclusions to relevant scientific concepts. They draw some connections between their investigations and wider social or environmental issues, recognising some of the implications of their work. For example, after conducting an investigation into Which is the best toilet paper? students may conclude that Brand X is the most absorbent but that it is not made from recycled paper, or it is too expensive, so people may choose not to use it.

**Standard four—scientific communication**

Students working within standard four are becoming more selective about the information sources they use, realising that some sources of information are dated, provide limited detail or are significantly biased. Moving through standard four, students begin to collect information from challenging texts, such as specialised textbooks and current affairs programs.

Students communicate confidently in a variety of ways, including the use of the scientific report style. The range of texts they construct include multimedia presentations, word processed documents, short films and emails. They are beginning to write clearly and provide adequate detail when communicating information about their scientific investigations and how they reached their conclusions. They communicate using the appropriate conventions of forums, chat, instant messaging, blogs and wikis.

At standard four, students increasingly use appropriate scientific terminology and representations, in familiar contexts. This is likely to include various graphs, models, diagrams, chemical symbols and circuit diagrams. They understand that different groups have different information needs and reflect on the appropriateness of different methods of presenting data in terms of clarity, ease of analysis and the background of the intended audience.

Standard four students are familiar with using ICT to collect, organise and communicate a range of scientific information. They use familiar software, such as Microsoft Office® products and conduct online searches as a matter of course but not always efficiently or to maximum effect. They are aware of the power of computers and consult others about how to achieve effects that they are not familiar with but they have a tendency to under utilise other sources of information. Students are aware of issues surrounding plagiarism.

**Standard four—science as a body of knowledge**

Students working within standard four are developing a working knowledge of a range of scientific concepts and are starting to refer to them in their investigations, particularly when designing the method and discussing their results.

Scientific concepts that students should have engaged with within standard four, and which will inform their investigations, include those from the national Statements of Learning for Science, Year 7.
Standard four – science as a human endeavour

Students should be provided with learning opportunities that develop their ability to:

<table>
<thead>
<tr>
<th>Main idea</th>
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</thead>
<tbody>
<tr>
<td><strong>Scientists work, think, inquire and know in particular ways</strong></td>
<td>• examine how and why people engage in science as a worthwhile and exciting career, including examining the work of Australian scientists</td>
<td>• consider what is characteristic of the way that scientists work, and why this is important e.g. integrity, rigour, regard for evidence</td>
<td>• identify some things that limit or control scientific work or understanding e.g. ethics, code of practice, government regulation, exclusion of certain groups—such as women or ethnic groups</td>
</tr>
<tr>
<td><strong>Applications of science have shaped and changed the world</strong></td>
<td>• recognise that different cultures may have different views in relation to science e.g. traditional medicine</td>
<td>• analyse how and why some products and processes used in work and leisure have changed over time / vary across cultures e.g. food preservation methods</td>
<td>• analyse how and why some products and processes have changed over time / vary across cultures, and the impact that this has on people e.g. contraception, IVF</td>
</tr>
<tr>
<td><strong>Applications of science have systems impacts</strong></td>
<td>• examine issues of sustainability of the natural, built or social environments extending from local to global perspectives</td>
<td>• identify system relationships when investigating local or global issues, including sustainability, and consider some of the reasons that different people make their decisions e.g. construct a Futures Wheel to consider the impact of a new development</td>
<td>• discuss some of the system relationships identified when investigating local and global issues, including sustainability</td>
</tr>
</tbody>
</table>

Possible learning contexts

Contexts should be drawn from Science as a body of knowledge

Sample learning activities

**Scientists work, think, inquire and know in particular ways**

- researching an inspirational scientist (e.g. Dian Fossey, David Suzuki, Stephen Hawking, Albert Einstein, Barbara McClintoff, Richard Buckminster Fuller), considering factors such as the areas that are their passion, their contribution to scientific knowledge, barriers they had to overcome, research they drew from, how they ensure rigor in their research, any conflicts with personal beliefs and using Microsoft PowerPoint® or PhotoStory® to present their findings
- interviewing a scientist (e.g. use an MP3 player or digital video) to find out how and why they became involved in science, what they do, how they do it, what barriers there are to their research, and make this into a podcast or movie for others to watch
- exploring the codes of practice via the internet for different groups of scientists (e.g. biologists, physicists, medical research, naturopaths). What are the key considerations, various approaches and why? Develop a class code of practice. What does it mean to be rigorous and to have integrity within different fields of research?
• exploring the story of an inspirational scientist who has overcome prejudice to become a scientist, or considering what contributions women have made to science and the perspectives they bring, or considering the contributions of scientists from other cultures
• exploring the difference between science and pseudo-science, considering what should be classified as pseudo-science instead of science
• considering what sceptics who engage in scientific investigation and journalistic research have to say http://www.skeptic.com/
• using the Learning Federation Meet a scientist series of learning objects to learn about the work of some different scientists

Applications of science have shaped and changed the world
• researching science from another culture (such as traditional Chinese medicine), examining how their practice of conducting research and gaining knowledge might be different from modern Western science approaches and considering its contribution to scientific thinking
• exploring and analysing the history, benefits and costs of a particular field of science and how it has changed the way people live or see the world e.g. space exploration, vaccination, ecology
• researching science that has gone wrong, the impact of that on people, other living things and the environment e.g. cane toad, Chernobyl, atomic testing on Pacific islands
• comparing indigenous understandings of the world with Western views, looking at how their way of understanding the world has shaped the way indigenous peoples live and relate to their environment and considering what we can learn from indigenous views about sustainable management of the land
• discussing an impact of science and technology on themselves e.g. use of mobile phones

Applications of science have systems impacts
• researching and commenting on contemporary science issues (e.g. reproductive technologies, gene therapy) and using Microsoft PowerPoint® or PhotoStory® to present their conclusions
• considering whether scientists might have gone beyond the boundaries of what can be considered to be reasonable in some of their investigations and activities e.g. animal behaviour research
• exploring the impacts that Western societies’ demand for resources have had on the local communities of underdeveloped countries and considering what responsibility they have in buying things that might be having adverse impacts e.g. mobile phones requiring the metal tantalum and the negative impact its mining had on local communities and environments, the demand for hamburger beef contributing to the deforestation of Amazon, the demand for coffee creating a mono-agriculture practice in Brazil
• evaluating the local community’s needs (food, clothing, transport, leisure, manufacturing etc.), looking at where inputs come from and where the outputs go and considering the effects on local and global communities and environments, including whether it is possible to live in a more sustainable way
• looking at current science issues that are in the media, using graphic organisers (e.g. use Inspiration®) to consider implications and connections, discussing issues that arise and considering how different stakeholders might regard the issue e.g. embryo research, construction of a processing mill or factory
• considering, stating and explaining their own perspective on a current science issue that is in the media, listening to the ideas of others and considering if the process has helped them to understand the different ways people make decisions and the different things that they value, then collating the information for a nominated audience using digital video and Microsoft MovieMaker®
### Standard four—scientific inquiry

**Students should be provided with learning opportunities that develop their ability to:**

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<tr>
<td><strong>Scientific inquiries are generated from observations, questions and predictions</strong></td>
<td>• formulate, clarify and refine questions and predictions suitable for testing, including refocusing ill-defined questions</td>
<td>• recognise some questions that cannot, or should not, be investigated scientifically and discuss why that is the case</td>
<td>• modify questions to hypotheses, showing an awareness that scientific hypotheses must be testable and written in a particular form</td>
</tr>
<tr>
<td><strong>Scientists plan and conduct investigations in particular ways</strong></td>
<td>• plan and conduct investigations demonstrating that they understand the requirements of fair testing — undertake systematic observation and data collection, taking steps to minimise error, and explaining the purpose of a control and repeat trials</td>
<td>• consider alternative approaches that might be used to answer a particular question and justify their choice</td>
<td>• plan and conduct their own investigations taking into account the principles of fair testing, and using appropriate techniques to improve reliability</td>
</tr>
<tr>
<td><strong>Scientists draw conclusions after considering various interpretations of their data</strong></td>
<td>• offer explanations for patterns in their data and draw conclusions from that data</td>
<td>• consider anomalies in observations or measurements and try to explain them</td>
<td>• interpret results in situations where more than one set of data has been collected</td>
</tr>
<tr>
<td></td>
<td>• make general suggestions for improving investigations, after considering their own and their peers’ findings, reviewing their understandings in light of new information</td>
<td>• make links between their investigations and relevant science concepts / contexts e.g. comment that they can determine a biscuit’s energy content by burning it</td>
<td>• identify further investigations that would allow them to collect additional information about their hypotheses</td>
</tr>
</tbody>
</table>

### Possible learning contexts

Contexts should be drawn from Science as a body of knowledge.

### Sample learning activities

#### Energy and force

- clarifying and refining questions such as Do different types of beach sand have different cooling times?
- hypothesising and testing how various factors will affect steamboat design (e.g. hull shape, boiler design, boiler material) re-evaluating their thinking and comparing their work with steam-driven machines
- establishing the criteria to assess flight characteristics in a fair test on how well paper planes fly e.g. time in air, distance covered, ability to carry a load
- planning and conducting an investigation into whether the weight of an object affects the rate at which it falls
- investigating the amount of energy produced from burning various types of biscuits and learning about energy use in their body
- making suggestions to improve an investigation into factors affecting the length of time a torch battery lasts
Matter

• rewriting a question independently in a form that can be investigated e.g. *Which is the best paper towel?* becomes *Which paper towel soaks up the most water?*

• hypothesising that the amount of sand added to cement affects the strength of the concrete produced, and designing an investigation in which the ratio of water : sand : cement is varied

• designing and conducting a controlled experiment in a context provided by the teacher e.g. when asked to determine which is the best sticky tape, they use three types of each type of sticky tape, cut the pieces to the same size, repeat their measurements three times and determine an average before drawing conclusions

• observing how commercial indicators work, then preparing their own from different natural materials and calibrating their own pH chart

• participating in an investigation into how to grow the largest alum or copper sulphate crystal

• choosing the instruments and equipment most suitable for an investigation and indicating the reasons for their selection e.g. compare a beaker or measuring cylinder to a burette or graduated pipette when sampling water

• making their own plant-based indicator and constructing a colour wheel for it, comparing their indicator with the universal indicator, evaluating their procedure, suggesting improvements, researching and identifying where their results may be useful e.g. water quality, soil tests, winemaking

• designing and conducting an investigation to determine the best adhesive to use in various situations by gluing paper, plastic, wood and metal with four different glues and then testing the strength of the bond

• having identified that the best paper towel might be more expensive, calculating if it is worth buying the more expensive variety e.g. calculate cost per sheet and compare that with how many sheets it takes to soak up a spill

Living things

• planning and carrying out investigations to examine the life cycles of animals and plants, and using information and communication technologies to explore the advantages associated with different kinds of reproduction

• working largely independently to design and conduct a simple controlled experiment e.g. to investigate whether tomatoes grow taller when fertiliser is added

• planning and conducting an ecological study to investigate the types of invertebrates in different habitats

• planning and conducting a study to compare invertebrates found in a fast flowing part of a creek to those found in a still area, and using Waterwatch indicator sheets to determine whether the creek is considered to be polluted

• designing and conducting an investigation into the factors (e.g. temperature, water, soil, light) necessary for optimum growth in a particular type of plant (e.g. different pasture grasses)

• following work on life cycles, formulate an hypothesis (e.g. Plants need water to survive) and set up a controlled experiment to investigate it (e.g. use fast plants), collecting results over an extended period

• suggesting plausible reasons for natural variation in the growth of a species e.g. different rates of growth of seeds under the same conditions may be due to the seeds originally being different sizes

• explaining why it is necessary to have a control group in an experiment that involves testing the effect of playing different types of music to plants

• maintaining a garden and investigating factors such as the requirements of different fruit and vegetables, the use of mulch, the effect of soil type, seasonal variations, methods of propagation

• using the Learning Federation *Fair test* series of learning objects to learn about fair testing

Earth and space

• formulating, clarifying and refining questions or predictions about which liquids will break down an oil spill

• identifying a testable problem with a specific focus (e.g. *Does the size of the object hitting the ground determine the size of the crater?*), comparing their results with those of others, suggesting reasons for the differences, and offering general suggestions for improving their investigations or conducting further investigations

• collecting relevant data in ways that minimise measurement error, including using repeat trials and calculating averages to determine if the angle at which the sun hits will affect the temperature of a surface and its surrounds

• identifying the independent and dependent variables when finding how temperature changes as you move away from a hot object and relating that to the distance of planets from the sun

• investigating how minerals differ in their physical properties, including explaining the importance of repetition when conducting a fair test and suggesting giving reasons, the number of repetitions appropriate for a particular experiment
Standard four—scientific communication

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<tr>
<td>Scientists consider accuracy, relevance and credibility when acquiring information</td>
<td>independently select information sources that will provide the required background to their science investigations</td>
<td>identify and use more challenging information sources (e.g. specialised textbooks, current affairs programs) and comment on their investigations in light of these sources</td>
<td>access information from a variety of texts, identifying the scientific concepts relevant to their investigation, and become selective about the texts that they use, realising that the source may provide limited detail or be selectively biased</td>
</tr>
<tr>
<td>Scientists need to communicate information in a variety of ways</td>
<td>present scientific ideas and understandings in a variety of ways using appropriate representations, (e.g. graphs, models, spreadsheets) and reflect on the effectiveness of their presentation in terms of clarity and/or ease of analysis</td>
<td>communicate the results of their science investigations, showing an increasing use of relevant terminology, and beginning to represent data in more sophisticated ways, including line graphs, models, diagrams, chemical symbols, circuit diagrams</td>
<td>present coherent reports, supported by relevant data, in ways and forms appropriate to nominated audiences</td>
</tr>
</tbody>
</table>

Possible learning contexts

Contexts should be drawn from Science as a body of knowledge.

Sample learning activities

Scientists consider accuracy, relevance and credibility when acquiring information

- making measurements to an appropriate degree of precision when investigating forces and machines
- gathering information on the source and impact of different forms of energy e.g. solar, hydro, nuclear
- carrying out a survey of class energy usage e.g. How do you get to school? How many televisions are in your house?
- researching some implications of and solutions to oil spills
- researching the science behind an issue in a newspaper or on a website then designing and carrying out an investigation about that issue e.g. What is the meat content of meat pies?
- constructing graphs to compare different sets of data they have collected e.g. comparing insulating materials
- reading and summarising an article on the need for expansion gaps in bridges
- identifying the type and number of atoms in a variety of simple chemical formulae e.g. $\text{H}_2\text{O}$, $\text{CO}_2$, $\text{HCl}$, $\text{H}_2\text{SO}_4$
- using a pH meter to measure the acidity of different water samples
- recording over time the behaviour of a mother guinea pig caring for her litter e.g. journal, digital photos or video
- collecting and summarising newspaper / web articles to find out about a current issue (e.g. using recycled water) and using Microsoft Publisher® design a pamphlet to share the information
- placing animals and plants in appropriate groups using a simple key
- using a microscope to view and make labelled diagrams of onion and cheek cells
- using the local library to obtain information to prepare for a project on local birds
- using the library microfiche / CD ROM to research changes to Tasmania’s flora and fauna over the last 200 years
deciding where relevant information regarding an endangered Australian animal can be found
researching the introduction of the cane toad or rabbit to Australia
understanding how to research the effect of human activities on plant and animal species
collecting information from the list of ingredients on food packaging and interpreting what the numbers mean
completing a webquest on space exploration
interpreting simple weather maps and/or satellite photos and writing a forecast based on them
deciding whether to use evidence from primary or secondary sources
recognising information deficiencies and seeking more information
investigating the Tree Octopus web site (http://zapatopi.net/treeoctopus/) and commenting on the problems associated with accuracy of scientific information on the internet
realising that information is subjective and affected by values and beliefs, so it may be deliberately biased
understanding that scientific knowledge is dynamic

Scientists need to communicate information in a variety of ways

drawing diagrams to show the reflection of light from different types of mirrors, simple circuit diagrams e.g. use Google SketchUp®
presenting a considered view as part of a debate on a global issue such as selling uranium to China
completing logs to show their steam boat designs, test results and modifications
drawing a correctly labelled graph that shows spring extension when different loads are placed on the spring e.g. use Microsoft Excel®
writing and presenting a drama depicting the life history of a material from raw material, through manufacture and use to disposal and using digital video to record the drama, then editing it in Microsoft MovieMaker®
creating a bibliography for a report on the effects of heavy metals on humans
shading a blank periodic table to show metals and non-metals / represent the different groups of elements
producing a poster tracing the possible life cycles of a product such as a glass bottle
collecting data on water quality over time and presenting it in a database to be accessible to others in the school
designing a visual presentation on the transfer and transformation of material and energy through a food web e.g. use Inspiration®
drawing particle diagrams to represent structural differences between solids, liquids and gases
assembling models of human systems and identifying the organs for a particular audience
debating the topic ‘that organ donation should occur automatically’ or a similar scientific issue
communicating using appropriate terminology (e.g. fertilise, sperm, ova) and technologies
presenting the results of their scientific investigation into biodiversity to an audience e.g. oral presentation, video,
drawing diagrams, or using models, to show the relative position of the Earth/Moon/Sun during eclipses
identifying the Southern Cross and Pointers in a diagram of the night sky
drawing or constructing a model of a cross section to show the interior of the Earth
reporting on future scenarios about a specific mining venture (e.g. uranium, coal, oil) to a community audience
debating the relative positive and negative effects that mining may have on the broader community
preparing a graph using Microsoft Excel® or another appropriate graphing tool to present data collected in an investigation
reporting on experiments, using science-specific language to record variables and characteristics of a fair test
presenting a balanced argument in addressing a scientific idea or issue of interest to an audience
using scientific symbols e.g. measurement units, degrees, some chemical symbols
framing questions and using a variety of resources, including web search, CD ROMs, DVDs and video to find out about food preservation
use the Learning Federation Science reporter series of learning objects to produce a report about a scientist
Students should be provided with learning opportunities that develop their ability to:

<table>
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<tbody>
<tr>
<td><strong>The behaviour of objects is determined by the forces that act on them</strong></td>
<td>• investigate the effects of forces supporting or opposing each other e.g. floating and sinking, simple machines, speeding up and slowing down</td>
<td>• investigate some ways that properties of objects affect the forces that act on them e.g. Which type of bridge is strongest? How do you need to hold your body for different dives or gymnastic moves?</td>
<td>• investigate and explain how the ways that forces act are important in a particular situation e.g. car design, biomechanics, space</td>
</tr>
<tr>
<td><strong>Energy can be transferred and transformed</strong></td>
<td>• explore how forms of energy differ in the way they can be transferred or stored e.g. electric circuits, batteries, heat by radiation / convection / conduction</td>
<td>• investigate some of the ways in which energy is transferred between objects and transformed from one form to another e.g. gravitational to movement, chemical to electrical, electrical to heat / light / sound</td>
<td>• investigate and discuss the energy transfers and transformations that occur in some particular situations e.g. car crashes, houses, global warming, roller coasters</td>
</tr>
<tr>
<td><strong>Humans use energy and this raises ethical and sustainability issues</strong></td>
<td>• compare how different renewable and non-renewable energy sources and systems are used</td>
<td>• describe how systems have been developed to obtain, transfer and use energy for particular purposes, and how these have changed over time e.g. development of an electricity grid</td>
<td>• identify some of the issues that need to be considered in using non-renewable and renewable energy systems e.g. cost of production, transportation, environmental implications</td>
</tr>
</tbody>
</table>

Possible learning contexts

Flight*, What would life be like without friction? How do you alarm a burglar, or use other electrical circuits? What will make your steamboat steam faster? Why do we need renewable energy? How energy efficient can you make your model house? You can’t see the air, but it’s there – what’s it doing? (* denotes LTAG learning sequence)

Sample learning activities

The behaviour of objects is determined by the forces that act on them

- exploring some of the effects of air pressure as a force e.g. collapsing can, breaking ruler under newspaper, fountain experiment, syphons, Bernoulli’s principle (e.g. blow between two sheets of paper, blow on a piece of card in front of a candle and observe what happens to the candle) and then relating the ideas to wing design
- investigating the densities of different liquids by making layered ‘cocktails’ and dropping small objects in to see how far they sink, comparing with ocean-going ships expelling ballast water before entering freshwater ports
- making Cartesian divers and hypothesising as to what is causing the effect observed
- investigating the effects of heat on a Galilean thermometer and suggesting causes for the effect
- drawing simple force diagrams to illustrate the opposing pairs of forces that act on a vehicle such as a boat
- considering the forces that act on different simple machines
- researching the body shapes of a variety of aquatic animals and using the research to decide on a hull shape design for constructing a boat
- questioning and discussing how the terms force, energy, work and power are used and the significance of these concepts
• discussing and explaining their observations of some situations in which unbalanced forces are acting e.g. parachutes slow free falling bodies, marshmallows expand in a vacuum, Magdeburg hemispheres, accelerating a car
• investigating stopping distances of a vehicle travelling at different speeds on a variety of surfaces
• comparing the magnetic fields produced by magnets of different shape and type (e.g. horseshoe, bar, electromagnet) by sprinkling iron filings on waxed paper or by using plotting compasses
• researching and explaining how auroras are formed as a result of the Earth’s magnetic field attracting particles
• investigate the strength of the magnetic field produced by different electromagnets (e.g. different numbers of coils, different amounts of current, different core materials) by recording how many paperclips they will pick up
• investigating the forces that have to be overcome in various types of gymnastics e.g. ribbon twirling
• use the Learning Federation object, Wild ride: race day, to investigate some of the forces involved in riding a bike

Energy can be transferred and transformed
• discussing and explaining examples of heat movement through conduction, convection and radiation
• investigating the effect of rising heat on a foil snake to demonstrate that heat energy is converted to kinetic energy in air particles and that this leads to rotational kinetic energy in the snake. Compare with oceanic and atmospheric circulation
• investigating the effect of heat on different metals e.g. bimetallic strips to show differential expansion
• investigating which metals are most suitable for making a saucepan e.g. consider heat conduction, price, toxicity
• designing and constructing steamboats, taking into consideration factors such as hull shape, metal choice for the boiler and heat box, the shape of the boiler and the size, position and shape of the steam vent
• making models of houses and investigating how adding different features (e.g. carpet, curtains, double-glazed windows) affects energy loss from / energy gain by the house (by comparing inside and outside temperatures), then using Google Sketchup® to draw and position their model
• measuring and comparing variables relating to the efficiency of various energy transfer systems e.g. compares performance of balls bouncing on different surfaces, results of collisions between toy cars of different weights
• examining a common appliance (e.g. screwdriver, hair dryer) and describing the energy changes involved
• comparing the effect of wiring light globes in series and parallel circuits and relating that to applications in daily life e.g. car headlights, Christmas tree lights, house circuits
• setting up appropriate electrical circuits to measure voltage and current through ohmic components and graphing and interpreting the results (Ohm’s Law) or using simulation software to investigate the effect of placing various components in different places in electrical circuits
• designing an electrical circuit to be a burglar alarm or a device to keep a plant watered
• planning and investigating the production of electricity (by moving wires in magnetic fields or vice versa) and the methods used to produce electricity in power stations (possibly visiting a power station)

Humans use energy and this raises ethical and sustainability issues
• identifying and classifying different energy sources and considering how and why the different sources are used
• communicating an understanding of various changes and transfers of energy in a system e.g. draws a flow chart showing the changes and transfers of energy from fossil fuel to use of electricity in the home using Inspiration®
• researching past, present and future use patterns of renewable and non-renewable fuel reserves, using a variety of data sources and discussing the implications for a sustainable future
• constructing energy chains to demonstrate the importance of the sun as a source of energy
• identifying a potential waste of energy at home or school and developing an action plan to raise awareness of this issue, including designing a pamphlet using Microsoft Publisher® to present their findings
• identifies personal and family energy use, proposes, carries out and evaluates the success of strategies to reduce the use and calculates the environmental impact before and after the strategies were employed e.g. by using a greenhouse calculator
• analysing patterns of energy use in different cultures / different localities / at different times (e.g. using online data sorted by country or industry) and makes suggestions for the future
• conducting and critically analysing energy usage patterns in eco-homes, homes, workplaces, schools, communities and other countries to compare energy use, and presenting data in an appropriate form, suggesting reasons for variations, and proposing ways to better use energy
• identifying the major sources of Tasmania’s electricity and explaining why local conditions make them appropriate
• using Audacity® to explore sound and the ways it can be manipulated
**Standard four—science as a body of knowledge—matter**

*Students should be provided with learning opportunities that develop their ability to:*

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<thead>
<tr>
<th>Main idea</th>
<th>Stage ten</th>
<th>Stage eleven</th>
<th>Stage twelve</th>
</tr>
</thead>
<tbody>
<tr>
<td>The chemical and physical properties of materials are determined by their</td>
<td>• investigate how the properties of materials can vary according to the proportions of the substances they are composed of, and how this may alter their suitability for a specific use e.g. strengths of mud bricks, rusting of iron alloys, bubble solution</td>
<td>• investigate the physical and chemical properties of some important types of substances (e.g. metals, acids and bases) and begin to use the language of chemistry e.g. symbol, formula, atom, molecule</td>
<td>• investigate and explain the characteristic chemical and physical properties of one group of commonly used substances, relating the properties to their production and use e.g. foods, cosmetics, plastics, beverages, minerals</td>
</tr>
<tr>
<td>structure</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Materials react and change in a variety of ways</td>
<td>• investigate physical and chemical changes and the reversibility of the change</td>
<td>• observe and describe the ways that some important types of substances react and / or change in everyday situations e.g. metals, acids and bases</td>
<td>• explore factors that affect chemical changes (e.g. temperature, concentration) and apply them to everyday situations e.g. food preservation</td>
</tr>
<tr>
<td>Humans use materials and this raises ethical and sustainability issues</td>
<td>• consider how some of the chemical procedures and processes they experience are used / occur in real life situations e.g. evaporation, decanting, sieving</td>
<td>• consider how some important types of substances (e.g. metals, acids and bases) are used in the home and community and any environmental impact their use may have</td>
<td>• describe some uses and effects of chemicals / chemical processes in everyday situations e.g. corrosion, dyeing, fermentation, drugs, lead</td>
</tr>
</tbody>
</table>

**Possible learning contexts**

Are chemicals dangerous?*, Will I be caught?* What happens when acids and bases meet? Why is my crystal bigger than yours? Why do we care about chemical change? What chemistry do jewellers use? (* denotes LTAG learning sequence)

**Sample learning activities**

**Structure and properties of materials**

- being introduced to the periodic table to become familiar with the language of chemistry such as *atom*, *molecule*, *element*, *compound*, chemical symbols for elements and simple compounds
- classifying metals and non-metals on the basis of physical properties
- using chemical formulae to represent chemical compounds, such as laboratory acids and bases, to increase their understanding of chemical language and symbols
- investigating the properties and uses of a range of household products e.g. drain cleaner
- researching why certain chemicals are used in the manufacture of cosmetics
- preparing and testing for common gases
- use the Learning Federation object, *Plastics*, to investigate properties of different plastics and the products they are suitable to use to make

**Materials react and change in a variety of ways**

- combining different solutions and recording signs of chemical changes, such as precipitate, bubbles, temperature change, colour change
• comparing simple physical changes (e.g. freezing ice, melting chocolate, breaking a biscuit) with simple chemical changes (e.g. cooking an egg, burning a candle) and noting differences
• comparing properties of materials, before and after physical or chemical change e.g. compare the hardness, strength, elasticity, texture and appearance of solid wood with chipboard, compare dry ice with gaseous CO₂, compare magnesium ribbon with magnesium oxide
• hypothesising about and selecting equipment to investigate and explain the separation of mixtures (e.g. salt and sand, iron filings, copper sulphate and chalk dust) through a variety of processes (e.g. filtration, evaporation, chromatography, centrifuge, decanting, distillation, crystallisation, magnetism) and discussing the uses of these processes in their homes and industry
• mixing substances to make solutions, suspensions, colloids or emulsions
• researching, conducting an investigation into and reporting on how to grow the biggest crystals possible (e.g. copper sulphate or alum crystals) and using the internet to find out about large natural crystals, e.g. http://www.canyonsworldwide.com/crystals/mainframe3.html
• devising a fair test to compare conditions affecting corrosion of metals e.g. effect of water and oxygen on iron, household cleaners on aluminium utensils
• investigating the effect of acids and bases on a wide range of common substances such as glass, plastic, tin cans, nails
• making and tasting sherbet mixture to gain an understanding of the reaction of acids and bases
• collaboratively planning and carrying out tests, using commercially available indicators (e.g. universal indicator) and those they make themselves (e.g. red cabbage) to measure pH of household acids and bases, and the pH in places such as swimming pools and gardens
• testing a range of flowers / vegetables to determine those from which they can prepare indicators and making their own indicator chart / wheel
• making honeycomb / baker’s toast and identifying what is happening chemically when the baking soda is added
• investigating the use of mordants in dyeing
• making a solar still to purify muddy or saline water
• hypothesising, planning and conducting an investigation to determine how to slow down a particular chemical reaction e.g. milk going off, metal rusting
• investigating properties of chemicals, before and after chemical reactions e.g. investigates properties before and after acid-base reactions
• investigates the effect of changing a variable (e.g. temperature) on the production of beverages such as ginger beer
• visiting a local industry and asking about factors that influence the quantity and quality of the product e.g. wine, cheese

Humans use materials and this raises ethical and sustainability issues
• collecting, analysing and organising information on the chemical properties of materials in order to identify their hazardous nature and the appropriate means for their storage, handling, recycling and disposal in local communities e.g. in contexts such as homes, shopping centres and local factories
• matching a variety of materials that they have investigated to a specified purpose, explaining the choices made in terms of the properties of those materials
• preparing casein glue and comparing their product with commercial adhesives
• researching and reporting on the life of a material from ‘dust to dump’ e.g. a steel can from mining to recycling
• researching actions of a group of potentially dangerous chemicals (e.g. solvents, steroids) and establishing their potential danger when abused by people
• researching sustainable alternatives to current practices e.g. electroplating versus painting, sewage as a fertiliser, wetlands in mining, ethanol versus petrol
• investigating and considering issues, including environmental, personal and community safety, associated with mining and metal extraction e.g. uranium mining, gold mining
• reporting on applications of chemical reactions in industry e.g. galvanising, making plastic, dyeing fabric
• researching and explaining a common industrial process such as beer production, pasteurisation, tanning
• asking a potter how they go about achieving similar glazes in different firings
• researching a raw material and describing the role of science in its location, mining and processing (e.g. gold at Beaconsfield, copper at Mt Lyell) and preparing a Microsoft PowerPoint® presentation about their findings
### Standard four—science as a body of knowledge—living things

**Students should be provided with learning opportunities that develop their ability to:**

<table>
<thead>
<tr>
<th>Main idea</th>
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<th>Stage eleven</th>
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</tr>
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<tbody>
<tr>
<td>The structure and characteristics of living things affect their behaviour and functioning</td>
<td>• identify characteristics of plant and animal cells, including recognising the cell as the basic unit of all living things</td>
<td>• investigate and describe some structural, physiological and / or behavioural adaptations that ensure the survival of living things in their environment e.g. the organ systems that animals use to locate, catch, eat, digest, transport and use food, photosynthesis</td>
<td>• investigate and describe particular factors that may affect the functioning and survival of living things e.g. microorganisms and disease, smoking / drugs</td>
</tr>
<tr>
<td>A diverse range of living things have evolved on the Earth</td>
<td>• apply accepted systems of scientific classification to living things, based on their structures</td>
<td>• understand that different reproductive methods have different advantages for the survival of their species e.g. mammals nurture their young, buzzies are dispersed by animals</td>
<td>• understand that reproduction can occur by both sexual and asexual means e.g. plant cuttings, cloning, seeds</td>
</tr>
<tr>
<td>Humans interact with ecosystems, and this raises ethical and sustainability issues</td>
<td>• construct and interpret food chains and webs to model relationships between organisms within an ecosystem</td>
<td>• examine a particular ecosystem, identifying human impacts on trophic relationships and the non-living environment</td>
<td>• discuss the impact that change has had on particular ecosystems and identify measures required for ecological sustainability</td>
</tr>
</tbody>
</table>

### Possible learning contexts

Has the thylacine had its day? Is there an ideal athlete? Biodiversity—who needs it? Does everything reproduce in a similar way? Where do dead things go? Micro-organisms—friend or foe? Why are plants green, but I’m not? How would you group these animals – and why? How are you affecting your local ecosystems? What do home gardeners need to know? (* denotes LTAG learning sequence)

### Sample learning activities

**The structure and characteristics of living things affect their behaviour and functioning**

- comparing and contrasting the features and properties of plant and animal cells, as viewed with a light microscope e.g. chloroplasts, cell wall, nucleus
- using microscope slides to explore the structure of different cells and then relating cell structure to function
- predicting the role of a cell on the basis of its characteristics that are visible with a light microscope
- investigating photosynthesis as the basis of most life on Earth
- planning and carrying out activities to investigate the transmission of energy and how humans and other animals detect and respond to energy e.g. bats use echolocation, snakes have heat detectors, the range of sound frequencies that humans can detect decreases as they age, pigeons detect the Earth’s magnetic field
- comparing the energy needs of people at different times in their lives (e.g. the needs of young children, teenagers, the elderly) and the importance of low glycaemic foods and exercise
- researching and explaining why governments support mass immunisation e.g. use the internet and local interviews
- researching and explaining how defective body systems can result in less effective functioning
• investigating the diversity of micro-organisms that exist on earth and considering the impact of different types on humans
• making yoghurt to test their predictions about the conditions needed for bacterial growth
• researching and discussing the effects of particular factors such as micro-organisms and disease, drugs, diet or trauma on the functioning and survival of living things
• analysing the meaning of the word *drug* and discussing the effects on the human body of commonly-used drugs and the changing social attitudes to drug usage, including creating a pamphlet using Microsoft Publisher®

*A diverse range of living things have evolved on the Earth*

• Comparing the body systems of different groups of vertebrates and invertebrates e.g. endoskeletons / exoskeletons, lungs / gills
• distinguishing between the living things in a local ecosystem on the basis of external characteristics and classifying them to accepted biological groups e.g. beetle, echinoderm, crustacean, conifer
• comparing the similarities and differences in the reproduction of plants and animals
• considering the advantages and disadvantages of different methods of reproduction e.g. egg laying / live birth, sexual / asexual
• comparing and contrasting the reproductive strategies of two organisms, commenting on the advantages of each to the organism / species
• investigating and reporting on the purposes for which humans might use cloning technology and preparing a presentation using Microsoft PowerPoint® or PhotoStory®
• using an identification key (e.g. *Eucaflip*) to identify local eucalypts, then considering features that are common to all eucalypts and the advantage of having these particular features

*Humans interact with ecosystems, and this raises ethical and sustainability issues*

• researching and reporting on the roles of producers and consumers in a food chain
• sampling a local ecosystem and explaining and comparing the adaptations that organisms have to aid survival within the environment (both structural and behavioural)
• exploring the feeding relationships that exist in a local ecosystem and investigating the potential effects of human intervention in the ecosystem
• gathering first and second hand information to identify and describe the factors that led to disturbance of a local ecological system and exploring alternatives for the future
• visiting and examining a local ecosystem and describing it in terms of cycles e.g. water, carbon
• documenting, after online or other research, the environmental impact that humans have had in different cultures and locations e.g. habitat destruction for mining, killing birds for headdresses, whaling, introduction of feral species, plantation timber
• appraising the sustainability of identified endangered species e.g. platypus, native cat, wedge-tailed eagle
• hypothesising about the effect of introducing a new species to an environment, showing how factors such as habitat, predator-prey relationships and competition for food could be affected
• critiquing articles (e.g. newspaper, magazine, internet, video documentary) on arguments for and against human alteration of a given environment
• exploring the consequence of change on the living and non-living components of an ecosystem
• suggesting possible futures resulting from various environmental practices e.g. forest versus plantation timber, density of housing, agricultural practices
• assessing the impact of introduced factors such as human settlement, pollution and introduced plants and animals on native habitats e.g. identifies and suggests reasons for trends in native species’ numbers in a habitat affected by the introduction of an exotic species
• discussing and developing possible scenarios for an endangered species given a variety of ecological and sociological conditions e.g. blue whales, elephants, orang-utans
• predicting the likely effects on a species if hypothesised changes to the environment occur e.g. construction of a new housing estate or marina
• identifying threats to the survival of Little penguins (*Eudyptula minor*) and suggesting actions that people could take to assist their survival
• use the Learning Federation object, *Environmental evaluation project: frog pond habitat*, to investigate likely causes of a frog population decline
### Standard four—science as a body of knowledge—earth and space

**Students should be provided with learning opportunities that develop their ability to:**

<table>
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<th>Main idea</th>
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<tbody>
<tr>
<td>Earth and space have characteristic features and patterns of activity</td>
<td>• model the orbits of the Earth, Moon and Sun in relation to each other and explore the effects observable from Earth e.g. model eclipses, seasons</td>
<td>• understand that gravity is the force that keeps the objects of the solar system in their orbits, and that gravitational attraction exists between all objects in the universe</td>
<td>• investigate and describe a variety of significant features and processes on Earth and / or in space e.g. erosion, weathering, earthquakes, faulting, folding, volcanic eruptions, weather, meteor impact, constellations, ice ages, supernova</td>
</tr>
<tr>
<td>Earth and space systems continue to be shaped by the changes they experience</td>
<td>• compare some processes that occur over a shorter time scale (e.g. evaporation and precipitation in the water cycle) with some that take longer e.g. rock formation</td>
<td>• use geological evidence to interpret some ways in which the Earth has changed since its formation, including through different geological periods</td>
<td>• describe some important interactions that occur, or have occurred in the past, within and / or between Earth and / or space systems e.g. sea-level changes, temperature changes, appearance of land bridges, death of a star</td>
</tr>
<tr>
<td>Humans use the Earth and this raises ethical and sustainability issues</td>
<td>• investigate which of Earth’s resources that they use are reusable or renewable and which are not</td>
<td>• describe some ways in which the properties of Earth’s resources affect how organisms use them e.g. hardness of rocks, salinity of water, conductivity of metals</td>
<td>• examine the long-term effects of humans on the Earth, and consider possible ways of modifying human behaviour to reduce deleterious effects e.g. pollution, loss of biodiversity</td>
</tr>
</tbody>
</table>

### Possible learning contexts

Unique ecosystems*, What’s up doc? – A health report on a local waterway*, What’s climate change got to do with me?*, Are we alone?*, Should I drink recycled water? What’s the reason for seasons and changes in the sky? What’s the Earth do for you – and what do you do for it? How and what does geology tell us about the Earth’s past? (* denotes LTAG learning sequence)

### Sample learning activities

**Earth and space have characteristic features and patterns of activity**

- modelling the relative movement of the Earth Sun Moon system and explaining associated phenomena e.g. day and night, the year, the seasons, eclipses
- predicting what the moon will look like when shown diagrams of the relative positions of the Earth, Moon, Sun
- locating and identifying stars, using binoculars and a star chart
- describing the Earth’s internal structure and relating it to changes in the crust e.g. volcanoes, earthquakes
- offering explanations for some features of the local landscape e.g. a range of hills, plateau, folding, fault line
- visiting a display to collect information on a local landform / geological feature
- making a model volcano to illustrate its structure
- modelling the formation of sedimentary rocks by allowing sand and silt to settle out in containers of water then using ArtRage® layers function to create an electronic example
- considering how human activity links to characteristics of the Earth e.g. where are roads / dams / bridges / towns constructed
Earth and space systems continue to be shaped by the changes they experience

- examining fossils and commenting on how some living things have changed over time
- using evidence of fossils and rock types to speculate about the geological history of an area
- constructing a diagram of the water cycle and explaining its importance
- describing causes of some natural events e.g. cyclones, volcanoes, tsunami, auroras
- researching earth movements and instruments used to monitor them and explaining how the data obtained can reveal patterns that can be used to predict future occurrences e.g. earthquakes, volcanoes, tsunami
- identifying patterns of global winds and air currents and how they are monitored
- researching and describing the impact of variations in weather patterns e.g. el Niño conditions
- examining and interpreting a weather map from a newspaper, the internet or the television and discussing its significance for boating
- describing the ocean as a system e.g. tides, currents, nutrient cycles
- designing and conducting field investigations into the impact of wind and/or water erosion in a local area and suggesting possible solutions to reduce or reverse such erosion
- explaining how the interaction of the air and the ocean influence the weather e.g. sea breezes
- researching and designing a flow chart to explain the interrelationships between the Earth, oceans, land and life forms at a given point in time for an identified area e.g. age of dinosaurs, early primates, Australia's megafauna
- use the Learning Federation object, *Shaping the land*, to explore geological processes such as deposition, faulting, folding, erosion and intrusion
- use the Learning Federation object, *The secret of Itsall mine*, - you have 30 minutes to explore an old mine and save the fossils in it from being blown up

Humans use the Earth and this raises ethical and sustainability issues

- explaining the difference in origins and potential uses of two or three commonly used rocks e.g. granite, sandstone, basalt, limestone
- discussing the significance of using renewable versus non-renewable resources
- visiting a local recycling facility or having a guest speaker from the facility, using video to capture the event and preparing an information sheet about responsible recycling to hand out to members of the school community
- surveying the local community about their recycling habits and the reasons for them and using Microsoft Excel® to assist in displaying and interpreting their results
- preparing scenarios about the use of renewable and non-renewable resources e.g. Will they run out? Will their quality deteriorate? Are they equitably distributed across the Earth? Are they needed by other living things?
- identifying the impacts of fossil fuel based energy generation and identifying alternatives e.g. delivers a presentation about greenhouse gases, smog, acid rain or carbon monoxide
- explaining ways in which the atmosphere, Earth and Sun impact on human activities e.g. UV radiation
- examining some of the factors that appear to affect animal migration and cyclical activity and the ways in which scientists think some animals navigate e.g. lunar cycles, using Earth’s magnetic field
- researching and discussing the environmental impact of historical and/or indigenous land use practices e.g. fire used by Australian Aborigines, hunting practices of North American Indians, intensive farming in Europe
- designing and conducting investigations through laboratory work, field work and research that demonstrate the impact of human interference on a local environment
- investigating the ocean as a resource e.g. habitat, methods of salt extraction and desalination, impact of commercial fishing
- carrying out choc-chip cookie or fruit cake mining
- debating the issues associated with mining and considering alternative futures e.g. loss of habitat, waste management, more efficient use of resources
- debating the environmental and economic implications of exploration and exploitation of precious and semiprecious minerals e.g. gold, diamonds, opals, emeralds, sapphires
- researching and explaining the importance of particular mining operations (e.g. iron, uranium, gold), considering social and economic perspectives as well as the use of the product
- describing coastal processes and debating issues relating to the use of the coastline e.g. canal developments
- comparing and contrasting past and present operations at a Tasmanian mine, considering factors such as the ores mined, metals extracted, processes used during refinement, environmental and social impacts e.g. Mt Lyell
Standard five—science overview

Students working within standard five have had substantial opportunity to work independently or in groups to complete both set and open-ended science investigations. This has provided them with exposure to a range of science concepts, a clear understanding of the processes that scientists use and an appreciation of the need to be sceptical when interpreting and questioning data and its sources. They understand that scientific knowledge is tentative and that scientific research and findings may have considerable implications for society.

Standard five—science as a human endeavour

Students working within standard five are competent investigators, who understand the value that science places on carefully collected data. They use evidence, logical argument and sound reasoning to support their conclusions. They are coming to more fully appreciate the tentative nature of scientific knowledge, recognising that current scientific laws, models and theories represent the culmination of significant discussion and experimentation and, that scientists are continually refining and revising ideas as new evidence shows existing views to be inadequate or incorrect. At the upper end of standard five, students understand that ideas are rejected by the scientific community if they are perceived to lack the necessary rigour (e.g. cold fusion, Intelligent Design) and they become more able to discern the reliability of particular scientific knowledge.

Students recognise that science is fundamentally a human endeavour and that it is shaped and influenced by the people working within it and their societies. They are aware of current issues that involve implications of research, applications of science or future sustainability (e.g. Human Genome Project). They explain how some scientific advances challenged understandings and practices in science and everyday life (for example, the work of Lister, or the work of Warren & Marshall on bacteria causing gastric ulcers). They consider instances in which progress in science can be affected by and influence social issues and priorities (e.g. water purification, stem cell research). They explore contemporary priorities for science and look at predictions of how science and society might develop in the future. They investigate the implications of current science research for local and global communities (e.g. energy sources).

Students are able to identify and analyse a variety of the different relationships between and within local and global systems. They debate local and global science-related issues, considering relevant personal, ethical, social, economic, political, technological and environmental implications. They begin to appreciate the dilemmas that occur in making decisions informed by multiple perspectives or using various worldviews.

Standard five—scientific inquiry

Students working within standard five are able to formulate hypotheses and refine questions to a point where they can be investigated using the available resources. They are developing into increasingly competent and independent researchers, who are able to conduct more complex investigations that examine more than one aspect of a problem. They modify questions to hypotheses ready for investigation, recognising that a good hypothesis is generally written as a statement, is based on observations and scientific understandings, is testable and, ideally, predicts results.

At the early stages of standard five, students competently design and conduct investigations involving a range of clear-cut variables (for example, they may grow four different species of grass at five different salinities). They control variables, include repeat trials and replication and use appropriate sample sizes as a matter of course. At the later stages of standard five, students become increasingly able to deal with situations where the control of conditions is challenging and recognise situations where including a control may not be feasible or ethical. For example, they recognise that an investigation that involves humans, such as one into the effects of smoking, cannot be set up as a simple controlled experiment. At the later stages of standard five they are also able to identify less easily controlled variables and suggest methods for taking their effect into account. For example, students may identify individual metabolism as a variable if they are investigating the effects of caffeine on heart rate. They may limit the impact of that by using a large number of subjects and looking at the average increase in heart rate rather than just the average heart rate.
Students working within standard five understand that mechanical, mathematical and computer modelling are valid forms of scientific investigation. They are able to use mathematical tools such as equations, statistics and probability to help make predictions and draw conclusions. For example, they may use the equations of motion to predict that a straight line velocity–time graph would result from constant acceleration of a trolley down an inclined plane under gravity, and then collect and graph data and comment on their predictions.

Students working within standard five collect, analyse and organise their data in a rigorous manner. They recognise trends, patterns or relationships drawn from two or more sources of data and point out obvious anomalies. They explain whether their hypotheses and findings are consistent with current scientific thinking. They recognise when they need information that their data does not provide.

Moving through standard five, students identify and acknowledge alternative interpretations of their data, where they exist, critically evaluating the reliability of their data and conclusions, and identifying potential sources of bias. For example, they may identify that in a monthly water quality monitoring study, some samples were collected following heavy rainfall. They discuss their results in greater depth, clearly explaining how their conclusions are linked to their data. They evaluate their results and conclusions in light of current scientific knowledge, and suggest plausible reasons for any discrepancies between their data and current scientific thinking.

Students identify and comment on the practical implications of their own research findings. They formulate further questions that arise from their work and propose additional investigations that are needed to add further weight to their conclusions.

**Standard five–scientific communication**

Students working within standard five are competent at acquiring and managing information from a wide variety of sources. Those sources include experiments, surveys, modelling exercises and texts. They compare and contrast information from relevant texts, which are likely to include books, media sources, electronic sources, the internet and experts. Moving through standard five, students access more academic scientific texts such as journals, reports and product specifications. They collect first-hand data with precision and rigour. They understand that data and information may be presented in different ways and can be used to support the views of various stakeholders.

Students present their investigations in an accepted scientific format using conventional headings and including adequate detail in all sections. They present scientific information in a variety of forms to meet the needs of diverse audiences. They routinely use scientific terminology correctly and in context and use standard conventions and symbols to communicate. They reference sources appropriately and acknowledge assistance that they have received.

At the later stages of standard five, students have a good grasp of the formal scientific report. They write in the third person past tense with accuracy, consistency and clarity, presenting convincing, persuasive, well-reasoned analyses.

At standard five, students are competent users of a variety of ICT and use them to effect in their scientific investigations.

**Standard five–science as a body of knowledge**

Students working within standard five have developed a broad understanding of the body of knowledge that constitutes science. They use their understanding of increasingly complex scientific concepts, laws, models, theories, equations and processes to inform their investigations. They also use those understandings when commenting on the implications of their own research (for example, they could carry out an investigation into the insulating properties of different materials and relate that to energy efficiency in buildings).
### Standard five—science as a human endeavour

**Students should be provided with learning opportunities that develop their ability to:**

<table>
<thead>
<tr>
<th>Main idea</th>
<th>Stage thirteen</th>
<th>Stage fourteen</th>
<th>Stage fifteen</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scientists work, think, inquire and know in particular ways</strong></td>
<td>• investigate how people working with science often draw on concepts and processes across multidisciplinary teams</td>
<td>• understand that the work of scientists is influenced by the cultural and political systems they are working within and by the teams they are a part of</td>
<td>• question and evaluate the reliability of scientific knowledge and scientific practice taking into account how scientific rigour and integrity may be influenced by historical, cultural, economic and political contexts</td>
</tr>
<tr>
<td></td>
<td>• appreciate that people of diverse cultures have contributed to and shaped the development of science</td>
<td></td>
<td>• relate their own experiences to the way the scientific community modifies its concepts and models as evidence becomes available from investigation</td>
</tr>
<tr>
<td><strong>Applications of science have shaped and changed the world</strong></td>
<td>• consider and discuss instances in which progress in science can be affected by and influence societal issues and priorities e.g. water purification, alternative energy sources, space exploration</td>
<td>• analyse the implications of some contemporary scientific research for local and global communities e.g. biotechnology</td>
<td>• critically evaluate the scientific, societal and historical events / thinking that have assisted or hindered scientific advancement e.g. how new areas have emerged, atomic bomb</td>
</tr>
<tr>
<td><strong>Applications of science have systems impacts</strong></td>
<td>• apply relevant scientific understandings to make responsible, ethical and informed decisions about issues, including applications of science and implications of research and sustainability e.g. salinity, nuclear energy</td>
<td>• identify and analyse how different systems and competing interests impact on local and global issues, including sustainability e.g. what are the implications for political, social, environmental and economic systems of a proposed new development</td>
<td>• critically evaluate how interacting systems and competing interests impact on local and global issues, including sustainability</td>
</tr>
<tr>
<td></td>
<td>• explain their own position, showing an understanding of several other perspectives</td>
<td></td>
<td>• clearly justify their own thinking and opinions in relation to applications of science and implications of research and sustainability</td>
</tr>
</tbody>
</table>

### Possible learning contexts

Contexts should be drawn from Science as a body of knowledge, What value wildlife?

### Sample learning activities

**Scientists work, think, inquire and know in particular ways**

- interviewing a scientist to find out things such as: why they became involved in science, what they do, how they do it, what contribution they are making, what dilemmas they are facing in their research, what barriers there might be to their research, what breakthroughs they have made, how they know they are on the right track, how they work within a greater community of practice and what challenges they face as a scientist, using a MP3 player or digital video camera to record the interview to use as a reference for further work or to make into a podcast
- investigating forms of scientific work and considering possible personal involvement through employment, education or voluntary service and creating a pamphlet/presentation about career opportunities in scientific work using Microsoft Publisher®, Microsoft PowerPoint® or PhotoStory®
• exploring the reliability of the scientific claims being made about a current issue by considering who is doing the research, who funds it, what questions are being asked, the role of the media in representing issues, what research methods are being used and the impacts being considered e.g. high voltage towers, climate change, CO₂ sequestration, nuclear energy, CSIRO diet

• exploring the climate change debate, considering the areas of disagreement and agreement in the community, whether the scientific community has a common position, who is funding the research of various scientists, who is expressing opinions, the role of the media in representing the issues involved and how different science disciplines contribute to our understanding of climate change

• exploring how views of the universe and its creation have differed over time and between cultures and how prevailing cultural beliefs have made it difficult for new scientific evidence to be accepted e.g. despite little initial supporting evidence, the Big Bang theory was originally accepted over a steady-state theory of the universe because it was consistent with God creating the universe

Applications of science have shaped and changed the world

• researching some Australian priorities for science research, evaluating progress and problems in those areas and considering how they might have implications for the future of local communities, Australia and / or the world. Details of current national research priorities are available at: http://www.dest.gov.au/sectors/research_sector/policies_issues_reviews/key_issues/national_research_priorities/default.htm

• investigating the response of the scientific and the non-scientific community to theories that were considered to be radical, considering how they challenged understandings and practices and their implications for scientific development e.g. Darwin’s theory of evolution, the cause and transmission of disease

• considering instances in which progress in science can be affected by and influence social issues and priorities e.g. water purification, alternative energy sources, space exploration, land degradation, the Human Genome Project

• researching the use of biotechnology and discussing ethical and system implications e.g. genetically modified canola, stem cell research

• listening to TED talks on future possibilities http://www.ted.com and discussing the issues they raise (TED is owned by an organisation whose goal is to foster the spread of great ideas)

• identifying uses of science and technology in monitoring and managing natural environments and their potential impacts on future industries, employment trends and local communities

Applications of science have systems impacts

• researching technologies that help people to live and work in a more sustainable way

• researching the ways in which products have been modified to make them safer, more useful, more efficient, or more environmentally sustainable

• considering the potential of products to be part of a natural recycling process or an industrial recycling process, considering questions such as: How much energy is used to make, use and recycle products?

• researching the systems that might be influencing a complex global issue, e.g. the role of immunology across international boundaries and the ethics of access and choice

• appraising and arguing the advantages / disadvantages of genetic engineering e.g. confidentiality and the sensitivity of discussing family inheritance patterns, insurance companies gaining access to genetic data and records

• viewing the film Gattaca and discussing the issues raised by its storyline

• exploring how indigenous communities and cultures make decisions about sustainability e.g. North American Indian communities base decisions on understanding the impacts for seven generations

• developing a process for making personal decisions and an agreed class decision on a contemporary issue (e.g. genetic engineering, Human Genome Project, forestry, nuclear power) considering scientific, system, social, cultural, ethical and economic perspectives, then reflecting on the class decision making process e.g. What processes were used in deciding a class position? Were they fair, by consensus or majority, based on ethical principles or ends-based or care-based? What processes would you want leaders to use?

• investigating how people in the local community are making decisions relating to sustainability e.g. What evidence or perspectives are they basing decisions on? What might be barriers to change?

• learning principles and practices of system dynamics using the Road Maps at http://sysdyn.clexchange.org/home.html

• researching the benefits that the construction of dams in Tasmania has brought and why their construction has been controversial e.g. Lake Pedder, Franklin and Gordon Rivers, Meander Dam
Standard five–scientific inquiry

**Students should be provided with learning opportunities that develop their ability to:**

<table>
<thead>
<tr>
<th>Main ideas</th>
<th>Stage thirteen</th>
<th>Stage fourteen</th>
<th>Stage fifteen</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scientific inquiries are generated from observations, questions and predictions</strong></td>
<td>• formulate questions or hypotheses, showing an awareness that good hypotheses allow predictions to be made</td>
<td>• identify multiple related questions or hypotheses that are relevant to an extended investigation e.g. consider strength, absorbency and softness of different brands of toilet paper</td>
<td>• formulate predictions and hypotheses that show an understanding of relevant scientific concepts</td>
</tr>
<tr>
<td><strong>Scientists plan and conduct investigations in particular ways</strong></td>
<td>• design investigations which will collect data to confirm or disprove their hypotheses, including conducting controlled investigations, and working with more complex data e.g. collect multiple data sets</td>
<td>• design and conduct investigations that consider more than one aspect of a problem, collecting information from multiple sources in a discerning manner e.g. experimental data, consult expert, survey, library</td>
<td>• design and conduct ethical investigations that mitigate for the effects of less easily controlled variables (e.g. making measurements on human subjects) or call for imaginative, creative approaches, working with precision and rigour</td>
</tr>
<tr>
<td><strong>Scientists draw conclusions after considering various interpretation s of their data</strong></td>
<td>• identify and explain trends, patterns or relationships in data in ways consistent with their scientific understanding</td>
<td>• comment on their results and conclusions in light of current scientific knowledge, suggesting plausible reasons for any discrepancies</td>
<td>• critically evaluate their results and conclusions, acknowledging any alternative interpretations and making recommendations for further research</td>
</tr>
<tr>
<td></td>
<td>• identify discrepancies in results, evaluate the reliability of their data, evaluate conclusions and suggest changes to investigations in order to reduce uncertainty</td>
<td>• identify and comment on some implications their findings have for society</td>
<td>• critically analyse the implications that their findings have for society, considering relevant social, political, technological, environmental, and/or economic perspectives</td>
</tr>
</tbody>
</table>

**Possible learning contexts**
Contexts should be drawn from Science as a body of knowledge, Why is it so?

**Sample learning activities**

**Energy and force**
- formulating an hypothesis about factors that affect the rolling or other characteristics of a skateboard
- planning and conducting an investigation into how effectively different tyre treads grip on different surfaces, possibly by modelling the different tyres or using bikes
- using a data logger to measure the motion of everyday objects and interpreting the data using ideas of time, position, speed and acceleration
- designing and conducting an investigation to determine the most effective material to use on the hand grip of a tennis or similar racquet and using Microsoft PowerPoint® or PhotoStory® to present their findings
- designing and conducting an investigation into the heating effect of a microwave oven at different power settings and commenting on the manufacturer’s recommendations and costs to the consumer in light of their results
- commenting on their experimental results and conclusions as to the value of the acceleration due to the gravity on Earth
- determining the line of best fit for their data, using it to extrapolate quantities they did not actually measure and commenting on the potential problems associated with this approach when verifying Ohm’s Law
Matter

- predicting and testing the reaction rates for materials in particulate and bulky form (e.g. whole and ground Alka Seltzer tablets) and explaining their results in terms of different surface areas
- designing an investigation considering more than one factor (e.g. absorbency, strength, cost and environmental impact of toilet papers), demonstrating an understanding of conducting a controlled investigation, relating results to scientific concepts and processes (e.g. wet strength versus dry strength, paper structure), and commenting on implications of findings (e.g. Which type should people buy? Are there environmental or ethical considerations?)
- designing and conducting a Choice magazine style of investigation to test the scientific validity of claims made in advertising e.g. Are antibacterial cleaners more effective than soap and water?
- carrying out a quantitative analysis of different antacid tablets, evaluating methodology and the reliability of their data, suggesting improvements, identifying and comparing the active ingredient in the tablets, linking their findings to the neutralisation of acids and commenting on where else the process is important (e.g. acid drainage water from mines) including looking at statistics and analysing data from library research
- designing a complex investigation, stating what other options were possible and why they were not used. e.g. We could have looked at the effects of water hardness but we did not think that variable was relevant.
- planning and conducting an investigation that considers multiple facets of a problem (e.g. a sunscreen investigation might consider a number of the following: Do different brands provide different amounts of protection? How long does it take before the protection from different brands wears off? How does a t-shirt compare with sunscreen for providing protection from the sun? Does moving into the shade offer protection from the sun?) and using digital video and Microsoft MovieMaker® to film an advertisement promoting their findings
- using mathematical tools (e.g. modelling, simulation software, equations, statistics) as appropriate, to help make predictions and analyse data when carrying out a titration
- explaining why they chose particular methods in an investigation e.g. when investigating enzyme-enhanced washing powders explain why particular testing temperatures and fabrics were selected

Living things

- suggesting a method for investigating a situation where it is more difficult to ensure the control of some of the variables e.g. Are pollutants affecting the fish in the Derwent estuary?
- recognising that when examining a situation, such as the impact of an algal blooms, it is not ethical to create more blooms, so as wide a range of naturally occurring blooms as possible should be studied
- researching how ecologists carry out environmental impact studies, selecting appropriate techniques to investigate a particular ecosystem in depth (e.g. transects, quadrats, pitfall traps, water quality tests) and using their results to make a decision or recommendation about managing the environment
- recognising that there are particular problems associated with using humans in investigations and attempting to allow for likely problems e.g. when investigating the effect that caffeine has on reaction rates, uses as large a sample as practicable, a mixture of males and females, chooses subjects matched in age as much as possible
- considering how evidence can be collected in contexts where variables cannot be readily controlled e.g. ecological fieldwork, surveys, human subjects

Earth and space

- making predictions based on prior research and understanding of science concepts such as how water movement affects the amount of dissolved oxygen in a river system
- identifying a current issue and investigating it practically e.g. by looking at the science concepts relating to global warming, measuring thermal expansion experimentally and relating it to potential sea level rises
- including repeat trials and replication and using appropriate sample sizes to improve reliability of data when investigating which soils contain the most amounts of nitrogen, phosphorous and potassium
- deciding on the most suitable form of investigation to test various hypotheses, designing appropriate methodologies and controlling variables when investigating questions such as which rocks are susceptible to weathering by acid
- designing a method that can be consistently replicated to find out if the salinity of soil affects the germination of seeds, then evaluating their investigations, considering factors such as the trustworthiness of their data and conclusions, factors that may have biased their research e.g. accuracy of equipment available, how subjects / samples were selected, whether variables were adequately controlled
## Standard five—scientific communication

*Students should be provided with learning opportunities that develop their ability to:*

<table>
<thead>
<tr>
<th>Main idea</th>
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<tbody>
<tr>
<td><strong>Scientists consider accuracy, relevance and credibility when acquiring information</strong></td>
<td>• compare and choose between sources of information relevant to science investigations, understanding that data may be presented in different ways and thus be used to support the ideas of various stakeholders</td>
<td>• compare and contrast relevant sources of information, including making judgements about the methods used to collect data where appropriate</td>
<td>• collect scientific data and information with precision and rigour from a variety of sources (e.g. experts, popular science journals, hands on investigations) clearly referencing sources and evaluating their reliability and credibility</td>
</tr>
<tr>
<td><strong>Scientists need to communicate information in a variety of ways</strong></td>
<td>• use accepted scientific formats, conventions, representations, terminology and understandings appropriately and in context to present information and develop ideas and opinions</td>
<td>• present the results of their science investigations in an appropriate format, providing and explaining the evidence that supports their thinking, and making explicit links to relevant science concepts</td>
<td>• present convincing, well-reasoned analyses, which are persuasive and supported by appropriately processed data and information, and relevant references from a variety of sources, selecting formats that are appropriate to their data and nominated audiences</td>
</tr>
</tbody>
</table>

### Possible learning contexts

Contexts should be drawn from Science as a body of knowledge.

### Sample learning activities

**Scientists consider accuracy, relevance and credibility when acquiring information**

- using library information search techniques when planning an investigation on superconductors
- using an oscilloscope to record sound patterns produced by different musical instruments
- consulting an expert about experimental methods that could be used for determining the fruit juice that is the best source of vitamin C
- identifying the type and number of atoms in more complex chemical formulae e.g. $\text{Mg(NO}_3\text{)}_2$, $\text{Al}_2\text{(SO}_4\text{)}_3$
- using technologies to gather information about the work of scientists in conceptualising the theories of matter
- planning, trialling and evaluating personal action plans for reducing their use of environmentally harmful chemicals
- using online sources of information to gather information about manufactured materials and their probable availability for future generations and environmental sustainability
- using online sources of information to research the historical and diverse cultural development of theories of the nature of matter and discusses it in a classroom context
- researching and writing a report about the adaptations shown by cacti
- interviewing a plant breeder to gather information about plant genetics, using MP3 or digital video camera to capture information
- reading a range of journals and newspaper articles when studying the impact of genetically modified organisms
- surveying a rocky shore using quadrats and transects
- analysing data provided to them on the temperature and oxygen levels in a local river over time
• using digital resources to gain information about relevant equipment and technologies that enable space exploration and research to occur
• recognising that they need more current information than a book or one website might provide
• measuring a variety of quantities with precision, using instruments with fine-scale divisions
• showing awareness of a range of views and perspectives on the use of alternative forms of energy
• deciding and justifying the extent and range of data to be collected (e.g. sample size) and the techniques, equipment and materials to be used
• accessing information from first and second hand sources
• using ICT (e.g. dataloggers) to monitor several variable at once, or over long or very short timeframes
• making sufficient observations and measurements to reduce error and obtain reliable evidence
• assessing the current state of scientific knowledge, approaching experts where appropriate
• use the Learning Federation Mystery disease series of learning objects to collect information about a fictitious disease outbreak

**Scientists need to communicate information in a variety of ways**
• drawing a concept map about energy e.g. use Inspiration®
• writing a consumer report based on their trials of the effectiveness of a particular product e.g. detergents, shoes
• investigating and reporting on the role of baking powder and bicarbonate of soda in cooking
• preparing a display for a science fair summarising their investigation into the effectiveness of sunscreens
• drawing a flow chart of the chemical processes involved in the refining of iron
• researching and explaining to the class the pros and cons of using herbicides and explaining alternatives
• communicating an understanding of chemical change of matter using the particle model and using symbols and the periodic table to write balanced equations and describe physical and chemical change
• writing an article for the local newspaper or school intranet about pollution in a local stream
• role playing some significant aspect of the work of a microbiologist e.g. Jenner, Lister, Pasteur, Fleming and Florey
• creating interactive objects that chart the transfer and transformation of material and energy through a food web
• developing a presentation on the interactions of living and non-living components of the biosphere in the cycling of carbon, oxygen and water e.g. electronic presentation, poster, speech
• drawing a labelled diagram to show the components of the carbon cycle e.g. use Google SketchUp® or ArtRage®
• using graphical representations to describe reproduction and patterns of inheritance
• investigating the differences between celestial bodies e.g. stars, planets, moons, black holes, comets, meteors
• presenting a scientific report of an investigation including the hypothesis investigated, a clearly outlined method, all relevant observations and data, thorough conclusions and discussion
• judging the level of uncertainty in observations and measurements e.g. by using the variation in repeat measurements to judge the likely accuracy of the average measured value
• communicating ideas and understandings using scientific terminology correctly and in context and using appropriate representations including graphs, models and symbols
• identifying different approaches to developing and communicating scientific knowledge or solving a scientific problem, including examples of correct and incorrect use of scientific language in the mass media
• using appropriate scientific units e.g. ms⁻¹, Newton
• reporting discussions and making explicit links to scientific theory
• identifying / devising a systemic solution to problems with environmental consequences
• reflecting on the meaning of results in terms of the scientific principles and the theory they have learnt
• recognising some of the different ways that scientists communicate information to each other
• explaining trends, patterns or relationships in data in ways consistent with their scientific understanding
• drawing conclusions that are consistent with their own data or that of others that address the initial hypotheses and explaining the extent to which their conclusions support any predictions made and enable further predictions
• explaining why they think that their explanation is the most likely whilst acknowledging other possible interpretations of their data
• using data collected with a GPS and appropriate GIS software to mark the position of their sampling sites on a map of a waterway
Standard five—science as a body of knowledge—energy and force

Students should be provided with learning opportunities that develop their ability to:

<table>
<thead>
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<th>Main idea</th>
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<tbody>
<tr>
<td>The behaviour of objects is determined by the forces that act on them</td>
<td>• investigate the effect of several forces on the motion and energy of an object</td>
<td>• use Newton’s Laws to explain the behaviour of a variety of objects</td>
<td>• work with established scientific laws and theories to predict the behaviour of objects (e.g. equations of motion) including quantitative calculations</td>
</tr>
<tr>
<td>Energy can be transferred and transformed</td>
<td>• recognise that when energy is transformed and transferred it is also conserved</td>
<td>• show an understanding of relevant scientific concepts when describing energy transfers and transformations e.g. kinetic energy, potential energy, electromagnetic spectrum, heat loss</td>
<td>• research, analyse and explain the energy transfers and transformations that occur in some common systems, commenting on their significance e.g. human body, the Earth, the Universe, electricity production, atoms</td>
</tr>
<tr>
<td>Humans use energy and this raises ethical and sustainability issues</td>
<td>• research and discuss some uses and the associated advantages and disadvantages of a particular form of energy e.g. nuclear power, X-rays, microwaves, hydro-electricity</td>
<td>• research, analyse and argue the merits of available energy sources and systems, considering issues such as viability, cost, human and environmental impact, sustainability</td>
<td>• analyse the implications (technological, political, social, economic) of current and likely future global energy demand (considering energy resources, energy production and energy distribution), including commenting on preferred futures and sustainability</td>
</tr>
</tbody>
</table>

Possible learning contexts

Drag!* Accident?* What are the implications of our energy choices? What does Newton do for you? Where does your energy go? Should Australia go nuclear? (* denotes LTAG learning sequence)

Sample learning activities

The behaviour of objects is determined by the forces that act on them

- drawing and explaining force diagrams that illustrate the various forces that act on a moving object e.g. a car is acted on by force due to friction, force from the engine, force of the road pushing on the car, force of the car on the road (weight / gravity)
- investigating, discussing and explaining that, while friction causes energy dissipation, it is also essential for some forms of motion (e.g. walking) and for many static situations (e.g. sitting on a slope)
- researching coefficients of restitution for various materials and designing an activity to investigate the effects of the varying coefficients on how different types of balls bounce, including at different temperatures
- researching and investigating factors that may affect the injuries obtained in a car crash e.g. air bags, crumpling bumper bars, speed, weather conditions
- discussing and identifying applications of Newton’s 1st Law (objects remain at rest or in uniform motion unless a force acts) e.g. What happens to you when a car turns suddenly? Why can you pull a tablecloth out from underneath the dishes?
- investigating the relationship between mass and force and acceleration (Newton’s 2nd Law) e.g. using a spring balance to lift objects of different masses then plotting $F$ vs $m$ and identifying a straight line relationship and the acceleration, or use balls of different mass rolling down a ramp then determine acceleration and plot $a$ vs $m$
• identifying, discussing and explaining applications of Newton’s 3rd Law (to every action there is an equal and opposite reaction) e.g. What happens if you are sitting on a computer chair with castors and push someone who is sitting on a similar chair? What happens to an astronaut tightening the bolts on the space station?
• carrying out investigations using rockets (e.g. balloon, water) and explaining the behaviour / effectiveness of different rockets in terms of Newton’s Laws
• identifying whether the quantities they are working with are scalar or vector quantities e.g. distance / displacement, mass / weight, speed / velocity
• using a motion detector and datalogger to record the motion of an object
• using ticker timers and trolleys to investigate the equations of motions \( s = ut + \frac{1}{2} at^2, v = u + at, v^2 = u^2 + 2as \)
• applying the equations of motion to situations that involve slowing down (negative acceleration) and falling bodies \((a = g = 9.8ms^{-2})\) e.g. determining the acceleration due to gravity by dropping balls from different heights, timing the length of the fall, graphing \( s-t^2 \), finding the slope of the line and doubling it (graphic calculators /software may be useful)
• watching cartoons such as Roadrunner and identifying events that misrepresent what would happen in the real world e.g. roadrunner goes off cliff and continues in straight line before falling, movement of boulders
• viewing a video or setting up an experimental demonstration to show that objects released at the same time fall at the same rate (ignoring air resistance), regardless of their initial horizontal velocity
• use the Learning Federation object, Accelerate, to explore Newton’s second law of motion

Energy can be transferred and transformed
• understanding the range of the electromagnetic spectrum and some of its applications and impacts e.g. use of sunscreen, medical use of X-rays and gamma rays, comparison of microwaves for cooking with microwaves for transmission of mobile phone signals, how the electromagnetic spectrum is different from sound
• visiting a medical facility or inviting a guest speaker for the purpose of learning about a practical application of electromagnetic radiation
• exploring the characteristics of visible light e.g. using a ray box to investigate the transmission, reflection and refraction of light using various lenses, mirrors and prisms, investigating total internal reflection and discussing its significance in fibre optic cables, carrying out investigations that demonstrate the refraction of light
• making a model eye and investigating defects that may occur and how to correct the image that is produced
• exploring the operation of various optical instruments (e.g. pinhole camera, microscope, telescope), building a working model and researching the instrument’s historical development
• investigating heat by looking at the ways in which different materials gain and lose heat energy e.g. Does tea or coffee cool faster? How does the type of cup used affect the cooling rate of a hot drink?
• investigating the effectiveness of water as a heat absorbing medium e.g. water can be heated in a paper cup, water is used to treat burns, water has a global role in moderating temperature
• discussing and explaining conservation of energy through considering the transfer and transformation of energy in systems such as trampolines, tennis and roller-coasters, using formulae to equate potential and kinetic energy
• investigating how a variety of musical instruments produce sound and how players modify the sounds that their instruments produce
• designing a recording studio or restaurant, considering how sounds will be reflected and absorbed
• investigating the roles of components in more advanced electrical circuits e.g. diodes, relays, capacitors
• using Audacity® to explore sound and how it can be modified electronically

Humans use energy and this raises ethical and sustainability issues
• researching, coming to a considered opinion and debating whether Australia should switch to nuclear power
• investigating some ways in which humans meet their energy needs in more remote areas e.g. use solar panels to power outback phones and lighthouse beacons
• exploring social issues in energy use and the ways that scientists estimate known and possible energy sources
• using ICT for information to investigate local, national and global energy resources, production and needs
• calculating the costs and benefits of energy production for diverse groups e.g. On whom does uranium mining impact? On whom does building a wind farm or coal fired power station or hydro scheme impact?
### Standard five—science as a body of knowledge—matter

**Students should be provided with learning opportunities that develop their ability to:**

<table>
<thead>
<tr>
<th>Main idea</th>
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<tbody>
<tr>
<td>The chemical and physical properties of materials are determined by their structure</td>
<td>• use the particle model to explain the properties of materials and the changes they undergo</td>
<td>• understand and explain that familiar chemical substances can be grouped into families that have characteristic chemical properties e.g. acids, metals, hydrocarbons</td>
<td>• understand and explain that the way elements are grouped in the Periodic Table gives information about their structure and properties, allowing predictions to be made</td>
</tr>
<tr>
<td>Materials react and change in a variety of ways</td>
<td>• explain physical and chemical changes in terms of arrangement and type of particle involved, understanding that matter is not created or destroyed in these processes</td>
<td>• interpret the information contained in chemical equations and formulae, recognising some common chemical reactions e.g. acid-base neutralisation, acid + metal (to give salt + hydrogen)</td>
<td>• use the information contained in valency tables to comment on the changes that the atoms have undergone and to write formulae for ionic compounds</td>
</tr>
<tr>
<td>Humans use materials and this raises ethical and sustainability issues</td>
<td>• consider and discuss some of the possible human and environmental impacts of industrial processes e.g. pollution, energy consumption</td>
<td>• research the functions and use of selected groups of chemicals, describe the effect of these on people and the environment and consider possible substitutes e.g. fluoride, CFCs, agricultural chemicals, petrochemicals, asbestos</td>
<td>• understand that there is a variety of arguments for and against the production and use of particular materials, including issues that relate to human and environmental impact e.g. tantalum demand, Bhopal gas spill</td>
</tr>
</tbody>
</table>

### Possible learning contexts

How does the zinc get into zinc cream? Why do we have the Periodic Table? What happens as atoms and molecules collide? What happens when chemistry goes bad (e.g. Bhopal, Ok Tedi)? (* denotes LTAG learning sequence)

### Sample learning activities

#### Structure and properties of materials

- investigating and reporting on the properties of materials in order to classify substances into groups (e.g. metal / non-metal, acid / base, element / compound) and relating that classification to their chemical structure
- using the particle model to explain states of matter and changes of state e.g. by constructing models of various molecules using commercial model kits or toothpicks and polystyrene balls
- using the particle model to compare the physical properties of matter e.g. draws diagrams showing how particles are distributed in the three states of water
- using the particle model to explain diffusion between liquids and gases and the differences between solutions, suspensions and colloids
- observing pollen grains under a microscope to demonstrate Brownian motion and hypothesising as to what is causing the motion
- understanding how the particle model can be used to explain physical and chemical properties and change of state
- safely conducting chemical investigations, recording observations and relating them to chemical formulae
- identifying the characteristics of the different groups that exist within the Periodic Table e.g. halogens, noble gases
- drawing diagrams to show the structure of an atom on the basis of its atomic number
• investigating essential oil production, including the source of the oils, how they are extracted and what different oils have in common

**Materials react and change in a variety of ways**

• writing and explaining simple chemical equations
• carrying out electrolysis of water to demonstrate that a compound can be broken down to elements
• carrying out electroplating to demonstrate that an element can be extracted from a solution
• investigating the evaporation rate of a range of perfumes, kept at different temperatures, by measuring changes in mass with time, in order to demonstrate the effect of temperature on particle movement
• recognising and describing conditions that influence reactions or change in materials e.g. pH, temperature, amount of each reactant
• investigating the rate of reaction of a whole Alka Seltzer tablet in water, as compared with a whole ground tablet
• investigating how jelly sets differently with and without added fresh pineapple to show the effect of an enzyme
• classifying substances into groups on the basis of their reactions with water, acids and alkalis e.g. reactivity series of metals
• designing and conducting an investigation into the effectiveness of a variety of commercial antacids to learn how to determine the volume of an acid that is required to neutralise an antacid
• using solubility tables to determine whether a precipitate will form in a given reaction and testing their prediction
• using chemical formulae and equations to represent and describe particular chemical changes using symbols from the Periodic Table e.g. investigating how various ionic compounds react and writing formulae for any new products that are formed
• identifying classes of chemical reactions (e.g. oxidation, acid + metal) and planning investigations to explore their characteristics
• conducting simple titrations, such as determining the volume of acid required to neutralise a given volume of base, when working with simple integer concentrations e.g. How much 1M NaOH is required to neutralise 50mL of 2M HCl?
• carrying out a titration to determine the acetic acid content of a variety of vinegars
• carrying out an investigation to identify unknown anions and cations or conducting flame tests to identify unknowns
• visiting a chemical processing plant, investigating the changes that occur from raw material to final product, identifying how the product is used and any issues its use raises
• using the Learning Federation object, Chemical reactions, to investigate conservation of atoms and energy in chemical reactions

**Humans use materials and this raises ethical and sustainability issues**

• carrying out an investigation that demonstrates the relative reactivities of a range of common metals and linking their results to the common usage of those metals
• critiquing and debating ways of obtaining and utilising materials to reduce harmful effects on environments and on diverse social and cultural groups
• investigating the costs and benefits to the environment and diverse groups in society of obtaining and manufacturing particular materials
• interviewing a boat builder about the use of sacrificial metal on boats
• researching the likely future availability of particular raw materials, exploring and considering viable alternatives and whether their use would be sustainable e.g. alternative fuels, recycling
• investigating the personal and environmental safety of particular household chemicals, how they should be stored and possible substitutes that may be more physiologically, socially and environmentally benign
• exploring carbon compounds and fuels to learn about everyday uses of petrochemicals
• debating an issue, such as asbestosis or fluoridation, to become aware of the effects of chemicals on our bodies
• visiting a local chemical production plant and collaboratively investigating how chemical reactions are applied in the extraction and modification of materials and in the synthesis of new materials
• investigating and critiquing new materials / products / technologies and appraising and reporting on their likely impact on themselves and future generations
• collaborating with others to predict future scenarios for chemical industries, locally, nationally or globally using chemical formulae and equations to represent and describe particular chemical changes
### Main idea

<table>
<thead>
<tr>
<th>The structure and characteristics of living things affect their behaviour and functioning</th>
<th>Stage thirteen</th>
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</thead>
<tbody>
<tr>
<td>• explore how complex organisms depend on interacting body systems to meet their needs e.g. relationship between the circulatory and respiratory systems</td>
<td>• investigate and explain the factors that affect a particular life process e.g. enzymes, hormones, physical factors in the environment</td>
<td>• investigate and explain how and why functioning and behaviour of living things changes in response to variations in internal and external conditions e.g. Alzheimer’s disease, Tasmanian devil facial tumour disease, IVF processes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A diverse range of living things have evolved on the Earth</th>
<th>Stage thirteen</th>
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</tr>
</thead>
<tbody>
<tr>
<td>• recognise that inherited characteristics are the result of genetic information (DNA) being passed from parent to offspring</td>
<td>• explain simple patterns of inheritance that operate in humans and other living things, including how to use them to predict the likelihood of particular characteristics in offspring</td>
<td>• investigate some applications and implications of genetic engineering</td>
<td></td>
</tr>
<tr>
<td>• examine the theory of evolution by natural selection to explain the diversity of living things</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Humans interact with ecosystems, and this raises ethical and sustainability issues</th>
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</thead>
<tbody>
<tr>
<td>• use scientific concepts and models to explain the interdependence of populations of organisms and the environment, and to predict the consequences of changes to an ecosystem e.g. use simulations and consider matter and energy flow</td>
<td>• investigate the potential long-term effects of changes in biodiversity e.g. urbanisation, forestry, tourism, biological control measures, conservation, natural disaster</td>
<td>• research, critically explore and develop a defensible position about a selected environmental issue affecting Australia e.g. old growth logging, Tasmanian devil facial tumour disease, whaling</td>
<td></td>
</tr>
</tbody>
</table>

### Possible learning contexts

Who owns the sea? What’s the future for Tasmania’s flora and fauna? What’s controlling me? Why are islands unique? How do human body systems affect each other? How does nature select the fittest? How does DNA make you who you are?

### Sample learning activities

**The structure and characteristics of living things affect their behaviour and functioning**

- identifying the cells that make up body tissues, the tissues that make up organs and the roles they play in systems e.g. researching and presenting an investigation about health problems resulting in breakdown of a system component e.g. asthma, diabetes or cystic fibrosis
- writing an essay or compiling a Microsoft PowerPoint presentation explaining how the impaired function of a component of a body system affects the whole organism
- brainstorming and researching a range of factors (biological / sociological / technological / cultural) that might contribute to diabetes, heart disease and other common diseases and / or disabilities and identifying their own risk factors and associated lifestyle choices
- explaining some of the modes of operation of various factors that affect human wellbeing e.g. enzyme systems, hormonal control
• researching, designing and conducting an investigation into the effects of light and / or temperature and / or carbon dioxide levels on the rate of photosynthesis as indicated by plant growth rates
• researching the historical development of understanding of cells and physiological systems, reporting on the contributions of past and present scientists in that area and debating future possibilities such as gene technologies
• exploring the access that humans in different parts of the globe have to medical technologies and critically evaluating the issues surrounding this e.g. the role of immunology across international boundaries and the ethics of access and choice

A diverse range of living things have evolved on the Earth
• investigating and describing patterns in the variability of a physical feature found within a species and how it may affect the species’ survival e.g. feather colour in budgerigars
• researching and reporting on the way domesticated animals and plants have changed for human purposes through selective breeding e.g. different breeds of sheep, cattle, apples
• investigating the structure of DNA, how DNA is passed from parent to offspring and how the manipulation of DNA can result in altered species
• using the theory of evolution by natural selection to explain the diversity of life on earth
• investigating the evidence in support of a theory of evolution, including comparative embryological studies, fossil records, genetics and DNA technology
• researching and analysing how aspects of an organism’s behaviour (e.g. courtship, aggression, response to light) or a physical feature (e.g. opposable thumb in humans and apes, surface or taproots in plants) may enhance its chance of survival
• applying theories of genetics and monohybrid crosses to understand patterns of inheritance e.g. interpreting pedigrees, growing ‘fast plants’, using simulation software
• using simulation software to predict the outcome of monohybrid crosses in organisms, identifying both recessive and dominant characteristics
• examining the pedigrees of organisms (e.g. peas, corn, roses, cattle, sheep, horses) making inferences about recessive and dominant characteristics and comparing the inheritance of characteristics in sexual and asexual reproduction
• researching and debating the ethics of applications of gene technology to develop organisms with desired characteristics e.g. designer babies, human organs from pigs, daughterless carp
• investigating and reporting on the potential of development of new strains of plants and animals through artificial selection or genetic modification e.g. cattle, flowers, food crops, cotton
• understanding of the manner in which a new characteristic or a new species might have arisen

Humans interact with ecosystems, and this raises ethical and sustainability issues
• analysing relationships in local environments for producers, consumers and decomposers, organising the information into food webs and discussing the role the various organisms play in carbon, oxygen and water cycles e.g. use Inspiration®
• applying information from a food web to a variety of scenarios e.g. habitat destruction, hunting, feral animals
• researching and explaining how organisms survive in special environments (e.g. very salty or very dry), incorporating explanations of physiological and behavioural factors
• identifying niche-sharing lifestyles of organisms (e.g. the symbiosis of mould and fungus in lichen, parasitism of tapeworms on animals, mistletoe birds) outlining the roles of each species and the likely impact of either species disappearing
• researching and explaining why Australia has a unique flora and fauna
• researching and debating issues associated with species diversity, including contemporary rates of species loss and human use of natural environments
• investigating and evaluating the impact that the use of DDT had on humans and other living things
• investigating enzyme activity by designing and carrying out controlled experiments and relating the results
• critically analysing human ecosystem intervention and proposing ecologically sustainable alternatives e.g. Murray River, old growth logging
• discussing the benefits and any issues associated with a local primary industry e.g. poppies, salmon, truffles, saffron, wine, dairy, canola
Students should be provided with learning opportunities that develop their ability to:

<table>
<thead>
<tr>
<th>Main idea</th>
<th>Stage thirteen</th>
<th>Stage fourteen</th>
<th>Stage fifteen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth and space have characteristic features and patterns of activity</td>
<td>• explore scientific theories of the origin of the universe</td>
<td>• describe some ways in which patterns of activity that have, or are likely to, occur on Earth and in space may impact on living things e.g. solar flares, volcanic islands, break up of Gondwana / Pangaea</td>
<td>• use scientific theories and ideas to explain past, present and possible future features and events on Earth and in space e.g. mineral distribution, patterns of volcanic activity</td>
</tr>
<tr>
<td>Earth and space systems continue to be shaped by the changes they experience</td>
<td>• use the theory of plate tectonics to explain global patterns of geological activity</td>
<td>• investigate and describe the sequence and characteristics of major events in the Earth’s past e.g. plate tectonics, CO₂ changes, species disappearance, early humans</td>
<td>• analyse and evaluate the evidence for past, present and predicted future changes to the Earth and space, and consider the possible implications e.g. global warming, death of our sun</td>
</tr>
<tr>
<td>Humans use the Earth and this raises ethical and sustainability issues</td>
<td>• consider the consequences of changes to the atmosphere (e.g. global warming, hole in the ozone layer) resulting from natural and human activities</td>
<td>• research, analyse and argue the merits of human use of Earth and space resources, considering issues such as viability, cost, human and environmental impact, sustainability e.g. fossil fuels, space travel, International Space Station</td>
<td>• analyse the implications (environmental, political, social, economic) of current and likely future use of resources from Earth and space, considering multiple perspectives e.g. sand mining, energy sources, colonising other planets</td>
</tr>
</tbody>
</table>

Possible learning contexts

Bushfire?* What are the benefits of funding space exploration? Where did the elements come from and where do they go? What happens when continental plates collide? How long will the Earth survive as we know it? What is the future of Antarctica? What are the most important scientific theories and ideas? (* denotes LTAG learning sequence)

Sample learning activities

Earth and space have characteristic features and patterns of activity
- discussing scientific theories on the origin of the universe e.g. big bang, steady state
- researching, identifying and explaining some of the ways in which scientists collect information about past and distant events e.g. species extinctions, birth of a star
- researching and reporting on astronomical features e.g. nebulas, various stars, pulsars, supernovas and quasars
- investigating and analysing astronomical features and changes seen from the Earth and discussing the ways scientists examine and explain them
- classifying rocks and landforms according to their formation in geological history in order to investigate the origin and structure of the changing Earth
- investigating various types and orbits of satellites and space probes e.g. researches the types, uses and orbits
- selecting and using information obtained from the use of satellites, telescopes, space probes and other space craft to develop their understanding of astronomical features and events

Earth and space systems continue to be shaped by the changes they experience
- exploring the theory of plate tectonics through modelling and simulation software and evaluating and reporting on the evidence that supports this ideas
• examining continental outlines to investigate how Gondwana and Pangaea may have fitted together
• comparing flora and fauna in continents that were once joined
• exploring ways in which materials such as minerals, water and gases are cycled and transformed over time
• considering the events that may have led to the thylacine and Tasmanian devil being confined to and surviving in Tasmania
• investigating and explaining why marsupials are found only in Australasia and South America
• using data about earthquake epicentres to locate Earth’s crustal plates on a map
• using the Learning Federation object, Tectonic boundaries, to explore plate tectonics.

Humans use the Earth and this raises ethical and sustainability issues
• researching and discussing the links between depletion of the ozone layer, human use of gaseous products and the incidence of skin cancer in Australia
• using simulations to examine the probable and preferred impact of greenhouse gas emissions on environments and future generations e.g. use greenhouse calculators to examine the effectiveness of lifestyle change
• viewing the film An inconvenient truth and analysing and commenting on its message and gathering information from additional sources
• considering the implications for a local area of some of the predictions about long-term climate change e.g. sea level rise, temperature changes in wine growing regions
• researching the effects on life of fossil fuel combustion
• identifying uses of science and technology in managing natural environments e.g. satellite imagery, seismography
• researching, evaluating, developing and explaining a personal position on an issue relating to Earth science, showing an awareness of a number of different stakeholder groups e.g. water use from the Murray River system, extending uranium mining in Kakadu, development of a new mine in Tasmania, oil spills, CO₂ sequestration
• investigating farming processes, including past land use practices, and their effect on available arable land in a given region and developing a policy statement, media article or presentation e.g. use of fertilisers, land clearing
• identifying key issues and putting questions to an expert on an Earth science issue e.g. rising salinity levels, impact of a proposed pulp mill on air and water quality in the local area
• writing futures scenarios, for particular audiences, that identify possible future uses of Earth resources and their substitutes and the associated social costs and benefits for several different groups of people
• researching the availability of resources on the Antarctic continent and sustainability of their current and possible future use e.g. mining, ecotourism, towing icebergs for water
• investigating and considering the evidence for the argument that human activity is responsible for increased numbers of extreme weather events e.g. tsunami, cyclones, el Niño events
• debating the value of space exploration, including considering the scientific and political motivations behind it
• analysing the requirements for colonising another planet e.g. by writing a realistic story about living on a futuristic space station, taking into account some of the technologies that would make that possible, such as miniaturisation, solar cells, ceramics, insulation, food preservation and life support
• debating the moral and ethical issues of space travel and considering desirable future directions e.g. human versus robot exploration
• researching the relationship between technological advances and space exploration and the positive and negative impacts of those technologies
• analysing the implications of human geological-related activity (e.g. mining exploration, extraction and transportation) on communities of humans and on natural environments, focusing on who gains and loses in such activities e.g. the reasons for and the effects of increased tantalum demand
• discussing how the use of Earth’s resources (e.g. water, land) is affected by competing interest groups e.g. miners, industry, farmers, recreational users, indigenous peoples
Assessment evidence guide

The Assessment Evidence Guide lists examples of evidence of student achievement across each standard and at each of the stages within a standard. Teachers use the Assessment Evidence Guide to help make on-balance judgements when assessing student work. So that students are challenged to improve their learning, opportunities to learn should be provided in advance of students’ expected assessment ratings.

Students do not have to be capable of achieving everything within a particular stage to be rated as performing at that stage, but they should be capable of demonstrating most of the evidences. Students need as many opportunities as possible to demonstrate their understanding and skill level. Teachers make an on-balance judgement about whether a student’s performance is at a similar level to the evidences described in this guide.

A range of performances are possible within each stage. For assessment purposes, teachers should make a judgement as to whether the student has only just reached that stage (proficient) or has progressed well towards the next stage (advanced). The assessment of being proficient or advanced is based on teacher judgement supported by collegial discussions, feedback and moderation. This level of discrimination should also be reflected in the teachers’ written comments on student performance. It is important that teachers can explain what key understandings and skills are required for students to progress to the next stage.

The points of reference for assessment can be shown as below:

<table>
<thead>
<tr>
<th>Stage</th>
<th>Standard 1</th>
<th>Standard 2</th>
<th>Standard 3</th>
<th>Standard 4</th>
<th>Standard 5</th>
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</thead>
<tbody>
<tr>
<td>Level</td>
<td>P A P A P A P A P A P A P A P A P A</td>
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<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15</td>
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</tbody>
</table>
Expected stages by year

<table>
<thead>
<tr>
<th>Year level</th>
<th>Kinder and Prep</th>
<th>Years 1 and 2</th>
<th>Years 3 and 4</th>
<th>Years 5 and 6</th>
<th>Years 7 and 8</th>
<th>Years 9 and 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards (1–5)</td>
<td>1</td>
<td>1 – 2</td>
<td>2 – 3</td>
<td>2 – 4</td>
<td>3 – 4</td>
<td>4 – 5</td>
</tr>
<tr>
<td>Stages (1–15)</td>
<td>1 – 3</td>
<td>2 – 5</td>
<td>4 – 8</td>
<td>6 – 10</td>
<td>8 – 12</td>
<td>10 – 15</td>
</tr>
</tbody>
</table>

Assessment evidence at each stage

The table below describes sample indicators of performance at each stage. It is not intended to be used as a set of criteria or a checklist of performance for each stage and it does not map the entire territory of Science. It does, however, give some examples of what might be expected at each stage. The table draws from a range of sources such as *Science – a curriculum profile for Australian schools*, the national *Statement of Learning for Science*, the *Trends in International Mathematics and Science Study*, the Tasmanian Calibration Project and the *Tasmanian Curriculum for Science*. The examples will help teachers use their professional judgement to locate each student’s performance within the appropriate standard.

The Science assessment evidence guide

The Science assessment evidence guide includes outcome statements that summarise the learning described by each of the performance criteria descriptors. It also includes sample indicators for each main idea at each stage.
## Science

**Standard one** - The points listed here are intended as examples only. Teachers observe and collect a wider range of evidence to make on-balance assessment judgements.

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</tr>
</thead>
<tbody>
<tr>
<td><strong>Science as a human endeavour</strong>&lt;br&gt;Scientists work, think, inquire and know in particular ways</td>
<td>Describe some ways that people find things out and make things e.g.</td>
<td>Understand that work or hobbies can involve science e.g.</td>
<td>Understand that scientists find out how the world works and help make useful things e.g.</td>
<td>Understand that scientists investigate the world in a particular way e.g.</td>
</tr>
<tr>
<td>Applications of science have shaped and changed the world</td>
<td>- talk about how doctors decide if you are sick</td>
<td>- explain that a person they met has a science hobby (such as shell or rock collecting)</td>
<td>- role play the work of a scientist they met on an excursion, such as a vet or geologist</td>
<td>- explain that scientists make observations and carry out investigations</td>
</tr>
<tr>
<td>Identify some things that help us e.g.</td>
<td>Describe some ways in which the products of science assist people e.g.</td>
<td>Describe that they share the world and need to care for it e.g.</td>
<td>Suggest what their lives would be like without science e.g.</td>
<td>Describe the work of a particular scientist and why it is useful e.g.</td>
</tr>
<tr>
<td>- name some objects which help us, such as fridge, scissors</td>
<td>- explain that glasses assist vision</td>
<td>- say that you should look after the schoolyard Don’t tread on the gardens</td>
<td>- talk about and then act out what their life would be like without a particular tool, such as computers</td>
<td>- contribute to a list of pluses and minuses on how people affect the environment They drop litter</td>
</tr>
<tr>
<td>Identify ways we need to care for living things e.g.</td>
<td>Explain that they share the world and need to care for it e.g.</td>
<td>Understand that living things depend on other living things and their environment to survive e.g.</td>
<td>Explain that people shouldn’t litter because the litter can injure animals</td>
<td></td>
</tr>
<tr>
<td>- explain that pets have needs that have to be met</td>
<td>- say that you should look after the schoolyard Don’t tread on the gardens</td>
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<td></td>
</tr>
<tr>
<td><strong>Scientific inquiry</strong>&lt;br&gt;Scientific inquiries are generated from observations, questions and predictions</td>
<td>Make simple statements about events that they experience e.g.</td>
<td>Identify questions that let them find out how and why things are happening e.g.</td>
<td>Make guess type predictions about a question the class is discussing e.g.</td>
<td>Identify interesting questions to investigate scientifically e.g.</td>
</tr>
<tr>
<td>Scientists plan and conduct investigations in particular ways</td>
<td>- say The sunset is red, The balloon made a loud pop, That plant smells like lemons, The brown rock feels smooth</td>
<td>- ask simple questions to elicit science information Why don’t those trees have any leaves? How did the crane get on top of that building? When will it be dark?</td>
<td>- suggest that putting a dead flower in soil will bring it back to life</td>
<td>- ask What will happen to plants if the pond dries up?</td>
</tr>
<tr>
<td>Make observations about science experiences e.g.</td>
<td>Follow precise, single step directions to complete a task e.g.</td>
<td>Predict which of a selection of objects will float and which will sink</td>
<td>Understand how to make measurements and record data e.g.</td>
<td>Follow a given short sequence of steps to collect and record data e.g.</td>
</tr>
<tr>
<td>- describe objects teacher has placed under a microscope</td>
<td>- work with an adult helper to make slime as instructed</td>
<td></td>
<td>- measure and record how far different toy cars roll</td>
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</tr>
<tr>
<td>- identify the variable that is being changed in a simple teacher-led investigation The teacher planted two kinds of seed, cress and bean</td>
<td>- identify the variable that made their slime different to another group’s We added more water</td>
<td></td>
<td>- suggest one variable that might affect the outcome in a simple investigation The amount of water might affect how well the plant grows</td>
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*NEALS*
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</thead>
</table>
| **Scientists draw conclusions after considering various interpretations of their data** | Identify similarities and differences e.g.  
• correctly interpret what happened in a simple investigation The beans grew taller than the cress | Suggest reasons for causes and effects they observe e.g.  
• suggest one reason for the outcome observed The ball didn’t roll very far because the grass was muddy, My plant died because its pot was too small | Draw a conclusion when presented with simple alternatives e.g.  
• suggest a reason for their observations Magnets don’t attract plastic so they didn’t pick up Lego blocks | Draw simple conclusions when led by the teacher e.g.  
• use data presented in a simple table to draw obvious conclusions |
| **Scientific communication**  
Scientists consider accuracy, relevance and credibility when acquiring information | Read / view picture-based science texts e.g.  
• look at a book showing animals of the world | Identify links between science texts and their own experiences e.g.  
• look at a book showing animals of the world and say We have kangaroos like that in our school yard | Identify a text that they can collect particular scientific information from e.g.  
• find information in simple visual texts e.g. What do platypuses look like? | Locate, record and report simple science information, as directed by the teacher e.g.  
• locate a text about volcanoes and tell the class two interesting things from it |
| Scientists need to communicate information in a variety of ways | Use words, signs, picture symbols, actions, drawings or photos to communicate scientific information e.g.  
• respond to questions about what the weather is like in different photos, using terminology such as snow, rain, clouds, sunny, lightning | Use simple scientific vocabulary when communicating scientific information e.g.  
• Put the headings fine and overcast on a chart, and glue pictures of the weather into the correct column after looking at the clouds in them | Use simple labels and images when creating scientific texts about familiar situations e.g.  
• draw a picture of stormy weather and label the clouds, thunder and lightning | Use simple sentences when creating science texts about familiar situations e.g.  
• record what they did and what they found in a science journal template |
| **Energy and force**  
The behaviour of objects is determined by the forces that act on them | Understand that it is possible to change things by applying a force e.g.  
• say I can make the ball move by throwing it or rolling it | Describe ways that objects of different shapes and sizes move e.g.  
• group objects according to whether they roll or slide down a slope The soccer ball rolls, the square block doesn’t roll | State how different types of objects behave in different situations e.g.  
• say what happened in their investigation The soccer ball rolled further than the table tennis ball | Describe some of the ways that forces change the shape and motion of objects e.g.  
• identify everyday forces as push or pull forces |
| Energy can be transferred and transformed | Identify how to make a variety of different objects move e.g.  
• demonstrate how to make different kinds of toys | Identify ways that using more energy creates more movement e.g.  
• explain If you throw a ball harder, it goes further, If you blow harder, the toy windmill turns faster | Identify some effects of energy in their lives e.g.  
• explain that Energy from the wind is making the trees move, the window rattle and the papers blow around | Describe some ways in which energy may affect objects e.g.  
• name several types of energy and say how they, are used Heat makes us warm, Light lets us read |
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<tbody>
<tr>
<td><strong>Humans use energy and this raises ethical and sustainability issues</strong></td>
<td>Explain how to make different kinds of toys work e.g.</td>
<td>Explain some ways in which energy affects them personally e.g.</td>
<td>Identify the energy source used by some common objects e.g.</td>
<td>Identify ways energy is used in their homes and at school e.g.</td>
</tr>
<tr>
<td></td>
<td>• explain The train needs batteries, but you just push the car</td>
<td>• give one reason they need energy / need energy to stay warm in winter</td>
<td>• explain where different things get their energy from Cars need petrol,</td>
<td>• list ways energy is used in the school</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>people need food, the torch needs batteries</td>
<td></td>
</tr>
<tr>
<td><strong>Matter</strong></td>
<td>Identify and describe familiar materials e.g.</td>
<td>Describe and group familiar objects e.g.</td>
<td>Sort materials using less obvious properties e.g.</td>
<td>Describe less obvious properties of common materials e.g.</td>
</tr>
<tr>
<td>The chemical and physical properties of materials are determined by their structure</td>
<td>• make accurate observations The playdough is blue and squishy, The rose is spiky and smells nice</td>
<td>• group objects according to whether they are rough or smooth</td>
<td>• group objects according to whether they are natural or made</td>
<td>• describe observations they have made about how liquids The water was runner than the honey</td>
</tr>
<tr>
<td>Materials react and change in a variety of ways</td>
<td>Describe what things look like after they have changed e.g.</td>
<td>Describe some common changes that materials undergo e.g.</td>
<td>Describe some ways the properties of materials can be changed e.g.</td>
<td>Describe differences in how materials change e.g.</td>
</tr>
<tr>
<td></td>
<td>• describe how an object left in the sun changed The chocolate has gone soft and runny</td>
<td>• describe changes they have observed common foods undergo The sugar dissolved in the water</td>
<td>• describe how they changed a material We boiled the eggs and made their yolks go hard</td>
<td>• compare how much of different powders they can dissolve</td>
</tr>
<tr>
<td>Humans use materials and this raises ethical and sustainability issues</td>
<td>Describe what familiar objects / materials are used for e.g.</td>
<td>Identify objects / materials suitable for familiar activities e.g.</td>
<td>Explain why common materials are used in particular situations e.g.</td>
<td>Describe one property of a common material e.g.</td>
</tr>
<tr>
<td></td>
<td>• describe some ways they use paper We use paper for drawing , cutting and wrapping presents</td>
<td>• draw the clothes and toys that they would take to the pool</td>
<td>• talk about why glass is usually used for windows but not for chairs</td>
<td>• investigate the absorbency of different paper towels</td>
</tr>
<tr>
<td><strong>Living things</strong></td>
<td>Identify the needs of a particular living thing e.g.</td>
<td>Describe the function of common body parts e.g.</td>
<td>Understand that living things have different characteristics at different times of their lives e.g.</td>
<td>Describe the function of external and internal structures e.g.</td>
</tr>
<tr>
<td>The structure and characteristics of living things affect their behaviour and functioning</td>
<td>• tell an adult that their classroom pet needs food, water and a box to stay healthy</td>
<td>• discuss how having limited use of a particular body part would affect them</td>
<td>• glue pictures of eggs, tadpoles, frogs in the correct lifecycle order</td>
<td>• draw in major organs on a template of the body and say what they do</td>
</tr>
<tr>
<td>A diverse range of living things have evolved on the Earth</td>
<td>Identify different groups of living things e.g.</td>
<td>Describe ways in which things can be grouped e.g.</td>
<td>Describe how to group living things in different ways e.g.</td>
<td>Identify the features of particular groups e.g.</td>
</tr>
<tr>
<td></td>
<td>• sort drawings of objects into groups, such as birds, fish, frogs, insects</td>
<td>• sort drawings according to whether they are plants or animals</td>
<td>• sort photos of animals in different ways e.g.</td>
<td>• make a PowerPoint showing the features of birds</td>
</tr>
</tbody>
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<tbody>
<tr>
<td><strong>Humans interact with ecosystems, and this raises ethical and sustainability issues</strong></td>
<td>Identify different ecosystems e.g. • draw pictures of three different environments, such as beach, river, bush</td>
<td>Describe the kinds of living things found in common environments e.g. • glue pictures on posters to show the living things found in some different ecosystems</td>
<td>Describe how living things rely on their environment and how humans may have an impact e.g. • explain Moving rocks means that crabs have nothing to protect them from the sun and birds</td>
<td>Understand that the environment determines the kinds of things living there e.g. • make a poster showing the kinds of animals that live in a desert environment</td>
</tr>
</tbody>
</table>
| **Earth and space**
*Earth and space have characteristic features and patterns of activity* | Identify a variety of features of the Earth and sky e.g. • draw a picture of the sky at night, showing stars and the moon | Identify patterns in their physical environment e.g. • draw pictures showing what the moon looks like at different times | Identify and describe various familiar and non-familiar features of the Earth e.g. • identify and describe different features of the physical environment, such as different kinds of waterways | Identify and describe the characteristics of various landforms and patterns of movement e.g. • draw in the East Australian Current on a map |
| **Earth and space systems continue to be shaped by the changes they experience** | Identify obvious changes that occur on the Earth e.g. • observe changes in their immediate environment, The leaves have turned yellow | Identify basic cause and effect relationships that occur on the Earth and in the sky e.g. • describe seasonal changes, Some trees don’t have any leaves because it is winter | Describe short and longer term patterns of events e.g. • draw pictures showing the order of the seasons | Understand that the Earth is very old and has changed e.g. • describe what the Earth was like at a particular time in the past |
| **Humans use the Earth and this raises ethical and sustainability issues** | Describe some activities that occur in familiar environments e.g. • contribute to a class collage showing what people do at the beach | Identify some ways they use and care for the Earth e.g. • pick up rubbish in their playground | Explain ways they care for their environment and why this is important e.g. • explain why they recycle paper in their classroom | Identify the materials and energy sources that allow us to live on Earth e.g. • make a list of all the materials that humans need to survive |
Standard two - The points listed here are intended as examples only. Teachers observe and collect a wider range of evidence to make on-balance assessment judgements.

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</table>
| **Science as a human endeavour**<br>Scientists work, think, inquire and know in particular ways | Understand that scientists find out how the world works and help make useful things e.g.  
• role play the work of a scientist they met on an excursion, such as a vet or geologist | Understand that scientists investigate the world in a particular way e.g.  
• explain that scientists make observations and carry out investigations | Understand that science values investigations that are based on evidence e.g.  
• explain that scientists draw conclusions based on the evidence they collect | Understand that science values investigations that are fair, and are based on evidence and logical reasoning e.g.  
• explain that science investigations need to be fair | Describe some of the ways that people think and work scientifically e.g.  
• read about the discovery of penicillin and explain how luck played a part |
| **Applications of science have shaped and changed the world** | Suggest what their lives would be like without science e.g.  
• talk about and then act out what their life would be like without a particular tool, such as computers | Describe the work of a particular scientist and why it is useful e.g.  
• explain that meteorologists collect information and make observations about the weather | Describe some of the ways that applications of science are used in their community e.g.  
• produce a simple report on a way that science benefits their community, such as weather reports helping farmers | Describe how they are engaging in science in their interests and activities within and beyond school and e.g.  
• explain that their family uses the weather report to decide whether it is safe to go fishing | List positive and negative outcomes that a product of science has for society e.g.  
• draw up a table showing the positive and negative impacts that cars have |
| **Applications of science have systems impact** | Understand that living things depend on other living things and their environment to survive e.g.  
• explain that people shouldn’t litter because the litter can injure animals | Identify positive and negative impacts that humans have on the world e.g.  
• contribute to a list of pluses and minuses on how people affect the environment They drop litter | Identify ways they can be more responsible for sustainability e.g.  
• make a list of ways to be more sustainable We will use recyclable bags | Explain why conserving resources is important for the environment e.g.  
• explain the effect that cutting down trees has on living things | |
| **Scientific inquiry**<br>Scientific inquiries are generated from observations, questions and predictions | Make guess type predictions about a question the class is discussing e.g.  
• suggest that putting a dead flower in soil will bring it back to life  
• predict which of a selection of objects will float and which will sink | Identify interesting questions to investigate scientifically e.g.  
• ask What will happen to the plants if the pond dries up? | Suggest questions and make reasoned predictions about the answer e.g.  
• suggest a reason for carrying out a particular investigation and predict what will happen in it | Contribute ideas to discussion about developing a scientifically testable question e.g.  
• contribute to modifying a question We could ask which is the strongest paper instead of which is the best | Identify questions and make predictions with some scientific basis e.g.  
• predict which parts of a river will have the highest turbidity |
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<tr>
<td><strong>Scientists plan and conduct investigations in particular ways</strong></td>
<td>Understand how to make measurements and record data e.g.</td>
<td>Follow a given short sequence of steps to collect and record data e.g.</td>
<td>Suggest why the teacher has selected a particular method e.g.</td>
<td>Plan and carry out simple investigations e.g.</td>
<td>Use scaffolds to plan fair science investigations e.g.</td>
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<td>• measure and record how far different toy cars roll</td>
<td>• record what happens when you make jelly using different amounts of crystals</td>
<td>• recognise that a variable is being deliberately changed in a simple investigation</td>
<td>• design an investigation that includes one of the following: measurement over time, accurate measurement or comparison with a control</td>
<td>• identify an appropriate independent variable, and the variables they will control in an investigation</td>
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<td>• suggest one variable that might affect the outcome in a simple investigation</td>
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<td>The amount of water might affect how well the plant grows</td>
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<td>Identify sources of fairness and unfairness that may influence their conclusion e.g.</td>
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<td>• identify an error in the procedure of a simple investigation</td>
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<td></td>
<td><strong>Scientists draw conclusions after considering various interpretations of their data</strong></td>
<td>Draw a conclusion when presented with simple alternatives e.g.</td>
<td>Draw simple conclusions when led by the teacher e.g.</td>
<td>Identify obvious patterns and give a reason why their results may differ from others e.g.</td>
<td>State if their results match their predictions and whether the method should be changed e.g.</td>
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<td></td>
<td>• suggest a reason for their observations Magnets don’t attract plastic so they didn’t pick up Lego blocks</td>
<td>• use data presented in a simple table to draw obvious conclusions</td>
<td>• reflect on an investigation and suggest why people got different results The plants that got more light grew better</td>
<td>• identify a problem that occurred in an investigation and a way to improve the investigation</td>
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<tr>
<td></td>
<td><strong>Scientific communication</strong></td>
<td>Locate, record and report simple science information, as directed by the teacher e.g.</td>
<td>Collect specified scientific information from a variety of simple texts e.g.</td>
<td>Describe how a science related text makes you think a particular thing or feel a particular way e.g.</td>
<td>Identify and use a variety of texts relevant to their science investigations e.g.</td>
</tr>
<tr>
<td></td>
<td>Scientists consider accuracy, relevance and credibility when acquiring information</td>
<td>• locate a text about volcanoes and tell the class two interesting things from it</td>
<td>• use the web, a book and a DVD to find out information about Antarctica</td>
<td>• the animals are all sad that there is not enough water, so it makes you feel sad</td>
<td>• look at a poster, and listen to a guest speaker to find out what threats there are to wetland birds</td>
</tr>
<tr>
<td></td>
<td>Scientists need to communicate information in a variety of ways</td>
<td>Use simple sentences when creating science texts about familiar situations e.g.</td>
<td>Recognise that scientific conventions and vocabulary should be used in scientific communications e.g.</td>
<td>Identify appropriate methods to communicate scientific information e.g.</td>
<td>Present the results of science investigations in ways that mimic those used by scientists e.g.</td>
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<td>• draw a picture of stormy weather and label the clouds, thunder and lightning</td>
<td>• select a method to organise and display their data, such as a table or graph, and construct the product</td>
<td>• add given, new information to a concept map about ways the Earth changes</td>
<td>• make a poster explaining how to better protect birds in their local area</td>
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<tr>
<td><strong>Energy and force</strong></td>
<td>State how different types of objects behave in different situations e.g.</td>
<td>Describe some of the ways that forces change the shape and motion of objects e.g.</td>
<td>Understand an object’s properties determine the effect of the forces that act on it e.g.</td>
<td>Identify ways in which forces act in everyday situations e.g.</td>
<td>Describe some of the ways in which people apply forces for specific purposes e.g.</td>
</tr>
<tr>
<td>The behaviour of objects is determined by the forces that act on them</td>
<td>• say what happened in their investigation The soccer ball rolled further than the table tennis ball</td>
<td>• identify everyday forces as push or pull forces</td>
<td>• talk about the ways that different balls bounce when dropped from the same height</td>
<td>• investigate and report on why different types of footwear (skis, football boots, rollerblades) are suited to different activities</td>
<td>• draw a diagram showing how they used a pulley to lift a heavy object</td>
</tr>
<tr>
<td>Energy can be transferred and transformed</td>
<td>Identify some effects of energy in their lives e.g.</td>
<td>Describe some ways in which energy may affect objects e.g.</td>
<td>Describe how the properties of an object affects how it absorbs and/or emits energy e.g.</td>
<td>Identify some effects of different forms of energy e.g.</td>
<td>Identify ways in which energy can be stored e.g.</td>
</tr>
<tr>
<td>Humans use energy and this raises ethical and sustainability issues</td>
<td>• explain that Energy from the wind is making the trees move, the window rattle and the papers blow around</td>
<td>• name several types of energy and say how they are used Heat makes us warm, Light lets us read</td>
<td>• describe how string length or thickness affects the sound of musical notes on home made instruments</td>
<td>• brainstorm effects of different forms of energy Sound energy from thunder causes windows to rattle, I ate a muesli bar to get energy</td>
<td>• identify energy storage devices in their classroom, such as batteries, rubber bands, springs</td>
</tr>
<tr>
<td><strong>Matter</strong></td>
<td>Identify the energy source used by some common objects e.g.</td>
<td>Identify ways energy is used in their homes and at school e.g.</td>
<td>Identify ways that energy is used in their community, and how this energy is obtained e.g.</td>
<td>Identify some of the different ways that various people get electricity e.g.</td>
<td>Identify practical ways in which to reduce their energy usage and explain why this is desirable e.g.</td>
</tr>
<tr>
<td>The chemical and physical properties of materials are determined by their structure</td>
<td>• explain where different things get their energy from Cars need petrol, people need food, the torch needs batteries</td>
<td>• list ways energy is used in the school</td>
<td>• draw a table showing how energy is used in the community and its source</td>
<td>• read about how different communities or people get electricity</td>
<td>• design a brochure that clearly explains how to save energy and why we should</td>
</tr>
<tr>
<td><strong>Materials react and change in a variety of ways</strong></td>
<td>Sort materials using less obvious properties e.g.</td>
<td>Describe less obvious properties of common materials e.g.</td>
<td>Classify materials as solids, liquids or gases e.g.</td>
<td>Compare the properties of common materials e.g.</td>
<td>Describe how changing the way parts are assembled can change the properties of the final product e.g.</td>
</tr>
<tr>
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<td>• group objects according to whether they are natural or made</td>
<td>• describe observations they have made about how liquids The water was runnier than the honey</td>
<td>• group jars of common materials according to whether they are solid, liquid or gas</td>
<td>• investigate, describe and compare the properties of the ingredients in a cake</td>
<td>• describe the results of investigating the strength of different shapes made from drinking straws</td>
</tr>
<tr>
<td></td>
<td>Describe some ways the properties of materials can be changed e.g.</td>
<td>Describe differences in how materials change e.g.</td>
<td>Describe how conditions affect the properties of some common materials e.g.</td>
<td>Describe how changing materials may change their properties e.g.</td>
<td>Identify and describe temporary and permanent changes e.g.</td>
</tr>
<tr>
<td></td>
<td>• describe how they changed a material We boiled the eggs and made their yolks go hard</td>
<td>• compare how much of different powders they can dissolve</td>
<td>• describe how temperature affects the speed at which iceblocks melt</td>
<td>• explain that heating the air in their hot air balloon made it rise</td>
<td>• explain that heat causes temporary expansion in a liquid thermometer</td>
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<tr>
<td>Humans use materials and this raises ethical and sustainability issues</td>
<td>Explain why common materials are used in particular situations e.g. • talk about why glass is usually used for windows but not for chairs</td>
<td>Describe one property of a common material e.g. • investigate the absorbency of different paper towels</td>
<td>Describe various properties of a common material e.g. • describe the elasticity, absorbency, strength of a piece of Lycra®</td>
<td>Explain how the properties of a material suit it to particular purposes e.g. • explain how the properties of Lycra® suit it to bathers</td>
<td>Describe how and why materials are used e.g. • list the different materials used to make a car and why they are used</td>
</tr>
<tr>
<td>Living things The structure and characteristics of living things affect their behaviour and functioning</td>
<td>Understand that living things have different characteristics at different times of their lives e.g. • glue pictures of eggs, tadpoles, frogs in the correct lifecycle order</td>
<td>Describe the function of external and internal structures e.g. • draw in major organs on a template of the body and say what they do</td>
<td>Identify characteristics of a particular living thing that help it survive e.g. • explain that the Tasmanian devil has strong jaws to crunch up bones and this helps it to survive</td>
<td>Draw conclusions about a living thing on the basis of its characteristics e.g. • infer where an animal lives from the fact that it has webbed feet</td>
<td>Explain whether an object is living, non-living or once living, on the basis of its features e.g. • explain what happens to food in the stomach</td>
</tr>
<tr>
<td>A diverse range of living things have evolved on the Earth</td>
<td>Describe how to group living things in different ways e.g. • sort photos of animals in different ways, such as fur / no fur, legs / no legs</td>
<td>Identify the features of particular groups e.g. • make a PowerPoint showing the features of birds</td>
<td>Identify characteristics that living things share e.g. • make a chart dividing up photos of living and non-living things</td>
<td>Explain that offspring have similar features to their parents e.g. • match pictures of adult and offspring organisms</td>
<td>Explain some of the interactions that occur between living things e.g. • identify a predator and its prey in a food chain</td>
</tr>
<tr>
<td>Humans interact with ecosystems, and this raises ethical and sustainability issues</td>
<td>Describe how living things rely on their environment and how humans may have an impact e.g. • explain Moving rocks means that crabs have nothing to protect them from the sun and birds</td>
<td>Understand that the environment determines the kinds of things living there e.g. • make a poster showing the kinds of animals that live in a desert environment</td>
<td>Explain ways that living things respond to environmental change e.g. • watch a video on hibernation and explain why animals hibernate</td>
<td>Describe how humans have impacted on the living things in a local area e.g. • make a list of how humans have changed their local area</td>
<td>Describe some of the ways in which humans explore the Earth and Solar System e.g. • describe ways that humans have explored the oceans, including underwater</td>
</tr>
<tr>
<td>Earth and space Earth and space have characteristic features and patterns of activity</td>
<td>Identify and describe various familiar and non-familiar features of the Earth e.g. • identify and describe different features of the physical environment, such as different kinds of waterways</td>
<td>Identify and describe the characteristics of various landforms and patterns of movement e.g. • draw in the East Australian Current on a map</td>
<td>Describe ways in which easily observable conditions vary in their local area e.g. • make a collection of different rocks from their local area</td>
<td>Describe ways in which easily observable conditions vary across the Earth e.g. • visit a museum to compare rocks from their local area with other rocks</td>
<td>Describe some of the ways in which humans explore the Earth and Solar System e.g. • describe ways that humans have explored the oceans, including underwater</td>
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</table>
| Earth and space systems continue to be shaped by the changes they experience | Describe short and longer term patterns of events e.g.  
• draw pictures showing the order of the seasons | Understand that the Earth is very old and has changed e.g.  
• describe what the Earth was like at a particular time in the past | Identify the impact of various types of change on earth systems e.g.  
• describe the change that tsunamis can bring about | Identify predictable changes e.g.  
• observe and describe what the moon looks over one month | Describe and categorise some of the changes that occur on Earth e.g.  
• make lists of the natural and man-made changes that have occurred in their local area in the last year, such as weather, fire, tides |
| Humans use the Earth and this raises ethical and sustainability issues | Explain ways they care for their environment and why this is important e.g.  
• explain why they recycle paper in their classroom | Identify the materials and energy sources that allow us to live on Earth e.g.  
• make a list of all the materials that humans need to survive | Describe some ways their community depends on Earth’s resources e.g.  
• order the resources that their community needs according to importance | Identify ways that living things depend on and are affected by changes on Earth e.g.  
• describe what happens when there is more or less rain than usual | Describe how changes to the Earth’s characteristics may affect living things e.g.  
• describe the possible effect of a giant meteor hitting Earth |
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</table>
| **Science as a human endeavour**<br>Scientists work, think, inquire and know in particular ways | Understand that science values investigations that are fair, and are based on evidence and logical reasoning e.g. | Describe some of the ways that people think and work scientifically e.g. | Identify and explain some different ways that carry out scientific investigations e.g. | Understand that scientific ideas are modified over time by a community of scientists e.g. | Explain why people engage in science as a career and describe the work of Australian scientists e.g. | **Applications of science have shaped and changed the world**
| | • explain that science investigations need to be fair | • read about the discovery of penicillin and explain how luck played a part | • explain that some scientists conduct experiments and others do, ecological studies | • explain that people used to think that the Earth was flat but they now think it is round | • present a PowerPoint on the work of a particular Australian scientist | **Applications of science have systems impact**
| | Describe how they are engaging in science in their interests and activities within and beyond school and e.g. | List positive and negative outcomes that a product of science has for society e.g. | Describe how some products used in work and leisure have changed over time e.g. | Explain ways that science influences and is influenced by history / community needs e.g. | Describe how the use of science has changed the way people live, and, identify some different cultural perspectives in relation to science e.g. | **Scientific inquiry**<br>Scientific inquiries are generated from observations, questions and predictions
| | • explain that their family uses the weather report to decide whether it is safe to go fishing | • draw up a table showing the positive and negative impacts that cars have | • make a timeline showing planes of different eras | • explain that fewer people die from tetanus now that we have vaccines | • research food preparation and preservation methods, including how these have changed over time / vary across cultures | **Contribute ideas to discussion about developing a scientifically testable question e.g.**
| | Describe ways of caring for their environment and conserving resources, understanding that they are part of a system e.g. | Explain why conserving resources is important for the environment e.g. | Identify how humans impact on a local ecosystem e.g. | Identify relationships within and between local systems, and consider different views e.g. | Identify the issues that a particular application of science raises, including stating their own position e.g. | **Identify questions that are suitable for scientific investigation e.g.**
| | • explain how some of their actions can have a flow on effect in conserving resources | • explain the effect that cutting down trees has on living things | • explain the effect that cutting down trees has on their local ecosystem / | • role play the positions of different interest groups on a new local development | • debate whether animals should be used in scientific research | **Identify questions for investigation and explain their predictions e.g.**
| | **Identify questions for investigation and explain their predictions e.g.** | **Identify questions that are suitable for scientific investigation e.g.** | **Identify questions for investigation and explain their predictions e.g.** | **Identify questions for investigation and explain their predictions e.g.** | **Identify questions for investigation and explain their predictions e.g.** | **Formulate, clarify and refine questions and predictions e.g.**
| | **Contribute ideas to discussion about developing a scientifically testable question e.g.** | | | | **refine the question Is salinity a problem for Tasmania to one they can investigate** | **refine the question Is salinity a problem for Tasmania to one they can investigate**
| | • contribute to modifying a question We could ask which is the strongest paper instead of which is the best | **Identify questions and make predictions with some scientific basis e.g.** | | **explain why they think that running through a farm will increase a river’s water turbidity?** | **What is the effect of different salt concentrations on bean seed germination** |
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<tr>
<td><strong>Scientists plan and conduct investigations in particular ways</strong></td>
<td>Plan and carry out simple investigations e.g.</td>
<td>Use scaffolds to plan fair science investigations e.g.</td>
<td>Recognise where comparisons are fair and unfair, and check and repeat observations e.g.</td>
<td>Identify alternative methodologies that improve or add to an investigation e.g.</td>
<td>Plan and conduct fair tests, explaining how they have minimised error e.g.</td>
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<tr>
<td></td>
<td>• design an investigation that includes one of the following: measurement over time, accurate measurement or comparison with a control</td>
<td>• identify an appropriate independent variable, and the variables they will control in an investigation</td>
<td>• describe a method to make a simple investigation fair</td>
<td>• explain changes that they made as they conducted their investigation</td>
<td>• explain how they minimised error when investigating the effect of salt on seed germination I used the same balance each time and checked my measurements</td>
</tr>
<tr>
<td></td>
<td>State if their results match their predictions and whether the method should be changed e.g.</td>
<td>Identify sources of fairness and unfairness that may influence their conclusion e.g.</td>
<td>Identify patterns in their data and use them to draw conclusions e.g.</td>
<td>Draw reasonable conclusions and state any obvious implications e.g.</td>
<td>Consider the findings of others when explaining patterns, drawing conclusions and suggesting improvements e.g.</td>
</tr>
<tr>
<td></td>
<td>• identify a problem that occurred in an investigation and a way to improve the investigation</td>
<td>• identify an error in the procedure of a simple investigation</td>
<td>• provide an explanation of results that is consistent with given data, identifying problems such as human error</td>
<td>• suggest what the implications of their findings might be You need to give beans fertiliser</td>
<td>• review their conclusions in light of what others found</td>
</tr>
<tr>
<td><strong>Scientists draw conclusions after considering various interpretations of their data</strong></td>
<td>Describe how a science text makes you think a particular thing or feel a particular way e.g.</td>
<td>Identify and use a variety of texts relevant to their science investigations e.g.</td>
<td>Describe a way of checking the credibility of texts e.g.</td>
<td>Collect information relevant to a science question, identifying any ways that the texts they used promoted particular points of view e.g.</td>
<td>Use texts to deliberately collect information that will allow them to comment on their own investigations e.g.</td>
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<td>• the animals are all sad that there is not enough water, so it makes you feel sad</td>
<td>• look at a poster, and listen to a guest speaker to find out what threats there are to wetland birds</td>
<td>• explain The man who told us that works at the museum so he would probably know</td>
<td>• say The newspaper article only had good things about building a marina</td>
<td>• locate information on photosynthesis in a children’s information book and use it to explain why the plants in the dark died</td>
</tr>
<tr>
<td></td>
<td>Identify appropriate methods to communicate scientific information e.g.</td>
<td>Present the results of science investigations in ways that mimic those used by scientists e.g.</td>
<td>Understand that some texts are more appropriate than others to communicate particular scientific information e.g.</td>
<td>Compose texts that present scientific findings clearly and logically, and include tables and diagrams e.g.</td>
<td>Compose scientific texts that include appropriate use of spreadsheets, graphs, models, and diagrams, and reflect on their effectiveness e.g.</td>
</tr>
<tr>
<td></td>
<td>• add given, new information to a concept map about ways the Earth changes</td>
<td>• make a poster explaining how to better protect birds in their local area</td>
<td>• explain that they are going to show a group of parents a PowerPoint because the photos will help them understand better than just talking</td>
<td>• include a table of the kind of birds that they saw in different months, and a diagram of the parts of the shore that different species use when presenting their study of local shorebirds</td>
<td>• deliver an oral presentation, using models to explain what causes eclipses and reflect on how effective it was</td>
</tr>
<tr>
<td><strong>Scientific communication Scientists consider accuracy, relevance and credibility when acquiring information</strong></td>
<td>Identify appropriate methods to communicate scientific information e.g.</td>
<td>Describe how a science text makes you think a particular thing or feel a particular way e.g.</td>
<td>Identify and use a variety of texts relevant to their science investigations e.g.</td>
<td>Describe a way of checking the credibility of texts e.g.</td>
<td>Identify alternative methodologies that improve or add to an investigation e.g.</td>
</tr>
<tr>
<td><strong>Scientists need to communicate information in a variety of ways</strong></td>
<td>Plan and carry out simple investigations e.g.</td>
<td>Use scaffolds to plan fair science investigations e.g.</td>
<td>Recognise where comparisons are fair and unfair, and check and repeat observations e.g.</td>
<td>Identify alternative methodologies that improve or add to an investigation e.g.</td>
<td>Plan and conduct fair tests, explaining how they have minimised error e.g.</td>
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### Standard three - The points listed here are intended as examples only. Teachers observe and collect a wider range of evidence to make on-balance assessment judgements.

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<tr>
<td><strong>Energy and force</strong></td>
<td><em>The behaviour of objects is determined by the forces that act on them</em></td>
<td>Identify some ways in which forces act in everyday situations e.g. • investigate and report on why different types of footwear (skis, football boots, rollerblades) are suited to different activities</td>
<td>Describe some of the ways in which people apply forces for specific purposes e.g. • draw a diagram showing how they used a pulley to lift a heavy object</td>
<td>Describe some of the relationships that exist between force, motion and energy e.g. • explain that a larger force is needed to move a larger car, so the car will use more energy</td>
<td>Identify some forces that support or oppose each other e.g. • discuss friction as the force that opposes motion</td>
</tr>
<tr>
<td><strong>Energy can be transferred and transformed</strong></td>
<td></td>
<td>Identify some effects of different forms of energy e.g. • brainstorm effects of different forms of energy Sound energy from thunder causes windows to rattle, I ate a muesli bar to get energy</td>
<td>Identify ways in which energy can be stored e.g. • identify energy storage devices in their classroom, such as batteries, rubber bands, springs</td>
<td>Explain how living things use different energy transfers e.g. • recognise the sun as source of stored chemical energy • recognise fossil fuels were formed from living matter</td>
<td>Describe some ways in which energy is transferred and transformed e.g. • describe different ways that heat can be transferred</td>
</tr>
<tr>
<td><strong>Humans use energy and this raises ethical and sustainability issues</strong></td>
<td></td>
<td>Identify some of the different ways that various people get electricity e.g. • read about how different communities or people get electricity</td>
<td>Identify practical ways in which to reduce their energy usage and explain why this is desirable e.g. • design a brochure that clearly explains how to save energy, and why this is important</td>
<td>Identify and explain how energy can be used more efficiently e.g. • describe how and why covering the windows changes the temperature in their classroom</td>
<td>Compare different renewable and non-renewable energy sources and systems e.g. • identify where various renewable and non-renewable energy sources are used</td>
</tr>
<tr>
<td><strong>Matter</strong></td>
<td><em>The chemical and physical properties of materials are determined by their structure</em></td>
<td>Compare the properties of common materials e.g. • investigate, describe and compare the properties of the ingredients in a cake</td>
<td>Describe how changing the way parts are assembled can change the properties of the final product e.g. • describe the results of investigating the strength of different shapes made from drinking straws</td>
<td>Identify and describe how materials’ properties affect how they behave e.g. • investigate and describe how different materials break down / decay</td>
<td>Describe how varying a substance’s composition can change its properties e.g. • describe how changing the concentration of detergent affects the bubbles that can be produced</td>
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<tr>
<td><strong>Materials react and change in a variety of ways</strong></td>
<td>Describe how changing materials may change their properties e.g.</td>
<td>Identify and describe temporary and permanent changes e.g.</td>
<td>Describe a variety of changes that materials can undergo e.g.</td>
<td>Identify patterns in the types of change that take place e.g.</td>
<td>Differentiate between physical and chemical change e.g.</td>
</tr>
<tr>
<td>Humans use materials and this raises ethical and sustainability issues</td>
<td>• explain that heating the air in their hot air balloon made it rise</td>
<td>• explain that heat causes temporary expansion in a liquid thermometer</td>
<td>• make a poster showing the effect of dying materials using different mordants</td>
<td>• place iodine on different foods and suggest what the ones that turn purple have in common</td>
<td>• explain condensation on glass is an example of physical rather than chemical change</td>
</tr>
<tr>
<td></td>
<td>Explain how the properties of a material suit it to particular purposes e.g.</td>
<td>Describe how and why materials are used e.g.</td>
<td>Identify some factors that influence the selection of which material to use e.g.</td>
<td>Explain how effectively a manufactured material meets its purpose and its potential environmental impact e.g.</td>
<td>Identify and discuss how some chemical procedures and processes are used e.g.</td>
</tr>
<tr>
<td></td>
<td>• explain how the properties of Lycra® suit it to bathers</td>
<td>• list the different materials used to make a car and why they are used</td>
<td>• make a list of criteria that could be used to decide which material to use for a rabbit hutch</td>
<td>• investigate the strength and biodegradability of plastics</td>
<td>• describe how evaporation, decanting and sieving are used in the kitchen</td>
</tr>
<tr>
<td><strong>Living things</strong></td>
<td>Draw conclusions about a living thing on the basis of its characteristics e.g.</td>
<td>Explain how some internal and external features of living things function e.g.</td>
<td>Explain how various structures are suited to their function e.g.</td>
<td>Explain how the survival of an organism is influenced by its environment e.g.</td>
<td>Identify characteristics of plant and animal cells e.g.</td>
</tr>
<tr>
<td>The structure and characteristics of living things affect their behaviour and functioning</td>
<td>• infer where an animal lives from the fact that it has webbed feet</td>
<td>• explain what happens to food in the stomach</td>
<td>• explain how Venus fly trap leaves allow them to catch insects</td>
<td>• describe how a disease spreads in a particular species</td>
<td>Explain the basis of accepted systems of classification e.g.</td>
</tr>
<tr>
<td>A diverse range of living things have evolved on the Earth</td>
<td>Explain that offspring have similar features to their parents e.g.</td>
<td>Explain whether an object is living, non-living or once living , on the basis of its features e.g.</td>
<td>Explain systems that can be used to sort living things, including reproductive processes e.g.</td>
<td>Identify differences in closely related living things e.g.</td>
<td>• use a key to identify different groups of invertebrates and explain what the main differences between groups are</td>
</tr>
<tr>
<td>Humans interact with ecosystems, and this raises ethical and sustainability issues</td>
<td>• match pictures of adult and offspring organisms</td>
<td>• make a chart that lists living / non-living / once living objects</td>
<td>• explain the difference between monotremes, marsupials and placentals</td>
<td>Explain differences in closely related living things e.g.</td>
<td>Construct and interpret food chains and food webs e.g.</td>
</tr>
<tr>
<td></td>
<td>Describe how humans have impacted on the living things in a local area e.g.</td>
<td>Describe some of the interactions that occur between living things e.g.</td>
<td>Describe some of the interactions between living things and their non-living surroundings e.g.</td>
<td>Explain how humans have impacted on the living things in a particular ecosystem e.g.</td>
<td>• draw a food web for an identified ecosystem</td>
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<td></td>
<td>• make a list of how humans have changed their local area</td>
<td>• identify a predator and its prey in a food chain</td>
<td>• predict and explain some effects of change to a pond ecosystem</td>
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**NEALS**
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| Earth and space  
Earth and space have characteristic features and patterns of activity | Describe ways in which easily observable conditions vary across the Earth e.g.  
- visit a museum to compare rocks from their local area with other rocks  
Identify predictable changes e.g.  
- observe and describe what the moon looks over one month | Describe some of the ways in which humans explore the Earth and Solar System e.g.  
- describe ways that humans have explored the oceans, including underwater  
Describe and categorise some of the changes that occur on Earth e.g.  
- make lists of the natural and man-made changes that have occurred in their local area in the last year, such as weather, fire, tides  
Describe how changes to the Earth’s characteristics may affect living things e.g.  
- describe the possible effect of a giant meteor hitting Earth | Describe the planets and other objects in the solar system e.g.  
- list some differences between the moon and Earth, such as why the moon has craters  
Identify causes and effects of some of the changes which occur on Earth e.g.  
- list different sources of pollution along the length of a river and suggest the impact they may have  
Explain how Earth’s resources are used in the community e.g.  
- visit an education centre and describe a Tasmanian industry | Explain why only the Earth seems to support life e.g.  
- complete a webquest on the planets and explain why people can live on Earth but not other planets  
Describe interactions between Earth systems and / or space systems e.g.  
- explain why rainfall is continually produced as part of the water cycle  
Explain why their community is participating in a particular environmental project e.g.  
- listen to a guest speaker and then explain why their project is important | Explain effects caused by the positions of the Earth / Sun / Moon e.g.  
- model the positions of the Earth, Moon and Sun, and explain some effects that these positions cause  
Describe processes that occur over short and long time scales e.g.  
- model and explain the formation of stalactites and stalagmites  
Identify and explain which of Earth’s resources are reusable and renewable e.g.  
- describe the variety of materials that are recycled in their community |
| Earth and space systems continue to be shaped by the changes they experience | Humans use the Earth and this raises ethical and sustainability issues |  |  |  |  |
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| **Science as a human endeavour**   | Understand that scientific ideas are modified over time by a community of scientists e.g.  
• explain that people used to think that the Earth was flat but they now think it is round | Explain why people engage in science as a career and describe the work of Australian scientists e.g.  
• present a PowerPoint on the work of a particular Australian scientist | Identify what is characteristic of the way that scientists work, and why this is important e.g.  
• research a case of scientific fraud and explain how the scientist involved ignored good practice | Identify some things that limit or control scientific work or understanding e.g.  
• discuss the pros and cons of a ban on stem cell research | Understand that scientists often work in multidisciplinary teams, and that people from diverse cultures have contributed to and shaped science e.g.  
• describe an example of a scientific project that requires input from many different science disciplines, such as sea ice research |
| **Applications of science have shaped and changed the world** | Explain ways that science influences and is influenced by history / community needs e.g.  
• explain that fewer people die from tetanus now that we have vaccines | Describe how the use of science has changed the way people live, and, identify some different cultural perspectives in relation to science e.g.  
• research food preparation and preservation methods, including how these have changed over time / vary across cultures | Analyse how and why some products and processes have changed over time / vary across cultures e.g.  
• research an aspect of medicine that people have different beliefs about (such as acupuncture or naturopaths) including the relevant science | Analyse the impact that changes in products and processes can have e.g.  
• research advances in contraception and reproductive technologies over time, and consider the impact these advances have had | Identify and discuss instances in which progress in science can be affected by and influence societal issues and priorities e.g.  
• discuss factors that have influenced the development of water purification technologies |
| **Applications of science have systems impact** | Identify relationships within and between local systems, and consider different views e.g.  
• role play the positions of different interest groups on a new local development | Identify the issues that a particular application of science raises, including stating their own position e.g.  
• debate whether animals should be used in scientific research | Identify system relationships and consider reasons for different perspectives e.g.  
• construct a futures wheel showing the possible impacts of a new development | Identify and explain some of the system relationships that exist in local and global issues e.g.  
• research global warming and identify some of its likely impacts on Earth’s systems | Explain their own position on an issue, incorporating relevant scientific understandings e.g.  
• explain their position on whether Australia should use nuclear energy |
| **Scientific inquiry**              | Identify questions for investigation and explain their predictions e.g.  
• explain why they think that running through a farm will increase a river’s turbidity | Formulate, clarify and refine questions and predictions e.g.  
• refine the question Is salinity a problem for Tasmania to one they can investigate  
What is the effect of different salt concentrations on bean seed germination | Recognise questions that cannot or should not be investigated e.g.  
• identify ethical reasons for not carrying out some research, such as the effect of nuclear radiation on humans | Modify questions and rewrite as testable hypotheses e.g.  
• identify the hypothesis for a given investigation by completing ‘if . . ., then . . .’ | Formulate questions and hypotheses that allow predictions to be made e.g.  
• modify research questions to hypotheses that make predictions about events beyond their immediate research |

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<tr>
<td><strong>Scientists plan and conduct investigations in particular ways</strong></td>
<td>Identify alternative methodologies that improve or add to an investigation e.g. • explain changes that they made as they conducted their investigation</td>
<td>Plan and conduct fair tests, explaining how they have minimised error e.g. • explain how they minimised error when investigating the effect of salt on seed germination I used the same balance each time and checked my measurements</td>
<td>Describe alternative methods of conducting an investigation and justify their choice e.g. • explain that they couldn’t deliberately make an area saline so they had to use lab trials</td>
<td>Plan and conduct investigations, stating how they have improved the reliability of the data they collect e.g. • explain that they improved reliability by using seeds from different packets and different species and more accurate measuring equipment • question the effectiveness of data presented in a table based on other evidence</td>
<td>Design and conduct investigations that involve working with more complex data e.g. • collect multiple data sets relating to water quality in a waterway, such as pH, dissolved oxygen and turbidity</td>
</tr>
<tr>
<td><strong>Scientists draw conclusions after considering various interpretations of their data</strong></td>
<td>Draw reasonable conclusions and state any obvious implications e.g. • suggest what the implications of their findings might be You need to give beans fertiliser</td>
<td>Consider the findings of others when explaining patterns, drawing conclusions and suggesting improvements e.g. • review their conclusions in light of what others found</td>
<td>Identify and explain anomalous data, and identify the relevant science concepts e.g. • consider relevant science concepts when reflecting on an investigation’s design, the usefulness of the question asked and further information that is needed</td>
<td>Draw conclusions based on multiple data sets and identify further investigations e.g. • measure the effectiveness of using different glues on a range of materials and draw a conclusion about the overall most effective glue</td>
<td>Identify and explain trends and suggest how uncertainty can be reduced e.g. • explain that an advantage of their methodology was that they had ten subjects in each group, and having more subjects increases accuracy • question their results critically to determine whether further investigation is necessary</td>
</tr>
<tr>
<td><strong>Scientific communication</strong></td>
<td>Collect information relevant to a science question, identifying any ways that the texts they used promoted particular points of view e.g. • say The newspaper article only had good things about building a marina</td>
<td>Use texts to deliberately collect information that will allow them to comment on their own investigations e.g. • locate information on photosynthesis in a children’s information book and use it to explain why the plants in the dark died</td>
<td>Use challenging texts to deliberately collect information that will allow them to comment on their own investigations e.g. • locate information on photosynthesis in a science textbook and use it to explain why the plants in the dark died</td>
<td>Access relevant scientific information from a variety of texts, understanding that a source may lack detail or show bias e.g. • explain why they think a particular text is biased</td>
<td>Compare and choose between available sources of information for a scientific investigation e.g. • explain if they think their own results or those contained in a textbook are more likely to be accurate</td>
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| **Scientists need to communicate information in a variety of ways** | Compose texts that present scientific findings clearly and logically, and include tables and diagrams e.g.  
- include a table of the kind of birds that they saw in different months, and a diagram of the parts of the shore that different species use when presenting their study of local shorebirds | Compose scientific texts that include appropriate use of spreadsheets, graphs, models, and diagrams, and reflect on their effectiveness e.g.  
- deliver an oral presentation, using models to explain what causes eclipses and reflect on how effective it was | Compose scientific texts that show increasing use of relevant scientific terminology and representations e.g.  
- prepare a report that includes circuit diagrams and correct electrical units | Compose a variety of cohesive scientific texts, that are appropriate for different intended audiences e.g.  
- write a formal scientific report on their investigation, and then produce a PowerPoint suitable for Year 1 students | Use accepted scientific formats, conventions, representations, terminology and understandings appropriately e.g.  
- prepare a formal scientific report that includes appropriately presented and detailed information in each section |

| **Energy and force** | **The behaviour of objects is determined by the forces that act on them** | Describe some of the relationships that exist between force, motion and energy e.g.  
- explain that a larger force is needed to move a larger car, so the car will use more energy | Identify some forces that support or oppose each other e.g.  
- discuss friction as the force that opposes motion | Explain some ways that varying the properties of objects can affect the forces that act on them e.g.  
- report on the strength of different types of bridges | Explain how the ways that forces act are important in a particular situation e.g.  
- explaining the basis for the particular design that they used to build their steam or solar power boat | Explain how interacting forces affect an object  
- draw a force diagram showing the forces that act on a car moving at constant speed or a boat being rowed against the current |
| **Energy can be transferred and transformed** | Explain how living things use different energy transfers e.g.  
- recognise the sun as source of stored chemical energy  
- recognise fossil fuels were formed from living matter | Describe some ways in which energy is transferred and transformed e.g.  
- describe different ways that heat can be transferred | Explain how energy transfers and transformations that occur in particular situations e.g.  
- recognise path of light from source to visible object to eye | Analyse the energy transfers and transformations that occur in particular situations e.g.  
- explain the basis for the particular design that they used to build their steam or solar power boat | Understand conservation of energy and explain how and why the movement of energy varies according to the medium through which it is transferred |
| **Humans use energy and this raises ethical and sustainability issues** | Identify and explain how energy can be used more efficiently e.g.  
- describe how and why covering the windows changes the temperature in their classroom | Compare different renewable and non-renewable energy sources and systems e.g.  
- identify where various renewable and non-renewable energy sources are used | Explain how energy systems have been developed and changed over time e.g.  
- research and explain the use and impact of Basslink cable | Identify issues that need to be considered when using different energy sources e.g.  
- discuss the advantages and disadvantages of wind power | Identify and analyse use of a particular form of energy  
- explain their position on whether Australia should use nuclear energy |
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<td><strong>Matter</strong></td>
<td>Identify and describe how materials’ properties affect how they behave e.g.</td>
<td>Describe how varying a substance’s composition can change its properties e.g.</td>
<td>Identify and describe chemical and physical properties of common substances e.g.</td>
<td>Explain how the properties of a group of substances affect their production and use e.g.</td>
<td>Explain properties and changes using the particle model, including differences between elements and compounds e.g.</td>
</tr>
<tr>
<td>The chemical and physical properties of materials are determined by their structure</td>
<td>• investigate and describe how different materials break down / decay</td>
<td>• describe how changing the concentration of detergent affects the bubbles that can be produced</td>
<td>• distinguish between chemical and physical properties of metals</td>
<td>• explain how wine is produced</td>
<td>• use the particle theory to explain the structure of solids, liquids and gases</td>
</tr>
<tr>
<td>Materials react and change in a variety of ways</td>
<td>Identify patterns in the types of change that take place e.g.</td>
<td>Differentiate between physical and chemical change e.g.</td>
<td>Describe how some substances react e.g.</td>
<td>Describe some factors that affect chemical change e.g.</td>
<td>Explain physical and chemical change and conservation of matter using particle model e.g.</td>
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<td>Humans use materials and this raises ethical and sustainability issues</td>
<td>• place iodine on different foods and suggest what the ones that turn purple have in common</td>
<td>• explain condensation on glass is an example of physical rather than chemical change</td>
<td>• explain that oxygen is needed for combustion</td>
<td>• explain how temperature affects the rate of chemical reactions</td>
<td>• use molecular models to illustrate what happens to the atoms and molecules in different chemical reactions, including showing that matter is conserved</td>
</tr>
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<td><strong>Living things</strong></td>
<td>Explain how effectively a manufactured material meets its purpose and its potential environmental impact e.g.</td>
<td>Identify and discuss how some chemical procedures and processes are used e.g.</td>
<td>Explain the importance and use of a chemical group e.g.</td>
<td>Explain some effects of chemicals / chemical processes in everyday situations e.g.</td>
<td>Analyse the impact of an industrial process e.g.</td>
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<td>The structure and characteristics of living things affect their behaviour and functioning</td>
<td>• investigate the strength and biodegradability of plastics</td>
<td>• describe how evaporation, decanting and sieving are used in the kitchen</td>
<td>• explain some uses of acids and bases</td>
<td>• research and report on some examples of heavy metal poisoning</td>
<td>• analyse the impact of an industry such as zinc or aluminium production</td>
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<tr>
<td>A diverse range of living things have evolved on the Earth</td>
<td>Explain how the survival of an organism is influenced by its environment e.g.</td>
<td>Identify characteristics of plant and animal cells e.g.</td>
<td>Explain how various adaptations ensure the survival of organisms e.g.</td>
<td>Analyse how a particular factor affects the survival of living things e.g.</td>
<td>Explain how complex organisms depend on interacting body systems to meet their needs e.g.</td>
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<tr>
<td></td>
<td>• describe how a disease spreads in a particular species</td>
<td>• draw diagrams showing the difference between plant and animal cells</td>
<td>• describe the adaptations that enable a cactus to survive</td>
<td>• report on how smoking affects the human body</td>
<td>• explain how the human circulatory and respiratory systems interact</td>
</tr>
<tr>
<td></td>
<td>• use a simple key to identify macroinvertebrates they have observed on an excursion</td>
<td>• use a key to identify different groups of invertebrates and explain what the main differences between groups are</td>
<td>Explain the basis of accepted systems of classification e.g.</td>
<td>Explain the difference between sexual and asexual reproduction e.g.</td>
<td>Explain that DNA is inherited and describe how this is the basis for natural selection and evolution e.g.</td>
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<td>Describe and explain the advantages of different reproductive methods e.g.</td>
<td>• propagate a variety of plants by sexual and asexual means and explain how the methods differ</td>
<td>• explain how evolution by natural selection explains sickle cell anaemia’s range</td>
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<td><strong>Humans interact with ecosystems, and this raises ethical and sustainability issues</strong></td>
<td>Explain how humans have impacted on the living things in a particular ecosystem e.g. • research and explain how humans contributed to the extinction of the thylacine</td>
<td>Construct and interpret food chains and food webs e.g. • draw a food web for an identified ecosystem</td>
<td>Identify and explain how humans have impacted on a particular ecosystem e.g. • research the scallop fishing industry describing human impacts</td>
<td>Describe measures required for sustainability e.g. • suggest how the scallop fishing industry could be made more sustainable</td>
<td>Explain the interdependence of populations of organisms and their environment e.g. • interpret computer simulations, investigating effects of changes to populations or the environment</td>
</tr>
<tr>
<td><strong>Earth and space</strong></td>
<td>Explain why only the Earth seems to support life e.g. • complete a webquest on the planets and explain why people can live on Earth but not other planets</td>
<td>Explain effects caused by the positions of the Earth / Sun / Moon e.g. • model the positions of the Earth, Moon and Sun, and explain some effects that these positions cause</td>
<td>Explain the importance of gravity e.g. • explain that gravity is the force that keeps the Moon circling the Earth</td>
<td>Describe a variety of significant features and processes on Earth and / or in space e.g. • describe how erosion has affected a local coastal area</td>
<td>Explain scientific theories of the origin of the universe e.g. • explain the big bang theory for the origin of the universe</td>
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<td></td>
<td>Describe interactions between Earth systems and / or space systems e.g. • explain why rainfall is continually produced as part of the water cycle</td>
<td>Describe processes that occur over short and long time scales e.g. • model and explain the formation of stalactites and stalagmites</td>
<td>Explain how geological evidence allows us to explain past events e.g. • examine pictures of fossilised footprints, and make plausible inferences about past events • make model fossils and use them to explain how scientists make inferences about past events</td>
<td>Describe some important interactions on Earth and in space e.g. • explain that molten lava from a volcano becomes igneous rock when it hardens</td>
<td>Explain how plate tectonics predicts patterns of geological activity e.g. • explain how the shape of the continents today provides evidence for the theory of plate tectonics</td>
</tr>
<tr>
<td><strong>Humans use the Earth and this raises ethical and sustainability issues</strong></td>
<td>Explain why their community is participating in a particular environmental project e.g. • listen to a guest speaker and then explain why their project is important</td>
<td>Identify and explain which of Earth’s resources are reusable and renewable e.g. • describe the variety of materials that are recycled in their community</td>
<td>Explain ways in which the properties of the Earth’s resources affect how organisms use them e.g. • explain how the hardness of rocks affects the way in which humans use them</td>
<td>Describe human impacts on the Earth and suggest ways of reducing the deleterious effects e.g. • research global warming and suggest ways of reducing its impact</td>
<td>Explain the consequences of changes to the atmosphere e.g. • research and explain some effects of the hole in the ozone layer</td>
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</table>
| **Science as a human endeavour**  
**Scientists work, think, inquire and know in particular ways** | Identify some things that limit or control scientific work or understanding e.g.  
• discuss the pros and cons of a ban on stem cell research | Understand that scientists often work in multidisciplinary teams, and that people from diverse cultures have contributed to and shaped science e.g.  
• describe an example of a scientific project that requires input from many different science disciplines, such as sea ice research | Understand that scientists’ work is influenced by cultural and political systems and the teams they are a part of e.g.  
• analyse how the development of the atomic bomb was influenced by political and cultural factors | Question and evaluate the reliability of scientific knowledge and practice and compare their experiences to the way the scientific community works e.g.  
• evaluate the global warming debate, commenting on the reliability of different information that is presented as being scientific |
| **Applications of science have shaped and changed the world** | Analyse the impact that changes in products and processes can have e.g.  
• research advances in contraception and reproductive technologies over time, and consider the impact these advances have had | Identify and discuss instances in which progress in science can be affected by and influence societal issues and priorities e.g.  
• discuss factors that have influenced the development of water purification technologies | Analyse the implications of some contemporary scientific research for local and global communities e.g.  
• analyse the implications of allowing or banning the use of genetically modified organisms by farmers | Critically evaluate the scientific, societal and historical events / thinking that have assisted or hindered scientific advancement e.g.  
• evaluate how a variety of events led to the US landing on the moon |
| **Applications of science have systems impact** | Identify and explain some of the system relationships that exist in local and global issues e.g.  
• research global warming and identify some of its likely impacts on Earth’s systems | Explain their own position on an issue, incorporating relevant scientific understandings e.g.  
• explain their position on whether Australia should use nuclear energy | Identify and analyse how different systems and competing interests impact on local and global issues, including sustainability e.g.  
• analyse the political, social, environmental, and economic implications of a proposed new development | Critically evaluate how interacting systems and competing interests impact on local and global issues, including sustainability, justifying their thinking and opinions e.g.  
• critically evaluate the pros and cons of a world wide moratorium on whaling, justifying their opinion |
| **Scientific inquiry**  
**Scientific inquiries are generated from observations, questions and predictions** | Modify questions and rewrite as testable hypotheses e.g.  
• identify the hypothesis for a given investigation by completing ‘if . . . then . . .’ | Formulate questions and hypotheses that allow predictions to be made e.g.  
• modify research questions to hypotheses that make predictions about events beyond their immediate research | Identify multiple related questions and hypotheses to base an extended investigation on e.g.  
• identify a variety of testable questions related to strength, absorbency and softness when testing toilet papers | Formulate predictions and hypotheses that show an understanding of relevant scientific concepts e.g.  
• formulate predictions and hypotheses around the vitamin C content of a range of products, including considering potential impact of storage methods |
<table>
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</thead>
</table>
| Scientists plan and conduct investigations in particular ways | Plan and conduct investigations, stating how they have improved the reliability of the data they collect e.g.  
- explain that they improved reliability by using seeds from different packets and different species and more accurate measuring equipment  
- question the effectiveness of data presented in a table based on other evidence | Design and conduct investigations that involve working with more complex data e.g.  
- collect multiple data sets relating to water quality in a waterway, such as pH, dissolved oxygen and turbidity | Design and conduct investigations that consider more than one aspect of a problem and involve collecting information from multiple sources e.g.  
- collect multiple data sets relating to water quality in a waterway, including expert data that details healthy levels for different tests | Design and conduct ethical investigations which mitigate for the effects of less easily controlled variables with precision and rigour e.g.  
- collect multiple data sets about water quality in a river, research expert data that details healthy levels, and consider how to allow for the effect of variation in weather conditions |
| Scientists draw conclusions after considering various interpretations of their data | Draw conclusions based on multiple data sets and identify further investigations e.g.  
- measure the effectiveness of using different glues on a range of materials and draw a conclusion about the overall most effective glue | Identify and explain trends and suggest how uncertainty can be reduced e.g.  
- explain that an advantage of their methodology was that they had ten subjects in each group, and having more subjects increases accuracy  
- question their results critically to determine whether further investigation is necessary | Explain their results in light of current scientific knowledge, commenting on implications for society e.g.  
- make links between their investigation and current scientific thinking, commenting on some implications  
- examine data critically to determine questions that it does not address | Critically evaluate and analyse their conclusions and the implications of these e.g.  
- identify factors that seem to have impacted on an investigation when critically questioning results  
- reflect on the quality of data presented in a graph and identify two reasons for its possible inaccuracy |
| Scientific communication  
Scientists consider accuracy, relevance and credibility when acquiring information | Access relevant scientific information from a variety of texts, understanding that a source may lack detail or show bias e.g.  
- explain why they think a particular text is biased | Compare and choose between available sources of information for a scientific investigation e.g.  
- explain if they think their own results or those contained in a textbook are more likely to be accurate  
- use accepted scientific formats, conventions, representations, terminology and understandings appropriately e.g.  
- prepare a formal scientific report that clearly articulates and explains their thinking and reasoning | Compare and contrast sources of information for a scientific investigation e.g.  
- compare two different reports on people’s attitudes to a new pulp mill and suggest reasons for any discrepancies  
- communicate the results of their investigations appropriately, making clear links to the supporting scientific evidence e.g.  
- prepare a formal scientific report that clearly articulates and explains their thinking and reasoning | Critically evaluate scientific information collected from a variety of sources e.g.  
- collect information from different types of credible sources with precision and rigour, and appropriately reference them  
- prepare a convincing, persuasive formal scientific report that explicitly identifies and evaluates their findings and conclusions |
| Scientists need to communicate information in a variety of ways | Compose a variety of cohesive scientific texts, that are appropriate for different intended audiences e.g.  
- write a formal scientific report on their investigation, and then produce a PowerPoint suitable for Year 1 students | Use accepted scientific formats, conventions, representations, terminology and understandings appropriately e.g.  
- prepare a formal scientific report that includes appropriately presented and detailed information in each section | Communicate the results of their investigations appropriately, making clear links to the supporting scientific evidence e.g.  
- prepare a formal scientific report that clearly articulates and explains their thinking and reasoning | Present well-reasoned, persuasive analyses of their scientific investigations, which are supported by data e.g.  
- prepare a convincing, persuasive formal scientific report that explicitly identifies and evaluates their findings and conclusions |
### Standard five - The points listed here are intended as examples only. Teachers observe and collect a wider range of evidence to make on-balance assessment judgements.

<table>
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<tr>
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</thead>
</table>
| **Energy and force**  
The behaviour of objects is determined by the forces that act on them | Explain how the ways that forces act are important in a particular situation e.g.  
- explaining the basis for the particular design that they used to build their steam or solar power boat  
Analyse the energy transfers and transformations that occur in particular situations e.g.  
- recognise path of light from source to visible object to eye | Explain how interacting forces affect an object  
- draw a force diagram showing the forces that act on a car moving at constant speed or a boat being rowed against the current  
Understand conservation of energy and explain how and why the movement of energy varies according to the medium through which it is transferred  
- describe echoes in terms of sound absorption and reflection  
Identify and analyse use of a particular form of energy  
- explain their position on whether Australia should use nuclear energy | Explain the behaviour of objects using Newton’s Laws  
- use Newton’s 1st Law to explain the motion of an object, such as a baseball thrown in space  
Describe and explain energy transfers and transformations using relevant concepts  
- explain changes in kinetic and potential energy when considering the motion of a roller coaster  
Analyse the merits of available energy sources and systems  
- participate in a debate about the merits of various energy sources | Make quantitative calculations to predict the behaviour of objects  
- solve quantitative problems based on the equations of motion  
Analyse and explain the energy transfers and transformations that occur in some common systems  
- analyse the energy transfers that occur in a car crash, including the impact of safety features  
Critically evaluate the implications of energy demand  
- evaluate the likely implications of increased energy demands in particular countries |
| Energy can be transferred and transformed | | | | |
| Humans use energy and this raises ethical and sustainability issues | | | | |
| **Matter**  
The chemical and physical properties of materials are determined by their structure | | | | |
| **Materials react and change in a variety of ways** | Explain how the properties of a group of substances affect their production and use e.g.  
- explain how wine is produced  
Describe some factors that affect chemical change e.g.  
- explain how temperature affects the rate of chemical reactions | Explain properties and changes using the particle model, including differences between elements and compounds e.g.  
- use the particle theory to explain the structure of solids, liquids and gases  
Explain physical and chemical change and conservation of matter using the particle model e.g.  
- use molecular models to illustrate what happens to the atoms and molecules in different chemical reactions, including showing that matter is conserved | Understand that chemical substances can be grouped into families e.g.  
- explain why metals are considered to be a particular chemical group  
Interpret the information contained in chemical equations and formulae e.g.  
- explain what a chemical equation, such as $\text{H}_2\text{SO}_4 + \text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$ is telling them | Understand why elements are grouped as they are in the Periodic Table e.g.  
- identify and explain the properties of some of the groups in the Periodic table  
Write and balance chemical equations and ionic formulae e.g.  
- write and balance chemical equations for acid / base reactions  
Critically evaluate the issues associated with the production of a particular material e.g.  
- critically evaluate the impact of the increased demand for tantalum |
| Humans use materials and this raises ethical and sustainability issues | Explain some effects of chemicals / chemical processes in everyday situations e.g.  
- research and report on some examples of heavy metal poisoning | Analyse the impact of an industrial process e.g.  
- analyse the impact of an industry such as zinc or aluminium production | Analyse the use and effects of, and substitutes for, particular chemicals e.g.  
- research and analyse why petrochemicals are important and if suitable alternatives are available | |
Standard five - The points listed here are intended as examples only. Teachers observe and collect a wider range of evidence to make on-balance assessment judgements.

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<tr>
<td><strong>Living things</strong></td>
<td>The structure and characteristics of living things affect their behaviour and functioning. A diverse range of living things have evolved on the Earth.</td>
<td>Explain how complex organisms depend on interacting body systems to meet their needs e.g.</td>
<td>Analyse the factors that affect a particular life process e.g.</td>
<td>Analyse how and why functioning and behaviour of living things changes e.g.</td>
</tr>
<tr>
<td><strong>Humans interact with ecosystems, and this raises ethical and sustainability issues</strong></td>
<td></td>
<td>explain how the human circulatory and respiratory systems interact.</td>
<td>analyse the factors thought to be responsible for devil facial tumour disease</td>
<td>research and explain how hormones are important to human wellbeing</td>
</tr>
<tr>
<td><strong>Earth and space</strong></td>
<td>Earth and space have characteristic features and patterns of activity. Earth and space systems continue to be shaped by the changes they experience.</td>
<td>Explain that DNA is inherited and describe how this is the basis for natural selection and evolution e.g.</td>
<td>Explain simple patterns of inheritance, including how they can be used to make predictions e.g.</td>
<td>Analyse the implications of genetic engineering for living things e.g.</td>
</tr>
<tr>
<td><strong>Humans use the Earth and this raises ethical and sustainability issues</strong></td>
<td>Describe a variety of significant features and processes on Earth and / or in space e.g.</td>
<td>explain how evolution by natural selection explains sickle cell anaemia’s range</td>
<td>work out the predicted results from a simple monohybrid cross</td>
<td>discuss possible implications of scientists cloning humans</td>
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<tr>
<td></td>
<td>describe how erosion has affected a local coastal area.</td>
<td>Explain the interdependence of organisms and their environment e.g.</td>
<td>interpret computer simulations, investigating effects of changes to populations or the environment</td>
<td>Critically evaluate a selected environmental issue e.g.</td>
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<tr>
<td></td>
<td>describe how erosion has affected a local coastal area.</td>
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<td>critically evaluate the pros and cons of a world wide moratorium on whaling, justifying their opinion</td>
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<td>Explain how plate tectonics predicts patterns of geological activity e.g.</td>
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<td>explain that molten lava from a volcano becomes igneous rock when it hardens.</td>
<td>explain how the shape of the continents today provides evidence for the theory of plate tectonics.</td>
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<td></td>
<td>Describe human impacts on the Earth and suggest ways of reducing the deleterious effects e.g.</td>
<td>Explain the consequences of changes to the atmosphere e.g.</td>
<td>Argue the merits of human use of the Earth and space resources e.g.</td>
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<td></td>
<td>research global warming and suggest ways of reducing its impact.</td>
<td>research and explain some effects of the hole in the ozone layer</td>
<td>debate the merits of maintaining the International Space Station</td>
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<td>critically evaluate the implications of uses of the Earth and space e.g.</td>
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<tr>
<td><strong>Earth and space systems continue to be shaped by the changes they experience</strong></td>
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<td></td>
<td></td>
<td>evaluate and discuss the practical and ethical aspects of humans colonising other planets</td>
</tr>
</tbody>
</table>
Glossary of terms:

The terms included here largely refer to the scientific inquiry process. A scientific dictionary or text will provide definition of science knowledge terms.

**Act responsibly**  
Act to achieve a positive outcome for communities and the environment.

**Classification**  
Systems that scientists use to organise the world, grouping things that look or behave similarly together.

**Classify**  
Analyse the properties of objects or events in order to determine the group they belong to.

**Conclusion**  
Summary of what the data collected in an investigation showed.

**Consider**  
Thinks about carefully, taking all available information into account.

**Control group**  
A group used for comparison in a scientific investigation. The control group is as identical to the experimental group as possible but does not receive the treatment that is being used on the experimental group e.g. in an investigation into the effect of fertiliser on plant growth, the experimental group would receive the fertiliser, the control group would not.

**Data**  
Information that is collected during an investigation and used as the basis for drawing conclusions.

**Dependent variable**  
The variable that is not under the investigator’s control but is one that they measure e.g. in an investigation looking at the effect of fertiliser on plant growth, the amount of growth would depend on the amount of fertiliser that was added. Therefore, growth is the dependent variable and the amount of fertiliser is the independent variable.

**Describe**  
Talk, write about or represent pictorially.

**Discuss**  
Consider the effect or significance of taking different aspects into consideration.

**Evaluate**  
Examine and analyse something critically to identify the relationships between the parts.

**Experiment**  
A scientific test to collect information to use as evidence in developing an explanation.

**Explain**  
Describe and interpret an occurrence, providing sequences of events and / or causes.

**Fair Test**  
An experiment where all conditions are kept constant except for the one variable that is being tested e.g. in an experiment to test if light is needed for plant growth, exposure to light would be the independent variable whereas factors such as the type of plants, access to water and soil, the initial size of the plants and the temperature of the area would need to be kept constant to make the test fair.

**Findings**  
Information gained or conclusions drawn as a result of investigations.

**Futures wheel**  
A graphic organiser that assists in predicting consequences of an action. This graphic organiser places a future event in a circle in the centre of a document. Consequences from this first event are placed in a second ring of circles, then a third, and so on. The futures wheel identifies expanding consequences.

**Guided (teacher initiated) Inquiry**  
An inquiry where the teacher poses the question that students are to investigate but does not specify the methods to be used (although they may specify limitations on materials that can be used).

**Hypothesis**  
An hypothesis is a tentative statement that proposes a possible explanation for some phenomenon or event. An hypothesis must be testable and better hypotheses allow predictions to be made about future events e.g. plants grow taller when they are given fertiliser.
<table>
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<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Independent variable</td>
<td>The manipulated variable – the one that is under the control of the investigator that they deliberately change e.g. in an investigation looking at the effect of fertiliser on plant growth, the amount of growth would depend on the amount of fertiliser that was added. Therefore, growth is the dependent variable and the amount of fertiliser is the independent variable.</td>
</tr>
<tr>
<td>Inference</td>
<td>Something that is assumed from the evidence, rather than directly observed.</td>
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<tr>
<td>Investigation</td>
<td>A study that systematically collects information / data.</td>
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<tr>
<td>Law</td>
<td>A scientific law generalises observations about an aspect of the world. There are no known exceptions to laws at the time that they are made. Scientific laws predict behaviour but they do not explain why it occurs e.g. Law of gravity, Laws of motion.</td>
</tr>
<tr>
<td>Model</td>
<td>An approximate representation of an object or process that serves to explain a physical phenomenon. May be physical or a computer simulation.</td>
</tr>
<tr>
<td>Observation</td>
<td>Information gathered from first-hand experience of the properties of an object or event, using the senses and /or scientific equipment.</td>
</tr>
<tr>
<td>Open (or student initiated) inquiry</td>
<td>An inquiry in which the student poses the question to be investigated and selects the methods that will be used.</td>
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<tr>
<td>Pose questions</td>
<td>Formulate questions that will guide investigations and research.</td>
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<tr>
<td>Prediction</td>
<td>A forecast of what will happen in a particular situation.</td>
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<tr>
<td>Record</td>
<td>Commit information to a permanent form for future reference e.g. write, photograph, draw, video.</td>
</tr>
<tr>
<td>Reflect on</td>
<td>Consider how effective a process was.</td>
</tr>
<tr>
<td>Report</td>
<td>Tell others about findings and understandings e.g. writing, oral presentation, poster, role-play, PowerPoint presentation.</td>
</tr>
<tr>
<td>Research</td>
<td>Collect and analyse facts and information.</td>
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<tr>
<td>Science</td>
<td>Knowledge gained through the process of using systematic inquiry to make observations and conduct investigations.</td>
</tr>
<tr>
<td>Scientific inquiry</td>
<td>The process that scientists use to study the world. It involves wondering why and asking questions, formulating hypotheses, actively carrying out an investigation, including collecting and recording information, analysing and critically evaluating the data collected (including comparing results with those of others), drawing conclusions, reflecting on the implications of the findings and communicating the findings.</td>
</tr>
<tr>
<td>Scientific literacy</td>
<td>The knowledge and understanding of scientific concepts and processes required for personal decision making, informed participation in civic and cultural affairs and economic productivity.</td>
</tr>
<tr>
<td>Scientific method</td>
<td>A systematic approach that generally involves formulating an hypothesis on the basis of observations, testing the hypothesis, replicating the test and communicating the results to others.</td>
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<tr>
<td>Scientific report</td>
<td>A report that mimics those that are presented in academic scientific journals, including headings such as Introduction (or Aim), Method, Results, Discussion, Conclusion, References.</td>
</tr>
<tr>
<td>Structured inquiry</td>
<td>An inquiry in which the teacher poses the question the students are to investigate and specifies the methods and materials to be used, and often the method of recording results.</td>
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<tr>
<td>Survey</td>
<td>A process that collects sample opinions, facts or figures in order to estimate the overall situation.</td>
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<tr>
<td><strong>Sustainability</strong></td>
<td>Meeting the needs of the present generation without compromising the ability of future generations to meet their own needs.</td>
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<tr>
<td><strong>Systems</strong></td>
<td>A combination of interconnected and interdependent things or parts forming a complex whole. A system may have properties not belonging to the individual parts. It may be natural or constructed (e.g. ecosystem, political system, solar system, body system). Systems thinking involves looking at events as components of a larger picture and considering the interactions that occur.</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>Application of scientific knowledge to solve practical problems and / or make new inventions.</td>
</tr>
<tr>
<td><strong>Test</strong></td>
<td>Collect evidence about how something stands up to scrutiny e.g. Does an hypothesis explain observations that are made? Does an object always behave in the way that is predicted?</td>
</tr>
<tr>
<td><strong>Theory</strong></td>
<td>Scientifically, a theory is something that is accepted because there is a lot of accumulated evidence to support it. An hypothesis becomes a theory after it has been tested many times or is supported by many observations. Important scientific theories include the Theory of evolution by natural selection, Atomic theory and the Theory of relativity.</td>
</tr>
<tr>
<td><strong>Thought experiment</strong></td>
<td>Experiments conducted within the imagination to help understand the way things are e.g. Einstein’s thought experiments on chasing a light beam.</td>
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<tr>
<td><strong>Understand</strong></td>
<td>Be able to make meaning of, explain and apply in new situations.</td>
</tr>
<tr>
<td><strong>Variable</strong></td>
<td>Something that is likely to vary; something that is subject to variation e.g. 'the weather is one variable to be considered'</td>
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</tbody>
</table>
Science teaching and learning resources

It is expected that most schools will have a variety of resources available to support science teaching. Except for policy documents, the following texts are cited as examples only. While the list is separated into primary and secondary categories, in reality the suitability of particular materials is dependent on student ability and literacy levels.

Tasmanian and national science education related documents


e-Centre for teachers http://www.ecentre.education.tas.gov.au [accessed 6 October 2007]. Numerous science references, work samples, websites and learning objects are available from the site by searching for science or by a refined search. Search in the Resource Centre section to find all the Learning Federation objects and LTAG learning sequences.


Pedagogy – general


Science teaching

Scientific inquiry and teaching


National Science Teachers Association (NSTA) journals
The US NSTA journals *Science and children* (primary) and *The Science teacher* (secondary) are available at the Department of Education Library and Information Centre (DELIC). Contact DELIC (lic.query@education.tas.gov.au) to gain electronic access. The journals contain numerous articles and ideas describing how teachers introduced particular science concepts in their classrooms, many using an inquiry approach.


Science as a body of knowledge


GEMS Great Explorations in Math and Science

Hands on Energy Discovery Centre

Project Forest package *Learning about our forests*


Early childhood science

Early childhood - General


Early childhood - Scientific inquiry


Primary science

Primary - General


Magic School Bus books


Marine Links kit
The kit was produced by the Department of Education, Tasmania. It contains teaching ideas, books, posters and other resources. It can be borrowed form DELIC (Department of Education Library and Information Services).

Primary Connections
An excellent, inexpensive series of science units that link the teaching of science with that of literacy, can be ordered from the above site. The units include teacher background information and inquiry activities. e.g. Australian Academy of Science. (2006). On the move. Australian Academy of Science, Canberra. ISBN: 0858472368


Primary - Human endeavour


Primary - Scientific inquiry


Early Bird Physics Books series

Educational Directions Publications


Primary Investigations – Australian Academy of Science

Primary Physics series
Currently a set of four books, that can be ordered from http://www.csiroshop.com/He/browse.3796 Contain numerous practical activities. e.g. Pels, M. and Davies, A. Primary physics book 1, energy mass force. New South Wales: Sunshine Educational. ISBN: 0958670102


Secondary science

Secondary - General

There are numerous sets of four books designed to cover Years 7–10 Science, which are useful either as class sets or for teacher reference. Teachers need to examine these book sets and decide which ones best meet the needs of their students.

Cosmos magazine
Articles suitable for teachers or students with good literacy. Teacher notes available from http://www.cosmosmagazine.com/ [accessed 1 October 2007].


Secondary - Human endeavour


Secondary - Scientific inquiry

Educational Directions Publications


New South Wales, Department of Education and Training. Investigating scientifically in stage 4.

Assessment

NAEP (National Assessment of Educational Progress)

NEMP (National Education Monitoring Project)
http://nemp.otago.ac.nz/i_reports.htm [accessed 1 October 2007]. Tasks from a New Zealand project monitoring Year 4 and 8 educational achievement. A few need adaptation to the Australian context.

PALS (Performance Assessment Links in Science)

SEAR Assessment
Websites

ABC Education
http://www.abc.net.au/learn/bysubject/subjectscience0.html [accessed 11 June 2007]. Contains an extensive number of science and science education sections, for example, the Surfing Scientist.

Access Excellence Mystery Spot

Australian Science Teachers Association (ASTA)

Australian Sustainable Schools Initiative (AuSSI)

Big Science

Biotechnology Online

Bureau of Meteorology

Classroom Antarctica

Court TV News–Forensics in the Classroom

CSIRO

Curriculum Corporation science

Globe Program

Gould Group
http://www.gould.edu.au/index.asp [accessed 1 October 2007]. Interactive sustainability websites (under products and services heading) and information on opportunities to be involved in environmental initiatives.

Le@rning Federation science objects
Interactive materials available by search on the e-Centre for teachers. A catalogue describing the science

Marine Discovery Centre Woodbridge

Minerals Council of Tasmania
A set of K-4 readers relating to mining can be downloaded from the website which also has links to other related sites. http://www.tasminerals.com.au/education.htm [accessed 7 October 2007]

NASA Education

Parks & Wildlife Tasmania

Printable periodic tables

Salters’ Chemistry Club
http://resources.schoolscience.co.uk/Salters/index.html [accessed 11 June 2007]. Contains numerous chemistry activities, suited mainly to secondary students.

Science Teachers Association of Tasmania (STAT)
http://key.org.au/stat/ [accessed 1 October 2007]. Includes information about the annual Tasmanian Science Talent Search, which provides many opportunities for students at all levels.

ScienceLynx

Science-related website list

Sofweb Family Science

Sustainability Education, Department of Environment and Water Resources

Tasmanian multipedes
This page, with photos, on the Queen Victoria Museum and Art Gallery site will let you identify the more than 200 species of centipedes, millipedes, Pauropoda, Symphyla and velvet worms in Tasmania. http://www.qvmag.tas.gov.au/zoology/multipedes/mulintro.html [accessed 7 October 2007].

University of Tasmania Faculty of Science, Engineering and Technology
Teacher resources page has online units to download, event details and ask an expert information. http://fcms.its.utas.edu.au/scieng/scieng/cpage.asp?ICpageID=8 [accessed 7 October 2007].
Up2Me

Waterwatch Tasmania
www.taswaterwatch.org.au [accessed 3 October 2007]. Various water related resources can be downloaded, including Understanding healthy waterways a complete package of science materials for middle to upper primary, containing hands-on activities and teacher information to help students learn about Waterwatch and what it takes to maintain a healthy waterway.

Webquest.org

Your genes, your choice

Digital resources

An Inconvenient Truth. [documentary] Paramount Pictures, USA.
Documentary about Global Warming presented by Al Gore who states: If we do nothing, in about 10 years the planet may reach a ‘tipping point’ and begin a slide toward destruction of our civilization and most of the other species on this planet.

Sci-net
http://lyris.education.tas.gov.au:8080/read/?forum=sci-net [accessed 30 September 2007]. An email forum maintained by the PEO Science. Members can send information about science related activities, such as competitions, lectures and new resources to all members of the forum.

Contains the films used by the Tasmanian Wilderness Society throughout 1982 in the successful campaign to save the Franklin River. Focuses on the environment, having a say and taking civic action.

Movies
There are numerous DVDs that can be used to engage student interest and begin discussion about relevant science concepts, but teachers need to check that movie ratings are appropriate to their classes. Movies that relate to biotechnology are discussed in the documents that can be downloaded from http://www.biotechnology.gov.au/index.cfm?event=search.showResults&verityIndexType=db&searchTerms=film [accessed 1 October 2007].
Other examples include:
- Deep impact – meteorite strikes Earth
- Gorillas in the mist – the story of Dianne Fossey
- Journey to the centre of the earth – early ideas on the inside of the Earth
- Logan’s run – people are killed off at age 30
- Outbreak – ebola outbreak
- Soylent Green – world runs out of food
- The omega man – one man has an immunity to a deadly virus that is decimating humans
- Total recall – implants to give you a virtual experience
- Volcano and Dante’s Peak – volcanic eruptions

Ollie’s world CDs
The CDS Ollie’s island and Ollie saves the planet CD ROMs include information, activities and units of work for teaching and learning about sustainability. They are supported by a group of government and industry groups from across Australia and can be purchased from http://www.olliesworld.com/index.html [accessed 6 October 2007].
The sheets on the following pages summarise the learning opportunities included in the Science curriculum document, firstly by strand and then by standard.

They are presented in a small font size so that the broadsheets fit on one page each. They are designed to be enlarged to A3 for ease of use.
### Science by strand – Science as a human endeavour

<table>
<thead>
<tr>
<th>Stage</th>
<th>Scientists work, think, inquire and know in particular ways</th>
<th>Applications of science have shaped and changed the world</th>
<th>Applications of science have systems impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• observe that some people like to find things out and make things</td>
<td>• identify some things that help us, e.g. scissors, computers, washing machines</td>
<td>• recognise that we need to care for living things to keep them alive, e.g. pets have needs that have to be met</td>
</tr>
<tr>
<td>2</td>
<td>• understand that work or hobbies can involve science</td>
<td>• describe some ways in which the products of science assist people, e.g. glasses to assist vision</td>
<td>• recognise that they share the world with other living things, and therefore need to care for the condition of their immediate environment</td>
</tr>
<tr>
<td>3</td>
<td>• understand that scientists find out how the world works and help make useful things</td>
<td>• speculate what their lives would be like without the products of science</td>
<td>• understand that the world is shared and that living things depend on other living things and their environment to survive</td>
</tr>
<tr>
<td>4</td>
<td>• understand that scientists investigate the world in a particular way</td>
<td>• describe the work of a particular scientist and explain why it is useful</td>
<td>• identify some things that might have a positive or negative impact on the world, and understand that they should be responsible and caring in things that they do</td>
</tr>
<tr>
<td>5</td>
<td>• understand that science values investigations that are based on evidence</td>
<td>• describe some of the ways that applications of science are used in their community, e.g. obtaining clean drinking water</td>
<td>• recognise some of the ways that they both rely and impact on their immediate environment and identify ways to be more responsible for sustainability in their home or school</td>
</tr>
<tr>
<td>6</td>
<td>• understand that science values investigations that are fair, and are based on evidence and logical reasoning</td>
<td>• explore how they are engaging in science in their interests and activities within and beyond school</td>
<td>• demonstrate their shared responsibility for the quality of their immediate environments and in conserving resources, understanding that they are part of a system</td>
</tr>
<tr>
<td>7</td>
<td>• describe some of the ways that people think and work scientifically, e.g. ideas, hunches, imagination, problem solving, investigations, theorising, decision making, serendipity, trial and error</td>
<td>• recognise products of science and that they may have both positive and negative outcomes for society, e.g. cars</td>
<td>• identify some of the relationships in simple natural and/or constructed systems, e.g. food chains</td>
</tr>
<tr>
<td>8</td>
<td>• identify and explain some different ways that people think and work scientifically to carry out investigations (e.g. experiment, ecological study, health study) and realise that many investigations have ethical considerations</td>
<td>• describe how some products used in work and leisure have changed over time, e.g. planes, refrigeration</td>
<td>• explore the consequences of human activity for the sustainability of a familiar system, including investigating how their actions contribute to sustainability of resources and local environments</td>
</tr>
<tr>
<td>9</td>
<td>• realise that scientific ideas are modified over time by a community of scientists as new perspectives and evidence are taken into account, e.g. flat earth, is Pluto a planet?</td>
<td>• explain some ways that scientific developments influence and are influenced by history and community needs, e.g. vaccines, sewage treatment, water recycling</td>
<td>• consider appropriate ethical issues in science-related contexts relevant to them</td>
</tr>
<tr>
<td>10</td>
<td>• examine how and why people engage in science as a worthwhile and exciting career, including examining the work of Australian scientists</td>
<td>• recognise that different cultures may have different views in relation to science, e.g. traditional medicine</td>
<td>• explore some of the relationships within and between local natural, constructed or social systems, and identify different perspectives in making responsible choices, e.g. consider the likely effect of a new development on the local ecosystem</td>
</tr>
<tr>
<td>11</td>
<td>• consider what is characteristic of the way that scientists work, and why this is important, e.g. integrity, rigour, regard for evidence</td>
<td>• analyse how and why some products and processes used in work and leisure have changed over time, e.g. across cultures, e.g. food preservation methods</td>
<td>• identify and analyse why different systems and competing interests impact on local and global issues, including sustainability, e.g. what are the implications for political, social, environmental and economic systems of a proposed new development</td>
</tr>
<tr>
<td>12</td>
<td>• identify some things that limit or control scientific work or understanding, e.g. ethics, code of practice, government regulation, exclusion of certain groups, such as women or ethnic groups</td>
<td>• analyse how and why some products and processes have changed over time, e.g. across cultures, and the impact that this has on people, e.g. contraception, IVF</td>
<td>• consider and respond to appropriate ethical and social issues in science-related contexts relevant to them, showing an awareness of several different perspectives that exist</td>
</tr>
<tr>
<td>13</td>
<td>• investigate how people working with science often draw on concepts and processes across multidisciplinary teams</td>
<td>• consider and discuss instances in which progress in science can be affected by and influence societal issues and priorities, e.g. water purification, alternative energy sources, space exploration</td>
<td>• explain their own position, showing an understanding of several other perspectives</td>
</tr>
<tr>
<td>14</td>
<td>• appreciate that people of diverse cultures have contributed to and shaped the development of science</td>
<td>• discuss some of the system relationships identified when investigating local and global issues, including sustainability</td>
<td>• examine issues of sustainability of the natural, built or social environments extending from local to global perspectives</td>
</tr>
<tr>
<td>15</td>
<td>• understand that the work of scientists is influenced by the cultural and political systems they are working within and by the teams they are a part of</td>
<td>• identify and analyse why different systems and competing interests impact on local and global issues, including sustainability, e.g. what are the implications for political, social, environmental and economic systems of a proposed new development</td>
<td>• apply relevant scientific understandings to make responsible, ethical and informed decisions about issues, including applications of science and implications of research and sustainability, e.g. salinity, nuclear energy</td>
</tr>
</tbody>
</table>

**NEALS**

143
<table>
<thead>
<tr>
<th>Stage</th>
<th>Scientific inquiries are generated from observations, questions and predictions</th>
<th>Scientists plan and conduct investigations in particular ways</th>
<th>Scientists draw conclusions after considering various interpretations of their data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• make observation statements about the world on the basis of first hand experiences e.g. the sunset is red, the balloon made a loud pop, that plant smells like lemons, the brown rock feels smooth</td>
<td>• make observations about science experiences e.g. look at objects teacher has placed under a microscope, watch a bulb grow</td>
<td>• identify similarities and differences on the basis of familiar characteristics</td>
</tr>
<tr>
<td>2</td>
<td>• pose questions to find out how and why things they have observed are happening e.g. Why don’t those trees have any leaves! How did the crane get on top of that building! When will it be dark?</td>
<td>• follow precise, single step directions to carry out a class investigation, when working in small groups with an adult helper</td>
<td>• speculate on reasons, causes and effects e.g. my plant died because its pot was too small!</td>
</tr>
<tr>
<td>3</td>
<td>• contribute to class discussion about a question and make guess type predictions e.g. ask can you bring dead flowers back to life, then put a dead flower in soil to see</td>
<td>• participate in teacher-guided experiments involving changing a variable, measurement and recording of data e.g. Which toy car rolls the fastest?</td>
<td>• interpret data and draw limited conclusions, when presented with simple alternatives e.g. the magnet didn’t attract any plastic objects, the flower didn’t come back to life</td>
</tr>
<tr>
<td>4</td>
<td>• ask questions (e.g. How! What will happen if?) and, with teacher prompting, modify them so that they can be investigated through scientific inquiry</td>
<td>• participate in teacher-guided investigations, following a short sequence of steps provided by the teacher to conduct a scientific investigation, including collecting and recording data</td>
<td>• interpret their data and draw simple conclusions if led through the process by teacher questioning</td>
</tr>
<tr>
<td>5</td>
<td>• suggest questions that could be investigated using a scientific approach and make reasoned (but not necessarily scientifically-based) predictions about what the answers will be e.g. Which ice block will melt the quickest?</td>
<td>• contribute to class discussion about why the teacher has suggested a particular method to investigate their questions</td>
<td>• recognise obvious patterns and trends in their data, draw simple conclusions based on them, and suggest reasons why their results are not the same as those of others e.g. The plants that got more water grew better</td>
</tr>
<tr>
<td>6</td>
<td>• work in small groups to develop a scientifically testable question on a class topic related to their interests and experiences</td>
<td>• plan and carry out investigations, that involve a small number of steps, using appropriate equipment, and following suggestions to collect, record and present data</td>
<td>• compare their results with their initial ideas</td>
</tr>
<tr>
<td>7</td>
<td>• ask questions and make predictions, with some scientific basis, related to their everyday experience</td>
<td>• understand that science investigations need to be fair, and, with scaffolding, (e.g. an investigation planner) work in small groups to plan and conduct simple fair investigations, that involve changing one variable and keeping everything else the same</td>
<td>• share findings, talk about the way in which the investigation could be changed and begin to consider fairness of tests</td>
</tr>
<tr>
<td>8</td>
<td>• create, from their interests or experience, appropriate questions and predictions for testing</td>
<td>• contribute to planning a variety of investigations, recognising where comparisons might be fair or unfair</td>
<td>• communicate their ideas and understandings and suggest improvements to the investigation</td>
</tr>
<tr>
<td>9</td>
<td>• pose questions that can be investigated scientifically, and explain the basis of their predictions about the outcome</td>
<td>• understand that science investigations need to be fair, and, with scaffolding, (e.g. an investigation planner) work in small groups to plan and conduct simple fair investigations, that involve changing one variable and keeping everything else the same</td>
<td>• identify sources of fairness and unfairness</td>
</tr>
<tr>
<td>10</td>
<td>• formulate, clarify and refine questions and predictions suitable for testing, including refocusing ill-defined questions</td>
<td>• plan and conduct investigations demonstrating that they understand the requirements of fair testing – undertake systematic observation and data collection, taking steps to minimise error, and explaining the purpose of a control and repeat trials</td>
<td>• rearrange data to allow easier identification of patterns, so that conclusions can be drawn</td>
</tr>
<tr>
<td>11</td>
<td>• recognise some questions that cannot, or should not, be investigated scientifically and discuss why that is the case</td>
<td>• consider alternative approaches that might be used to answer a particular question and justify their choice</td>
<td>• communicate their ideas and understandings and suggest improvements to the investigation</td>
</tr>
<tr>
<td>12</td>
<td>• modify questions to hypotheses, showing an awareness that scientific hypotheses must be testable and written in a particular form</td>
<td>• develop their own investigations taking into account the principles of fair testing, and using appropriate techniques to improve reliability</td>
<td>• identify sources of fairness and unfairness</td>
</tr>
<tr>
<td>13</td>
<td>• formulate questions or hypotheses, showing an awareness that good hypotheses allow predictions to be made</td>
<td>• plan and conduct their own investigations taking into account the principles of fair testing, and using appropriate techniques to improve reliability</td>
<td>• interpret results in situations where more than one set of data has been collected</td>
</tr>
<tr>
<td>14</td>
<td>• identify multiple related questions or hypotheses that are relevant to an extended investigation e.g. consider strength, absorbency and softness of different brands of toilet paper</td>
<td>• design and conduct investigations that consider more than one aspect of a problem, collecting information from multiple sources in a discerning manner e.g. experimental data, consult expert, survey, library</td>
<td>• identify further investigations that would allow them to collect additional information about their hypotheses</td>
</tr>
<tr>
<td>15</td>
<td>• formulate predictions and hypotheses that show an understanding of relevant scientific concepts</td>
<td>• design and conduct ethical investigations that mitigate for the effects of less easily controlled variables, (e.g. making measurements on human subject(s) or call for imaginative, creative approaches, working with precision and rigour</td>
<td>• critically evaluate their results and conclusions, acknowledging any alternative interpretations and making recommendations for further research</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• critically evaluate their results and conclusions, acknowledging any alternative interpretations and making recommendations for further research</td>
<td>• critically analyse the implications that their findings have for society, considering relevant social, political, technological, environmental, and/or economic perspectives</td>
</tr>
<tr>
<td>Stage</td>
<td>Scientists consider accuracy, relevance and credibility when acquiring information</td>
<td>Scientists need to communicate information in a variety of ways</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>• engage with simple scientific information from familiar sources e.g. a book showing the kinds of animals found at the beach</td>
<td>• communicate their science observations and understandings through words, signs, picture symbols, actions, drawings or photos</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>• link scientific information contained in texts with their own experiences e.g. We saw kangaroos like the ones on the DVD at the wildlife park</td>
<td>• communicate their science observations and understandings in ways that include using pictures, labels and simple sentences</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>• seek out science information from various texts e.g. find a book or website on echidnas, select a science-focused beginning reader</td>
<td>• use some scientific words, such as observe, experiment and investigate</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>• follow teacher directions to collect and record scientific information e.g. record experimental findings in the appropriate place on a template, locate a text about volcanoes and tell the class two interesting things about them</td>
<td>• organise science information with teacher guidance e.g. keep a science journal set up by a teacher, using short sentences, drawings and pictographs</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>• use a range of simple texts to help find information e.g. collect information from the web, books and a DVD for a report on Antarctica</td>
<td>• create a text that tells someone else how to do the same activity that they have carried out</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>• be aware that information on scientific issues can be presented to influence the reader’s thinking in particular ways e.g. a book might lead you to think that taking water from a river is bad</td>
<td>• use, and select from, a range of appropriate methods (e.g. PowerPoint, graphic organisers, tables, posters, reports) to communicate scientific observations, results, ideas and understandings, using scientific language relevant to contexts they have studied e.g. thoracic abdomen, friction, properties</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>• collect information relevant to their science investigations in ways that mimic those used by scientists e.g. library research, Internet, poster, experiment</td>
<td>• present results of their investigations in ways that mimic those used by scientists, such as a report, an oral presentation or a poster</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>• collect information relevant to their science investigations from a variety of sources, using simple strategies (e.g. check the author) to assess its accuracy, relevance and credibility</td>
<td>• be aware that they can present the results of their science investigations in a variety of ways (e.g. report, PowerPoint, poster, talk, role play, video, mind map, photo essay) and select appropriate ones, showing an awareness that some are more effective than others</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>• purposefully collect, select and organise information to answer particular science questions, being aware that data may be selectively presented to suit various groups’ needs</td>
<td>• compose texts that present the results of their science investigations clearly and logically, including the use of lists, tables, diagrams and pictures where appropriate</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>• independently select information sources that will provide the required background to their science investigations</td>
<td>• present scientific ideas and understandings in a variety of ways using appropriate representations, (e.g. graphs, models, spreadsheets) and reflect on the effectiveness of their presentation in terms of clarity and/or ease of analysis</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>• identify and use more challenging information sources (e.g. specialised textbooks, current affairs programs) and comment on their investigations in light of these sources</td>
<td>• communicate the results of their science investigations, showing an increasing use of relevant terminology, and beginning to represent data in more sophisticated ways, including line graphs, models, diagrams, chemical symbols, circuit diagrams</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>• access information from a variety of texts, identifying the scientific concepts relevant to their investigation, and become selective about the texts that they use, realising that the source may provide limited detail or be selectively biased</td>
<td>• present coherent reports, supported by relevant data, in ways and forms appropriate to nominated audiences</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>• compare and choose between sources of information relevant to science investigations, understanding that data may be presented in different ways and thus be used to support the ideas of various stakeholders</td>
<td>• use accepted scientific formats, conventions, representations, terminology and understandings appropriately and in context to present information and develop ideas and opinions</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>• compare and contrast relevant sources of information, including making judgements about the methods used to collect data where appropriate</td>
<td>• present the results of their science investigations in an appropriate format, providing and explaining the evidence that supports their thinking, and making explicit links to relevant science concepts</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>• collect scientific data and information with precision and rigour from a variety of sources (e.g. experts, popular science journals, hands on investigations) clearly referencing sources and evaluating their reliability and credibility</td>
<td>• use scientific language, conventions and symbols, including SI units, chemical symbols, formulae and equations, appropriately</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** By strand – Scientific communication
<table>
<thead>
<tr>
<th>Stage</th>
<th>The behaviour of objects is determined by the forces that act on them</th>
<th>Energy can be transferred and transformed</th>
<th>Humans use energy and this raises ethical and sustainability issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• make a variety of different objects move e.g. push a toy car, wind a key, take the lid off a jack-in-the-box, throw a toy glider or ball, pour water over a waterwheel, push a swing, blow bubbles, squeeze a water squarter, suck through a straw</td>
<td>• describe how to make different kinds of toys work e.g. put batteries in them, plug into a power point, push them, throw them!</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>• make observations about the ways that objects of different shapes and sizes move e.g. the soccer ball rolls further, the square block doesn’t roll, some objects roll and some slide</td>
<td>• make observations that show the more energy that is used on an object the more movement is created e.g. if you throw a ball harder, it goes further, if you blow harder, the toy windmill turns faster</td>
<td>• explain some ways in which energy affects them personally e.g. sun warms, flames burn, electricity makes the computer work</td>
</tr>
<tr>
<td>3</td>
<td>• make observations about the way that different types of objects behave in different situations (when different forces act on them) e.g. Do they float or sink if placed in water? Is it as easy to ride a bike on sand as on concrete?</td>
<td>• make observations about some effects of energy in their everyday lives e.g. rubbing hands together makes them warmer, the kite moves in the wind, running around makes you feel hot, plucking guitar strings makes a musical sound, putting a sausage on the barbeque cooks it</td>
<td>• identify the energy source used by some common objects e.g. electricity makes the television work, the batteries make a torch work, petrol makes the car go, food gives them energy</td>
</tr>
<tr>
<td>4</td>
<td>• describe and record some of the different ways that forces (pushes and pulls), including gravity, change the shape and motion of objects e.g. how pushes and pulls make different toys move, that gravity makes things fall</td>
<td>• describe and record some of the ways in which energy may affect objects e.g. heat energy melts ice, light helps make plants grow, people need warm clothes in the snow</td>
<td>• describe and record some of the ways in which electrical, light, heat, sound and movement energies are used in their homes and at school</td>
</tr>
<tr>
<td>5</td>
<td>• investigate and record how the properties of an object can determine the effect of the forces that act on it e.g. magnets pick up some objects and not others, some balls are more bouncy than others</td>
<td>• describe how the properties of an object affect how it absorbes and/or emits energy e.g. different coloured objects heat up differently, different length strings affect the sound of a musical note</td>
<td>• describe and record some of the ways that energy is used in their community, and how that energy is obtained</td>
</tr>
<tr>
<td>6</td>
<td>• investigate and record ways in which pushes and pulls (forces) act in everyday situations to make things stop, move or change shape e.g. brakes on a bike or car; friction on different surfaces</td>
<td>• explore a number of different forms of energy (e.g. heat, sound) and the way they are used in their everyday lives, using intuitive ideas of energy being needed to get things done</td>
<td>• identify some of the different ways that various people get electricity e.g. hydro, solar, coal, wind</td>
</tr>
<tr>
<td>7</td>
<td>• describe some of the ways in which people apply forces for specific purposes e.g. pulleys for lifting, levers for moving things, hammering in nails, bows and arrows, screwdriver, playing musical instruments</td>
<td>• identify ways in which energy can be stored (e.g. batteries, rubber bands, springs, water in dams) and how it is then used e.g. to make a torch work, to operate a toy, to make air particles vibrate</td>
<td>• suggest practical ways in which to reduce their energy usage (e.g. turn lights and television off) and suggest why this is desirable e.g. it would be cheaper, if everyone did it we wouldn’t need to worry about not having enough water in dams</td>
</tr>
<tr>
<td>8</td>
<td>• compare the effects of large and small forces on the motion and/or shape of an object</td>
<td>• investigate how some different forms of energy (e.g. heat, sound, light, electricity) are transferred e.g. electrical energy via the wires in an electrical circuit</td>
<td>• investigate how some different forms of energy are used in their community and research the sources of those forms of energy</td>
</tr>
<tr>
<td>9</td>
<td>• explore some forces that act at a distance and do not require direct contact between objects (e.g. magnets), and other forces which do require direct contact e.g. hitting a ball</td>
<td>• investigate and explain how living things use different energy transfers e.g. the chemical energy in food allows bodies to function, movement of water downhill allows electricity to be generated, vibrating air particles allow sounds to be heard</td>
<td>• investigate various ways of obtaining and using energy more efficiently e.g. insulation, type and amount of food that living things eat</td>
</tr>
<tr>
<td>10</td>
<td>• investigate and describe some of the relationships that exist between force, motion and energy e.g. pendulums, throwing a ball, levers, pulleys</td>
<td>• explore how forms of energy differ in the way they can be transferred or stored e.g. electric circuits, batteries, heat by radiation / convection / conduction</td>
<td>• compare how different renewable and non-renewable energy sources and systems are used</td>
</tr>
<tr>
<td>11</td>
<td>• investigate the effects of forces supporting or opposing each other e.g. floating and sinking, simple machines, speeding up and slowing down</td>
<td>• investigate some of the ways in which energy is transferred between objects and transformed from one form to another e.g. gravitational to movement, chemical to electrical, electrical to heat / light / sound</td>
<td>• describe how systems have been developed to obtain, transfer and use energy for particular purposes, and how these have changed over time e.g. development of an electricity grid</td>
</tr>
<tr>
<td>12</td>
<td>• investigate some ways that properties of objects affect the forces that act on them e.g. Which type of bridge is strongest? How do you need to hold your body for different dives or gymnastic moves?</td>
<td>• investigate some ways in which energy affects objects e.g. bridge, buildings, global warming, roller coasters</td>
<td>• identify some of the issues that need to be considered in using non-renewable and renewable energy systems e.g. cost of production, transportation, environmental implications</td>
</tr>
<tr>
<td>13</td>
<td>• investigate and explain some of the ways that forces act on different objects e.g. in a particular situation e.g. car design, biomechanics, space</td>
<td>• investigate and discuss the energy transfers and transformations that occur in some particular situations e.g. car crashes, houses, global warming, roller coasters</td>
<td>• research and discuss some uses, and the associated advantages and disadvantages, of a particular form of energy e.g. nuclear power, X-rays, microwaves, hydroelectricity</td>
</tr>
<tr>
<td>14</td>
<td>• use Newton’s Laws to explain the behaviour of a variety of objects</td>
<td>• recognise that when energy is transformed and transferred it is also conserved</td>
<td>• research, analyse and argue the merits of available energy sources and systems, considering issues such as viability, cost, human and environmental impact, sustainability</td>
</tr>
<tr>
<td>15</td>
<td>• work with established scientific laws and theories so as to predict the behaviour of objects, (e.g. equations of motion), including quantitative calculations</td>
<td>• research, analyse and explain the energy transfers and transformations that occur in some common systems, commenting on their significance, e.g. human body, the Earth, the Universe, electricity production, atoms</td>
<td>• analyse the implications (technological, political, social, economic) of current and likely future global energy demand (considering energy resources, energy production and energy distribution), including commenting on preferred futures and sustainability</td>
</tr>
<tr>
<td>Stage</td>
<td>The chemical and physical properties of materials are determined by their structure</td>
<td>Materials react and change in a variety of ways</td>
<td>Humans use materials and this raises ethical and sustainability issues</td>
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<td>-------</td>
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</tr>
<tr>
<td>1</td>
<td>• identify a variety of familiar materials e.g. paper, wood, plastic, metal</td>
<td>• talking about what things look like after they have watched them change e.g. ice cream melting</td>
<td>• understand that familiar materials and objects are suited to particular purposes e.g. paper for writing / cutting / gluing / folding, towel for drying, glue stick for sticking paper</td>
</tr>
<tr>
<td>2</td>
<td>• describe observable properties of a variety of familiar materials e.g. the playdough is blue and squishy, the rose is spiky and smells nice, the taddy is soft</td>
<td>• observe, describe and record some of the familiar changes that occur in materials e.g. dissolving (sugar in tea), heating / burning (bread to toast to charcoal), mixing (flour and eggs to pancakes), evaporating (boiling water to steam), condensation on windows, melting, cooking eggs, freezing</td>
<td>• communicate appropriate choices of objects and materials for familiar activities e.g. clothing suited to wet weather, toys suited to the bath or pool</td>
</tr>
<tr>
<td>3</td>
<td>• devise ways to sort materials into categories on the basis of less obvious properties e.g. recyclable / nonrecyclable, natural / made</td>
<td>• describe some ways in which the properties of materials may be changed, and how they change e.g. wetting paper makes it tear easily, cooking eggs makes their yolks hard, leaving metal in the rain can make it go rusty</td>
<td>• explain why common materials are used in particular situations e.g. clothing, sunscreen, glass for windows, packaging materials</td>
</tr>
<tr>
<td>4</td>
<td>• explore and compare simple physical properties of familiar objects, and use these properties to describe and group e.g. hard / soft, colours, magnetic / not magnetic, rough / smooth, floats / sinks, how sticky it is</td>
<td>• investigate and describe differences in the observable changes that materials undergo as a result of everyday processes e.g. some fabrics fade more, you can dissolve more of some substances</td>
<td>• investigate a property of a common material e.g. absorbency of paper towel</td>
</tr>
<tr>
<td>5</td>
<td>• classify materials as solids, liquids or gases, on the basis of their observable properties</td>
<td>• plan investigations to explore how conditions affect the properties of some common materials e.g. how temperature affects the speed at which ice blocks melt</td>
<td>• investigate the properties of a common material e.g. elasticity, absorbency, strength of a piece of Syntofel</td>
</tr>
<tr>
<td>6</td>
<td>• examine and compare the observable properties of common materials that a variety of everyday products are made from e.g. compare the ingredients in a cake</td>
<td>• observe, describe and investigate how changing a variety of familiar materials changes their properties e.g. adding salt to ice, heating air makes it rise</td>
<td>• investigate whether the properties of a material suit it to particular purposes e.g. packaging materials, clothes, bike helmet</td>
</tr>
<tr>
<td>7</td>
<td>• investigate how the manner in which parts are assembled can change the properties of the final product e.g. some shapes are more streamlined, some shapes are stronger</td>
<td>• investigate and describe temporary and more permanent changes that materials can undergo e.g. whipped cream, boiled eggs, ice, wax, garden waste, metal corrosion</td>
<td>• describe some of the ways common materials (e.g. water, wood, metals, fabrics) are used, and why these materials are used in preference to others</td>
</tr>
<tr>
<td>8</td>
<td>• explore the properties of an object in relation to the properties of the materials that it is made from e.g. eggs and sugar compared with meringue, sand and cement compared with concrete</td>
<td>• investigate different types of changes materials can undergo e.g. tanning leather so that it lasts and is more pleasant to wear, refining ores to obtain metal, dyeing with different mordants</td>
<td>• examine how the selection of material for a specific purpose depends on the selection criteria as well as the properties of the materials being considered e.g. cost, can it be recycled?</td>
</tr>
<tr>
<td>9</td>
<td>• find and observe the smaller visible parts that make up the materials under examination e.g. grains or fibres</td>
<td>• identify patterns in the types of change that take place in materials e.g. some metals rust / others do not, foods deteriorate faster at higher temperatures, liquids evaporate / solids do not</td>
<td>• investigate how effectively some manufactured materials meet their purpose and consider the potential impact their use may have on the environment e.g. biodegradability of plastics</td>
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<tr>
<td>10</td>
<td>• investigate the properties of materials can vary according to the proportions of the substances they are composed of, and how this may affect their suitability for a specific use e.g. strengths of mud bricks, rusting of iron alloys, bubble solution</td>
<td>• investigate physical and chemical changes and the reversibility of the change</td>
<td>• consider how some of the chemical procedures and processes they experience are used / occur in real life situations e.g. evaporation, decanting, sieving</td>
</tr>
<tr>
<td>11</td>
<td>• investigate the physical and chemical properties of some important types of substances (e.g. metals, acids and bases) and begin to use the language of chemistry e.g. symbol, formula, atom, molecule</td>
<td>• observe and describe the ways that some important types of substances react and / or change in everyday situations e.g. metals, acids and bases</td>
<td>• consider how some important types of substances (e.g. metals, acids and bases) are used in the home and community and any environmental impact their use may have</td>
</tr>
<tr>
<td>12</td>
<td>• investigate and explain the characteristic chemical and physical properties of one group of commonly used substances, relating the properties to their production and use e.g. foods, cosmetics, plastics, beverages, minerals</td>
<td>• explore factors that affect chemical changes (e.g. temperature, concentration) and apply these to everyday situations e.g. food preservation</td>
<td>• describe some uses and effects of chemicals / chemical processes in everyday situations e.g. corrosion, dyeing, fermentation, drugs, lead</td>
</tr>
<tr>
<td>13</td>
<td>• use the particle model to explain the properties of materials and the changes they undergo</td>
<td>• explain physical and chemical changes in terms of arrangement and type of particle involved, understanding that matter is not created or destroyed in these processes</td>
<td>• consider and discuss some of the possible human and environmental impacts of industrial processes e.g. pollution, energy consumption</td>
</tr>
<tr>
<td>14</td>
<td>• understand and explain that familiar chemical substances can be grouped into families that have characteristic chemical properties e.g. acids, metals, hydrocarbons</td>
<td>• interpret the information contained in chemical equations and formulae, recognising some common chemical reactions e.g. acid-base neutralisation, acid + metal (to give salt + hydrogen)</td>
<td>• research the functions and use of selected groups of chemicals, describe the effect of these on people and the environment, and consider possible substitutes e.g. fluorine, CFCs, agricultural chemicals, petrochemicals, asbestos</td>
</tr>
<tr>
<td>15</td>
<td>• understand and explain that the way elements are grouped in the Periodic Table gives information about their structure and properties, allowing predictions to be made</td>
<td>• use the information contained in valency tables to comment on the changes that the atoms have undergone, and to write formulae for ionic compounds</td>
<td>• understand that there is a variety of arguments for and against the production and use of particular substances, including issues that relate to human and environmental impact e.g. tantulium demand, Bhopal gas spill</td>
</tr>
<tr>
<td>Stage</td>
<td>The structure and characteristics of living things affect their behaviour and functioning</td>
<td>A diverse range of living things have evolved on the Earth</td>
<td>Humans interact with ecosystems, and this raises ethical and sustainability issues</td>
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</tr>
<tr>
<td>1</td>
<td>understand that living things have certain needs to keep them alive e.g. food, water, air, shelter</td>
<td>understand that there are different groups of living things e.g. plants, flowers, insects, frogs</td>
<td>understand that different familiar environments have different characteristics e.g. beaches have sand, bush has lots of trees</td>
</tr>
<tr>
<td>2</td>
<td>describe the function of common body parts, and how they help organisms obtain their needs e.g. eyes for seeing, nose for smelling, leg for moving</td>
<td>describe some of the ways in which things in the world can be grouped e.g. plant / animal</td>
<td>describe the kinds of living things that are likely to be found in common environments</td>
</tr>
<tr>
<td>3</td>
<td>understand that living things have different characteristics at different times of their lives e.g. frog life cycle, changes with age</td>
<td>group living things in different ways e.g. far / no far, legs / no legs, leaves / needles</td>
<td>describe how living things rely on their non-living environment and how humans may impact on this relationship e.g. moving rocks means that crabs have nothing to protect them from the sun and birds</td>
</tr>
<tr>
<td>4</td>
<td>describe some of the external and internal characteristics of living things and say what their function is e.g. the heart pumps blood</td>
<td>understand that groups of living things all have their own particular features e.g. fish have gills, plants have leaves, carnivores have sharp, pointy teeth, birds have feathers</td>
<td>understand that the type of non-living environment determines the kinds of living things found there e.g. aquatic, terrestrial, arid, city, agricultural</td>
</tr>
<tr>
<td>5</td>
<td>recognise that there is a relationship between the characteristics of a living thing and how it survives e.g. teeth for eating meat or grass, gills or lungs for breathing in water or air, claws for catching prey, wings for flying</td>
<td>understand that there are many different kinds of living things, and distinguish between living and non-living things using basic criteria e.g. need for food and water, need to sense their environment</td>
<td>describe and explain some of the ways in which plants or animals, including people, respond to normal environmental changes e.g. hibernation, bird migration, plants grown in sun and shade</td>
</tr>
<tr>
<td>6</td>
<td>observe the characteristics that a living thing has and use these to draw conclusions about its way of life e.g. What sort of environment does it live in? How does it reproduce? How does it feed?</td>
<td>describe some of the changes that take place as living things grow while realising that offspring are similar to their parents</td>
<td>explain that the basic needs of living things must be met for survival in an environment, and consider how humans have impacted on the living things in a local area</td>
</tr>
<tr>
<td>7</td>
<td>pose questions and seek explanations about the internal and external features of living things in order to better understand how they survive e.g. What happens to food in the stomach? What affects plant growth?</td>
<td>identify and describe various features of a variety of objects and explain whether they should be classified as living, non-living or once living</td>
<td>describe some of the interactions that occur between living things, including humans e.g. predator / prey, parasite / host</td>
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<tr>
<td>8</td>
<td>describe the relationship between the structures of living things and the functions those structures perform e.g. ears are shaped to catch sound waves, Venus fly traps have specialised leaves to catch insects</td>
<td>use observable characteristics to sort familiar and unfamiliar living things into groups</td>
<td>explore ways in which living things interact with each other and the non-living parts of their environment e.g. water, soil</td>
</tr>
<tr>
<td>9</td>
<td>explore ways in which the health and survival of organisms is dependent on their environment e.g. diet, disease, climate</td>
<td>investigate and classify closely related living things on the basis of easily observable characteristics e.g. blue whale / sperm whale / killer whale, eastern rosellas / green rosellas / rainbow lorikeet</td>
<td>explore ways in which humans have impacted on the living things in a particular ecosystem e.g. introduced species, hunting, habitat change, animal migration patterns</td>
</tr>
<tr>
<td>10</td>
<td>identify characteristics of plant and animal cells, including recognising the cell as the basic unit of all living things</td>
<td>apply accepted systems of scientific classification to living things, based on their structures</td>
<td>construct and interpret food chains and webs to model relationships between organisms within an ecosystem</td>
</tr>
<tr>
<td>11</td>
<td>investigate and describe some structural, physiological and / or behavioural adaptations that ensure the survival of living things in their environment e.g. the organ systems that animals use to locate, catch, eat, digest, transport and use food, photosynthesis</td>
<td>understand that different reproductive methods have different advantages for the survival of their species e.g. mammals nurture their young,自主 are dispersed by animals</td>
<td>examine a particular ecosystem, identifying human impacts on trophic relationships and the non-living environment</td>
</tr>
<tr>
<td>12</td>
<td>investigate and describe particular factors that may affect the functioning and survival of living things e.g. micro-organisms and disease, smoking / drugs</td>
<td>understand that reproduction can occur by both sexual and sexual means e.g. plant cuttings, cloning, seeds</td>
<td>discuss the impact that change has had on particular ecosystems and identify measures required for ecological sustainability</td>
</tr>
<tr>
<td>13</td>
<td>explore how complex organisms depend on interacting body systems to meet their needs e.g. relationship between the circulatory and respiratory systems</td>
<td>recognise that inherited characteristics are the result of genetic information (DNA) being passed from parent to offspring</td>
<td>use scientific concepts and models to explain the interdependence of populations of organisms and the environment, and to predict the consequences of changes to an ecosystem e.g. use simulations and consider matter and energy flow</td>
</tr>
<tr>
<td>14</td>
<td>investigate and explain the factors that affect a particular life process e.g. enzymes, hormones, physical factors in the environment</td>
<td>explain simple patterns of inheritance that operate in humans and other living things, including how to use them to predict the likelihood of particular characteristics in offspring</td>
<td>investigate the potential long-term effects of changes in biodiversity e.g. urbanisation, forestry, tourism, biological control measures, conservation, natural disaster</td>
</tr>
<tr>
<td>15</td>
<td>investigate and explain how and why functioning and behaviour of living things changes in response to conditions in the internal and external environment e.g. Alzheimer’s disease, Tasmanian devil facial tumour disease, IVF processes</td>
<td>investigate some applications and implications of genetic engineering</td>
<td>research, critically explore and develop a defensible position about a selected environmental issue affecting Australia e.g. old growth logging, Tasmanian devil facial tumour disease, whaling</td>
</tr>
</tbody>
</table>
### Science by strand – Science as a body of knowledge–Earth and space

<table>
<thead>
<tr>
<th>Stage</th>
<th>Earth and space have characteristic features and patterns of activity</th>
<th>Earth and space systems continue to be shaped by the changes they experience</th>
<th>Humans use the Earth and this raises ethical and sustainability issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• identify a variety of features of the Earth and sky e.g. mountain, beach, garden, river, sun, moon, star, clouds</td>
<td>• identify obvious changes that occur on the Earth e.g. day and night, rain and sun</td>
<td>• describe some of the activities that occur in familiar environments e.g. playing in the park, building sand castles at the beach, picking flowers in the garden, making things in factories</td>
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<tr>
<td>2</td>
<td>• share their ideas about some easily observable patterns of their physical environment e.g. weather, day and night, seasonal change, changes to the moon</td>
<td>• describe obvious events and identify basic cause and effect relationships that occur on the Earth and in the sky e.g. it is night-time because the sun has set, the trees don’t have any leaves because it is autumn</td>
<td>• discuss some of the ways in which they make use of the Earth and take care of it e.g. pick up rubbish in their playground, plant trees to give shade</td>
</tr>
<tr>
<td>3</td>
<td>• use terms that identify and describe various familiar and non-familiar features of the Earth e.g. soil, rocks, oceans, dams, tides, icebergs, clouds, glaciers, deserts</td>
<td>• explore and describe short and longer term patterns of events that occur on the Earth and in the sky e.g. seasons, soil erosion, drought, flood, changes in the moon’s appearance, movement of the sun, tides</td>
<td>• explain some ways in which they can care for their immediate environment, and why this is important e.g. by taking responsibility for the plants and shrubs in an area near their classroom, recycling paper in their classroom</td>
</tr>
<tr>
<td>4</td>
<td>• identify and describe the characteristics of various landforms and patterns of movement e.g. volcanoes, earthquakes, canyons, geyasers, coral reefs, ocean currents</td>
<td>• understand that the Earth is very old, and that the animals, plants and landscapes have changed over time e.g. dinosaurs, coastal erosion</td>
<td>• understand that there are essential materials and energy sources that allow us to live on the Earth e.g. energy from the sun, wood, coal, oil, stone, minerals, water</td>
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<tr>
<td>5</td>
<td>• describe some of the ways in which easily observable conditions vary in their local area e.g. weather, rock types, water flow in creeks</td>
<td>• identify and consider the impact of various types of change on the Earth’s animals, plants and landscapes e.g. day / night, drought, bushfire, storms, tsunami</td>
<td>• describe some of the ways in which their own community uses and is dependent on resources from the Earth e.g. rivers and oceans, dams, air, land, electricity, mining</td>
</tr>
<tr>
<td>6</td>
<td>• describe some of the ways in which easily observable conditions vary across the Earth e.g. weather, landforms</td>
<td>• observe and describe changes on Earth and in space (e.g. day/night, weather, erosion, geological activity)</td>
<td>• examine how they and other living things depend on the Earth and are affected by changes at the Earth’s surface</td>
</tr>
<tr>
<td>7</td>
<td>• explore the relationship between distance and the apparent size of objects e.g. a large object looks smaller as you move away from it</td>
<td>• describe some of the ways in which the Earth has changed in the past and how it continues to change and categorise some changes e.g. regular / irregular, sudden / gradual, natural / result of human activity</td>
<td>• describe the importance of the Earth’s characteristics in allowing living things to survive, and how changes to these characteristics may affect living things e.g. air and water pollution</td>
</tr>
<tr>
<td>8</td>
<td>• research current information from space exploration about other planets and objects in the solar system and compare the regular and predictable motions of various objects in the solar system e.g. by modelling</td>
<td>• suggest causes and effects of some of the changes which occur at the surface of the Earth or in the atmosphere e.g. pollution</td>
<td>• investigate how different Earth resources are used in the community for a variety of purposes e.g. forestry, mining, fishing, power production</td>
</tr>
<tr>
<td>9</td>
<td>• investigate the effects of gravity as the force that causes objects to fall towards the Earth</td>
<td>• investigate some interactions between systems of Earth (atmosphere, oceans Earth’s surface), and / or space e.g. weather, water cycle, erosion, rock formation, changing courses of rivers, meteor impacts</td>
<td>• investigate a local environmental issue and explain the reasons for the community’s involvement e.g. Landcare projects, water quality, recycling, Clean up Australia, reduced plastic bag use</td>
</tr>
<tr>
<td>10</td>
<td>• model the orbits of the Earth, Moon and Sun in relation to each other and explore the effects observable from Earth e.g. model eclipses, seasons</td>
<td>• compare some processes that occur over a shorter time scale e.g. evaporation and precipitation in the water cycle with some that take longer e.g. rock formation</td>
<td>• investigate which of Earth’s resources that they use are reusable or renewable and which are not</td>
</tr>
<tr>
<td>11</td>
<td>• understand that gravity is the force that keeps the objects of the solar system in their orbits, and that gravitational attraction exists between all objects in the universe</td>
<td>• use geological evidence to interpret some ways in which the Earth has changed since its formation, including through different geological periods</td>
<td>• describe some ways in which the properties of Earth’s resources affect how organisms use them e.g. hardness of rocks, salinity of water, conductivity of metals</td>
</tr>
<tr>
<td>12</td>
<td>• investigate and describe a variety of significant features and processes on Earth and / or in space e.g. erosion, weathering, earthquakes, folding, volcanic eruptions, weather, meteor impact, constellations, ice ages, supernova</td>
<td>• describe some important interactions that occur, or have occurred in the past, within and / or between Earth and / or space systems e.g. sea-level changes, temperature changes, appearance of land bridges, death of a star</td>
<td>• examine the long-term effects of humans on the Earth, and consider possible ways of modifying human behavior to reduce deleterious effects e.g. pollution, loss of biodiversity</td>
</tr>
<tr>
<td>13</td>
<td>• explore scientific theories of the origin of the universe</td>
<td>• use the theory of plate tectonics to explain global patterns of geological activity</td>
<td>• consider the consequences of changes to the atmosphere (e.g. global warming, hole in the ozone layer) resulting from natural and human activities</td>
</tr>
<tr>
<td>14</td>
<td>• describe some ways in which patterns of activity that have, or are likely to, occur on Earth and in space may impact on living things e.g. solar flares, volcanic islands, break up of Gondwana / Pangaea</td>
<td>• investigate and describe the sequence and characteristics of major events in the Earth’s past e.g. plate tectonics, CO₂ changes, species disappearance, early humans</td>
<td>• research, analyse and argue the merits of human use of Earth and space resources, considering issues such as viability, cost, human and environmental impact, sustainability e.g. fossil fuels, space travel, International Space Station</td>
</tr>
<tr>
<td>15</td>
<td>• use scientific theories and ideas to explain past, present and possible future features and events on Earth and in space e.g. mineral distribution, patterns of volcanic activity</td>
<td>• analyse and evaluate the evidence for past, present and predicted future changes to the Earth and space, and consider the possible implications e.g. global warming, death of our sun</td>
<td>• analyse the implications (environmental, political, social, economic) of current and likely future use of resources from Earth and space, considering multiple perspectives e.g. sand mining, mining energy sources, colonising other planets</td>
</tr>
<tr>
<td>Main idea</td>
<td>Stage one</td>
<td>Stage two</td>
<td>Stage three</td>
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<tr>
<td>observe that some people like to find things out and make things</td>
<td>understand that work or hobbies can involve science</td>
<td>understand that scientists find out how the world works and help make useful things</td>
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</tr>
<tr>
<td>scientific as a human endeavour</td>
<td>describe some ways in which the products of science assist people e.g. glasses to assist vision</td>
<td>speculate what their lives would be like without the products of science</td>
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</tr>
<tr>
<td>recognise that we should care for living things, e.g. pets have needs that have to be met</td>
<td>recognise that they share the world with other living things, and therefore need to care for the condition of their immediate environment</td>
<td>understand that living things depend on other living things and their environment to survive</td>
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<tr>
<td>make observation statements about the world on the basis of first hand experiences e.g. the sunset is red, the balloon made a loud pop, that plant smells like lemons, the brown rock feels smooth</td>
<td>make poses to questions out how and why things are happening e.g. Why don’t those trees have any leaves? How did the crows get on top of that building? When will it be dark?</td>
<td>contribute to class discussion about a question and make guess type predictions e.g. ask why can you bend, the flowers back to life, then put a dead flower in soil to see</td>
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<tr>
<td>make observations about science experiences e.g. look at objects teacher has placed under a microscope, watch a bulb grow</td>
<td>make observations that show that the more energy that is used on an object the more movement is created e.g. if you throw a ball harder, it goes further.</td>
<td>contribute to class discussion about a question and make guess type predictions e.g. ask why can you bend, the flowers back to life, then put a dead flower in soil to see</td>
<td></td>
</tr>
<tr>
<td>identify similarities and differences on the basis of familiar characteristics</td>
<td>speculate on reasons, causes and effects e.g. my plant died because its pot was too small</td>
<td>interpret data and draw limited conclusions, when presented with simple alternatives e.g. the magnet didn’t attract any plastic objects, the flower didn’t come back to life</td>
<td></td>
</tr>
<tr>
<td>engage with simple scientific information from familiar sources e.g. a book showing the kinds of animals found at the beach</td>
<td>link scientific information contained in texts with their own experiences e.g. we saw kangaroos like the ones on the DVD at the wildlife park</td>
<td>seek out science information from various texts e.g. find a book or website on chididas, select a science-focused beginning reader</td>
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<tr>
<td>understand that it is possible to change things by applying a force e.g. dropping / throwing / hitting / pushing / heating</td>
<td>make observations that show that the more energy that is used on an object the more movement is created e.g. if you throw a ball harder, it goes further.</td>
<td>make observations about the way that different types of objects behave in different situations (when different forces act on them) e.g. Do the flower or sink if placed in water? Is it as easy to ride a bike on sand as on concrete?</td>
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<tr>
<td>make a variety of different objects move e.g. push a toy car, wind a key, throw the lid off a jack-in-the-box, throw a toy glider or ball, pour water over a waterwheel, push a swing, blow bubbles, squeeze a water squirtier, suck through a straw</td>
<td>make observations about the ways that objects of different shapes and sizes move e.g. the soccer ball rolls further, the square block doesn’t roll, some objects roll and some slide</td>
<td>make observations about some effects of energy in their everyday lives e.g. rubbing hands together makes them warmer, the kite moves in the wind, running around makes you feel hot, plucking guitar strings makes a musical sound, putting a sausage on the barbeque cooks it</td>
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</tr>
<tr>
<td>describe how to make different kinds of toys work e.g. put batteries in them, plug into a power point, push them, throw them</td>
<td>explain some ways in which energy affects things personally e.g. sun warms, flames burn, electricity makes the computer work</td>
<td>identify ways energy source used by common objects e.g. electricity makes the television work, the batteries make a torch work, petrol makes the car go, food gives us energy</td>
<td></td>
</tr>
<tr>
<td>identify a variety of familiar materials e.g. paper, wood, plastic, metal</td>
<td>explore and compare simple physical properties of familiar materials and use those properties to describe and group e.g. hard / soft, colours, magnetic / non-magnetic, rough / smooth, floats / sinks, how sticky it is</td>
<td>devise ways to sort materials into categories on the basis of less obvious properties e.g. recyclable / nonrecyclable, natural / made</td>
<td></td>
</tr>
<tr>
<td>describe observable properties of a variety of familiar materials e.g. the play dough is blue and squishy, the rose is spiky and smells nice, the teddy is soft</td>
<td>describe the same ways in which energy affects things e.g. a magnet pulls a variety of different objects to it, changing position of materials may be changed, and how they change e.g. wetting paper makes it tear easily, cooking eggs makes them go yolk hard, leaving metal in the rain can make it go rusty</td>
<td>use terms that identify and describe various familiar and non-familiar features of the Earth e.g. soil, rocks, oceans, dams, tides, icebergs, clouds, glaciers, deserts</td>
<td></td>
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<tr>
<td>talk about what things look like after we have watched them change e.g. ice cream melting</td>
<td>observe and describe some of the familiar changes that occur in materials e.g. dissolving (sugar in tea), heating / burning (bread to toast to charcoal), mixing (flour and eggs to pancakes), evaporating (boiling water to steam), condensation on windows, melting, cooking eggs, freezing</td>
<td>observe and describe some of the familiar changes that occur in materials e.g. dissolving (sugar in tea), heating / burning (bread to toast to charcoal), mixing (flour and eggs to pancakes), evaporating (boiling water to steam), condensation on windows, melting, cooking eggs, freezing</td>
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<td>understand that familiar materials and objects are suited to particular purposes e.g. paper for writing / cutting / gluing / folding, towel for drying, glue stick for sticking paper</td>
<td>communicate appropriate choices of objects and materials for familiar activities e.g. clothing suited to wet weather, toys suited to the bath or pool</td>
<td>explain why common materials are used in particular situations e.g. clothing, sunscreen, glass for windows, packaging materials</td>
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<tr>
<td>understand that living things have certain needs to keep them alive e.g. food, water, air, shelter</td>
<td>describe the function of common body parts, and how they help organisms obtain their needs e.g. eyes for seeing, nose for smelling, legs for moving</td>
<td>understand that living things have different characteristics at different times of their lives e.g. frogs life cycle, changes with age</td>
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<td>understand that there are different groups of living things, flowers, insects, frogs have lots of trees</td>
<td>describe some of the ways in which things in the world can be grouped e.g. plant / animal</td>
<td>group living things in different ways e.g. fur / no fur, feathers / no feathers, leave / no leaves, leaves / need water</td>
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<td>understand that different familiar environments have different characteristics e.g. beaches have sand, bush has lots of trees</td>
<td>describe the kinds of living things that are likely to be found in common environments</td>
<td>describe how living things rely on their non-living environment and how humans may impact on this relationship e.g. moving rocks means that crabs have nothing to protect them from the sun and birds</td>
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<tr>
<td>identify a variety of features of the Earth and sky e.g. mountain, beach, garden, river, sun, moon, star, cloud</td>
<td>share their ideas about some easily observable patterns of their physical environment e.g. weather, day and night, seasonal change, changes to the moon</td>
<td>use terms that identify and describe various familiar and non-familiar features of the Earth e.g. soil, rocks, oceans, dams, tides, icebergs, clouds, glaciers, deserts</td>
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<td>identify obvious changes that occur on the Earth e.g. day and night, rain and sun</td>
<td>describe obvious events and identify basic cause and effect relationships that occur on the Earth and in the sky e.g. it is right-time because the sun has set, the trees don’t have any leaves because it is autumn</td>
<td>explore and describe short and longer term patterns of events that occur on the Earth and in the sky, such as seasons, soil erosion, drought, flood, changes in the moon’s appearance, movement of the sun, tides</td>
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<td>observe and describe the ways that occur in familiar environments e.g. playing in the park, building sand castles at the beach, picking flowers in the garden, making things in factories</td>
<td>describe some of the ways that living things can care for the Earth and take care of e.g. pick up rubbish in their playground, plant trees to give shade</td>
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<td>Earth and space</td>
<td>make observations about the ways in which they change, e.g. the Earth and take care of e.g. pick up rubbish in their playground, plant trees to give shade</td>
<td>understand that scientists find out how the world works and help make useful things</td>
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**Main idea** | **Stage four** | **Stage five** | **Stage six**
---|---|---|---
Science as a human endeavour | understand that scientists investigate the world in a particular way | understand that science values investigations that are fair, and are based on evidence and logical reasoning | understand that science values investigations that are fair, and are based on evidence and logical reasoning |
| describe the work of a particular scientist and explain why it is useful | describe the ways that applications of science are used in their community e.g. obtaining clean drinking water | explain the work of a particular scientist and explain why it is useful | explore the place of science in the work of people in their community |
| identify some things that might have a positive or negative impact on the world, and understand that they should be responsible and caring in things that they do | explore the place of science in the work of people in their community | describe some of the ways that they both rely on and impact on their immediate environment and identify ways to be more responsible for sustainability in their home or school | work in small groups to develop a scientifically testable question on a class topic related to their interests and experiences |

**Scientific inquiry** | ask questions (e.g. How? What will happen?) and, with teacher prompting, modify them so that they can be investigated through scientific inquiry | suggest questions that could be investigated using a scientific approach and make reasoned (but not necessarily scientifically-based) predictions about what the answers will be e.g. Which iceblock will melt the quickest? | suggest questions that could be investigated using a scientific approach and make reasoned (but not necessarily scientifically-based) predictions about what the answers will be e.g. Which iceblock will melt the quickest? |
| participate in teacher-guided investigations, following a short sequence of steps provided by the teacher to conduct a scientific investigation, including collecting, and recording data | contribute to class discussion about why the teacher has suggested a particular method to investigate their questions | participate in teacher-guided investigations, following a short sequence of steps provided by the teacher to conduct a scientific investigation, including collecting, and recording data | plan and carry out investigations, that involve a small number of steps, using appropriate equipment, and following suggestions to collect, record and present data |
| interpret their data and draw simple conclusions if led through the process by teacher questioning | recognise obvious patterns and trends in their data, draw simple conclusions based on them and suggest reasons why their results are not the same as those of others e.g. The plants that got more water grew better. | interpret their data and draw simple conclusions if led through the process by teacher questioning | compare their results with their initial ideas |

**Scientific communication** | follow teacher directions to collect and record scientific information e.g. record experimental findings in the appropriate place on a template, locate a text about volcanoes and tell the class two interesting things about them | use a range of simple texts to help find information e.g. collect information from the web, books and a DVD for a report on Antarctica | use a range of simple texts to help find information e.g. collect information from the web, books and a DVD for a report on Antarctica | be aware that information on scientific issues can be presented to influence the reader’s thinking in particular ways e.g. a book might lead you to think that taking water from a river is bad |
| organise science information with teacher guidance e.g. keep a science journal set up by a teacher, using short sentences, drawings and pictographs | organise science information with teacher guidance but showing increased independence and use of scientific language and conventions e.g. report headings, labelled diagrams, use vocabulary such as solid, liquid, gas | organise science information with teacher guidance but showing increased independence and use of scientific language and conventions e.g. report headings, labelled diagrams, use vocabulary such as solid, liquid, gas | use, and select from, a range of appropriate material e.g. PowerPoint, graphic organisers, tables, posters, reports to communicate scientific observations, results, ideas and understandings, using scientific language relevant to contexts they have studied e.g. thorax abdomen, friction, properties |
| describe and record some of the ways that different materials change their properties as a result of everyday processes e.g. some fabrics fade more, you can dissolve more of some substances in one solvent than another | investigate and record how the properties of an object can determine the effect of the forces that act on it e.g. magnets pick up some objects and not others, some balls are more bouncy than others | identify some of the ways that different materials change their properties as a result of everyday processes e.g. some fabrics fade more, you can dissolve more of some substances in one solvent than another | identify some of the ways that different materials change their properties as a result of everyday processes e.g. some fabrics fade more, you can dissolve more of some substances in one solvent than another |

**Energy and force** | describe and record some of the ways in which energy may affect objects e.g. heat energy melts ice, light helps make plants grow, people need warm clothes in the snow | describe how the properties of an object affect how it absorbs and/or emits energy e.g. different coloured objects heat up differently, different length strings affect the sound of a musical note | describe and record some of the ways that energy is used in their community, and how that energy is obtained | describe and record some of the ways that energy is used in their community, and how that energy is obtained |

**Matter** | explore some less obvious properties of common materials and the changes that they undergo e.g. do they dissolve, how runny are they, density of liquids, evaporation, melting, condensation | classify materials as solids, liquids or gases on the basis of their observable properties | classify materials as solids, liquids or gases on the basis of their observable properties | examine and compare the observable properties of common materials that a variety of everyday products are made from e.g. compare the ingredients in a cake |
| investigate and describe differences in the observable properties of rocks and minerals as a result of everyday processes e.g. some fabrics fade more, you can dissolve more of some substances in one solvent than another | plan investigations to explore how conditions affect the properties of some common materials e.g. how temperature affects the speed at which iceblocks melt | observe, describe and investigate how changing a variable of a material can affect its properties e.g. adding salt to ice, heating air makes it rise | observe, describe and investigate how changing a variable of a material can affect its properties e.g. adding salt to ice, heating air makes it rise |
| investigate a property of a common material e.g. absorbency of paper towel | investigate the properties of a common material e.g. elasticity, absorbency, strength of a piece of (scraft?) | investigate whether the properties of a material suit it to particular purposes e.g. packaging materials, clothes, bike helmet | investigate whether the properties of a material suit it to particular purposes e.g. packaging materials, clothes, bike helmet |

**Living things** | describe some of the external and internal characteristics of living things and say what their function is e.g. the heart pumps blood | recognise that there is a relationship between the characteristics of a living thing and how it survives e.g. eat fish, bricks, eat leaves because they contain water | observe the characteristics that a living thing has and use these to draw conclusions about its way of life e.g. a fish is adapted to life in water, how does it breathe? |
| understand that groups of living things all have their own particular features e.g. fish have gills, plants have leaves, carnivores have sharp, pointy teeth, birds have feathers | classify materials as solids, liquids or gases on the basis of their observable properties | examine and compare the observable properties of common materials that a variety of everyday products are made from e.g. compare the ingredients in a cake | examine and compare the observable properties of common materials that a variety of everyday products are made from e.g. compare the ingredients in a cake |
| understand that the type of non-living environment determines the kinds of living things found there e.g. aquatic, terrestrial, arid, city, agricultural | describe and explain how the properties of some non-living things suit them to live in a particular environment | explain that the basic needs of living things must be met for survival in an environment, and consider how humans have impacted on the living things in a local area | explain that the basic needs of living things must be met for survival in an environment, and consider how humans have impacted on the living things in a local area |

**Earth and space** | identify and describe the characteristics of various landforms and patterns of movement e.g. volcanoes, earthquakes, canyons, geysers, coral reefs, ocean currents | describe some of the ways in which easily observable conditions vary in their local area e.g. weather, rock types, water flow in creeks | describe some of the ways in which easily observable conditions vary in their local area e.g. weather, rock types, water flow in creeks | describe some of the ways in which easily observable conditions vary in their local area e.g. weather, rock types, water flow in creeks |
| understand that the Earth is very old, and that the animal, plant and landscape environments have changed over time e.g. dinosaurs, coastal erosion | analyse and consider the impact of various types of change on the Earth’s animals, plants and landscapes e.g. day / night, drought, bushfire, storms, tsunami | relate geologically recent events to their personal experience | observe and describe changes on Earth in space (e.g. day / night, weather, soil in, phases of the moon) and recognise that some changes are more predictable than others |
| understand that there are essential energy sources that allow us to live on the Earth e.g. energy from the sun, wood, coal, oil, stone, minerals, water | describe some of the ways in which changing the Earth is affected by changes at the Earth’s surface | describe some of the ways in which changing the Earth is affected by changes at the Earth’s surface | describe some of the ways in which changing the Earth is affected by changes at the Earth’s surface |

**Stage five:** Concepts are used and explained with increasing accuracy. Sets of terms are used in a variety of contexts. Students are able to apply scientific language and conventions to communicate effectively. Students present data and ideas in a logical order using scientific language and conventions. Students are able to organise science information with teacher guidance. Students can make reasoned (but not necessarily scientifically-based) predictions about scientific phenomena based on evidence. Students are able to identify some of the ways that they both rely on and impact on their immediate environment. They are able to discuss a particular method to investigate their questions. Students work in small groups to develop a scientifically testable question on a class topic related to their interests and experiences.

**Stage six:** Students are able to explain how the properties of an object can determine the effect of the forces that act on it. Students are able to classify materials as solids, liquids or gases on the basis of their observable properties. Students examine and compare the observable properties of common materials that a variety of everyday products are made from e.g. compare the ingredients in a cake. Students are able to identify some of the ways that different materials change their properties as a result of everyday processes e.g. some fabrics fade more, you can dissolve more of some substances in one solvent than another. Students are able to investigate and record ways in which pushes and pulls (forces) act in everyday situations to make things stop, move or change shape e.g. brakes on a bike or car, friction on different surfaces. Students are able to explain that the basic needs of living things must be met for survival in an environment, and consider how humans have impacted on the living things in a local area. Students are able to observe the characteristics that a living thing has and use these to draw conclusions about its way of life e.g. a fish is adapted to life in water, how does it breathe? Students are able to describe and explain how the properties of some non-living things suit them to live in a particular environment. Students are able to relate geologically recent events to their personal experience.
<table>
<thead>
<tr>
<th>Main idea</th>
<th>Stage seven</th>
<th>Stage eight</th>
<th>Stage nine</th>
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</thead>
<tbody>
<tr>
<td>Science as a human endevour</td>
<td>• describe some of the ways that people think and work scientifically e.g. ideas, hunches, imagination, problem solving, investigation, theorising, decision making, serendipity, trial and error</td>
<td>• identify and explain some different ways that people think and work scientifically to carry out investigations (e.g. experimentation, ecological study, health study) and realise that many investigations have ethical considerations</td>
<td>• realise that scientific ideas are modified over time by a community of scientists as new perspectives and ideas are taken into account e.g. flat earth, is Pluto a planet?</td>
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<tr>
<td>Scientific inquiry</td>
<td>• recognise products of science and that they may have both positive and negative outcomes for society or cars</td>
<td>• describe how some products used in work and leisure have changed over time e.g. planes, refrigeration</td>
<td>• explain some ways that scientific developments influence and are influenced by history and community needs e.g. vaccines, sewage treatment, water recycling</td>
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<tr>
<td>• identify some of the relationships in simple natural and/or constructed systems e.g. food chains</td>
<td>• explore the consequences of human activity for the sustainability of a familiar system, including investigating how their actions contribute to sustainability of local and local environments</td>
<td>• explain some of the connections within and between local natural, constructed or social systems; and identify different perspectives in making reasonable choices e.g. consider the likely effect of a new development on the local ecosystem</td>
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<tr>
<td>• explain why conserving resources is important for the environment</td>
<td>• ask questions and make predictions, with some scientific basis, related to their everyday experience</td>
<td>• contribute to planning a variety of investigations, recognising where comparisons might be fair or unfair</td>
<td>• pose questions that can be investigated scientifically, and explain the basis of their predictions about the outcome</td>
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<tr>
<td>• choose appropriate experimental methods and techniques for exploring ideas and testing predictions</td>
<td>• understand that science investigations need to be fair, and, with scaffolding, (e.g. an investigation plan, data table, graph and information about simple fair investigations, that involve changing one variable while keeping everything else the same)</td>
<td>• identify potential sources of fairness and bias in investigations as they plan and conduct them, suggesting procedures which may improve or add to an investigation</td>
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<tr>
<td>Scientific communication</td>
<td>• collect information relevant to their science investigations in ways that mimic those used by scientists e.g. library research, Internet, poster, experiment</td>
<td>• present results of their investigations in ways that mimic those used by scientists, such as a report, an oral presentation or a poster</td>
<td>• draw reasonable conclusions that are suggested by their data, and consider any obvious implications of their research findings</td>
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<td>• collect information relevant to their science investigations from a variety of sources, using simple strategies (e.g. check the author) to assess its accuracy, relevance and credibility</td>
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<td>• use data from a variety of sources, including the Internet, to summarise the results of their investigations as they plan and conduct them, ensuring the outcome is supported by evidence and arguments</td>
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<td>Energy and force</td>
<td>• describe some of the ways in which people apply forces for specific purposes e.g. pulleys for lifting levers for moving things, hammering in nails, bows and arrows, screwdriver, playing musical instruments</td>
<td>• compare the effects of large and small forces on the motion and/or shape of an object</td>
<td>• investigate and describe some of the relationships that exist between forces, motion and energy e.g. pendulums, throwing a ball, levers, pulleys</td>
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<tr>
<td>• identify ways in which energy can be stored (e.g. batteries, rubber bands, springs, water in dams) and how it is then used e.g. to make a torch work, to operate a toy, to make air particles vibrate</td>
<td>• investigate how some different forms of energy (e.g. heat, sound, light, electricity) are transferred e.g. electrical energy via the wires in an electrical circuit</td>
<td>• investigate and explain how living things use different energy transfers e.g. the chemical energy in food allows bodies to function, movement of water downhill allows electricity to be generated, blowing air particles allow sounds to be heard</td>
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<td>• suggest practical ways in which to reduce their energy use (e.g. small light bulbs, turning television off) and suggest why that is desirable e.g. it would be cheaper.</td>
<td>• investigate how some different forms of energy are used in their community and research the sources of those forms of energy</td>
<td>• investigate various ways of obtaining and using energy more efficiently e.g. insulation, type and amount of food that living things eat</td>
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<td>Matter</td>
<td>• investigate how changing the manner in which parts are assembled can change the properties of the final product e.g. some shapes are more streamlined, some shapes are stronger</td>
<td>• explore the properties of an object in relation to the properties of the materials that it is made from (e.g. eggs and sugar compared with meringue, sand and cement compared with concrete)</td>
<td>• explore some of the relationships that exist between materials’ properties and how they behave e.g. foods that contain starch turn purple when you add iodine, things that are made from animal or plant matter will decay in a compost bin</td>
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<td>• investigate and describe temporary and permanent changes that materials can undergo e.g. weathering of rocks, decayed eggs, ice, wax, garment waste, metal corrosion</td>
<td>• investigate different types of changes materials can undergo e.g. tanning leather so that it lasts and is more pleasant to wear, refining ores to obtain metal, dyeing with different mordants</td>
<td>• identify patterns in the types of change that take place in materials e.g. some metals rust / others do not, some deteriorate faster at higher temperatures, liquids evaporate / solids do not</td>
<td>• investigate how effectively some manufactured materials meet their purpose and consider the potential impact their use may have on the environment e.g. biodegradability of plastics</td>
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<td>• describe some of the ways common materials (e.g. water, wood, metals, fabrics) are used, and why these materials are used in preference to others</td>
<td>• describe how some materials meet their purpose and consider the potential impact their use may have on the environment e.g. diet, disease, climate</td>
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<td>Living things</td>
<td>• pose questions and seek explanations about the internal and external features of living things in order to better understand how they survive e.g. What happens to food in the stomach? What affects plant growth?</td>
<td>• explore the relationship between the structures of living things and the functions those structures perform e.g. ears are shaped to catch sound waves, Venus fly traps have specialised leaves to catch insects</td>
<td>• explore ways in which the health and survival of organisms is dependent on their environment e.g. diet, disease, climate</td>
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<td>• identify and describe the various features of a variety of objects and explain whether they should be classified as living, non-living or once living</td>
<td>• describe some of the interactions that occur between living things, including humans e.g. predator / prey, parasite / host</td>
<td>• identify and describe the conditions that sustain life on Earth and compare them with conditions on other planets</td>
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<td>Earth and space</td>
<td>• identify some of the ways in which humans explore the Earth and Solar System e.g. use satellites to collect information about deep ocean vents, use telescopes or space probes to collect information about other planets, collect fossils to see what the Earth used to be like</td>
<td>• describe some of the ways in which Earth’s characteristics are allowing living things to survive, and how changes to these characteristics may affect living things e.g. air and water pollution</td>
<td>• investigate some impacts of human activity on the Earth’s characteristics in the community for a variety of purposes e.g. forestry, mining, fishing, power production</td>
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<td>• describe the ways in which the Earth has changed in the past and how it continues to change and categorise those changes e.g. regular / irregular, sudden / gradual, natural / result of human activity</td>
<td>• explore ways in which living things interact with each other and the non-living parts of their environment e.g. water, rain</td>
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<td>• describe some of the ways in which Earth resources are being used in the community for a variety of purposes e.g. forestry, mining, fishing, power production</td>
<td>• investigate the reasons for the community’s involvement e.g. Landcare projects, water quality, recycling, Clean up Australia, reduced plastic bag use</td>
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<td>Main idea</td>
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<td><strong>Science as a human endeavour</strong></td>
<td>examine how and why people engage in science as a worthwhile and exciting career, including examining the work of Australian scientists</td>
<td>consider what is characteristic of the way that scientists work, and why this is important e.g. integrity, rigour, regard for evidence</td>
<td>identify some things that limit or control scientific work or understanding e.g. ethics, code of practice, government regulation, exclusion of certain groups—such as women or ethnic groups</td>
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<td>recognise that different cultures may have different views in relation to science e.g. traditional medicine</td>
<td>analyse how and why some products and processes have changed over time / vary across cultures e.g. food preservation methods</td>
<td>discover how and why local and global issues, including sustainability, are important</td>
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<td>describe how the use of science and technology has changed the way people live</td>
<td>identify system relationships when investigating local or global issues, including sustainability, and consider some of the reasons that different people make their decisions e.g. construct a Futures Wheel to consider the impact of a new development</td>
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<td>consider and respond to ethical and social issues in science-related contexts relevant to them, showing an awareness of several different perspectives that exist</td>
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**Scientific inquiry**

- formulate, clarify and refine questions and predictions suitable for testing, including refocusing ill-defined questions as necessary; and plan and conduct investigations demonstrating that they understand the requirements of fair testing – undertake systematic observation and data collection, taking steps to minimise error, and explaining the purpose of a control and repeat trials.

- offer explanations for patterns in their data and draw conclusions from that data.

- make general suggestions for improving investigations, after considering their own and their peers’ findings, reviewing their understandings in light of new information.

- consider anomalies in observations or measurements and try to explain them.

**Scientific communication**

- independently select information sources that will provide the required background to their science investigations.

- present scientific ideas and understandings in a variety of ways using appropriate representations (e.g. graphs, models, spreadsheets) and reflect on the effectiveness of their presentation in terms of clarity and ease of analysis.

- communicate the results of their science investigations, showing an increasing use of relevant terminology, and beginning to represent data in more sophisticated ways, including line graphs, micrographs, diagrams, chemical symbols, circuit diagrams.

- describe some of the issues that need to be considered in using renewable and non-renewable energy systems e.g. cost of production, transportation, environmental impacts.

**Energy and force**

- investigate the effects of forces supporting or opposing each other e.g. floating and sinking, simple machines, speeding up and slowing down.

- explore how forms of energy differ in the way they can be transferred or stored e.g. electric circuits, conductive heating, gravitational energy, work-energy principle.

- compare how different renewable and non-renewable energy sources and systems are used.

- investigate some ways that properties of objects affect the forces that act on them e.g. Which type of bridge is strongest? How do you need to hold your body for different dives or gymnastic moves?

- investigate some of the ways in which energy is transferred between objects and transformed from one form to another e.g. gravitational to mechanical, chemical to electrical, thermal to light / heat / sound.

- describe how systems have been developed to obtain, transfer and use energy for particular purposes, and how these have changed over time e.g. development of an electricity grid.

- investigate and explain how the forces act important in a particular situation e.g. car design, mechanics, space.

- investigate and discuss the energy transfers and transformations that occur in some particular situations e.g. car crashes / collisions, roller coasters.

**Matter**

- investigate how the properties of materials can vary according to the proportions of the substances they are composed of, and how this may alter their suitability for a specific use e.g. strengths of mud bricks, rusting of iron alloys, bubble solution.

- investigate and describe the characteristic chemical and physical properties of some important types of substances e.g. acids and bases and begin to use the language of chemistry e.g. symbol, formula, atom, molecule.

- consider some of the chemical processes and chemical changes that people use are used in real life situations e.g. evaporation, detonating, sieving using may have different time scales.

- observe and describe the ways that some important types of substances react and / or change in everyday situations e.g. acids, alkalis and bases.

- consider how some important types of substances e.g. metals, acids and bases are used in the home and community and any environmental impact their use may have.

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**Living things**

- identify characteristics of plant and animal cells, including recognising the cell as the basic unit of all living things.

- investigate and describe some structural, physiological and / or behavioural adaptations that ensure the survival of living things in their environment e.g. the organ systems that animals use to locate, catch, eat, digest, transport and use food, and the body systems that animals use to prevent and treat disease.

- understand that different replication mechanisms have different advantages for the survival of their species e.g. mammals nurture their young, bunnies are born naked.

- consider some of the chemical processes and chemical changes that people use are used in real life situations e.g. evaporation, detonating, sieving using may have different time scales.

- observe and describe the ways that some important types of substances react and / or change in everyday situations e.g. acids, alkalis and bases.

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**Earth and space**

- model the orbits of the Earth, Moon, Sun in relation to each other and explore the effects observable from Earth e.g. model eclipses, seasons.

- understand that gravity is the force that keeps the objects of the solar system in their orbits, and that gravitational attraction exists between all objects in the universe.

- use geological evidence and processes that occur on Earth to interpret some ways in which the Earth has changed since its formation, including through different geological periods.

- investigate which of Earth’s resources that they use are reusable or renewable and which are not.

- describe some ways in which the properties of Earth’s resources affect how organisms use them e.g. hardness of rocks, salinity of water, conductivity of metals.

- examine the long-term effects of human activities on the Earth’s environment, including how human behaviour can lead to deleterious effects e.g. pollution, loss of biodiversity.

- examine some of the reasons that different people make their decisions e.g. construct a Futures Wheel to consider the impact of a new development.

- consider some of the system relationships identified when investigating local or global issues, including sustainability.

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- consider some of the system relationships identified when investigating local or global issues, including sustainability.
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<th>Stage fourteen</th>
<th>Stage fifteen</th>
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<td><strong>Science as a human endeavour</strong></td>
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<td>consider and discuss instances in which progress in science is reflected by and influences societal issues and priorities e.g. water purification, alternative energy sources, space exploration</td>
<td>apply relevant scientific understandings to make responsible, ethical and informed decisions about issues, including applications of science and implications of research and sustainability e.g. salinity, nuclear energy</td>
<td>critically analyse how interacting systems and competing interests impact on local and global issues, including sustainability e.g. how the implications for political, social, environmental and economic systems of a proposed new development</td>
<td>clearly justify their own thinking and opinions in relation to applications of science and implications of research and sustainability</td>
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<td>design investigations which will collect data to confirm or disprove their hypotheses, including conducting controlled investigations, and working with more complex data e.g. collect multiple data sets</td>
<td>design and conduct investigations that consider more than one aspect of a problem, collecting information from multiple sources in a discerning manner e.g. experimental data, consult expert, survey, library research</td>
<td>critically analyse the implications that their findings have for society</td>
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<td><strong>Scientific communication</strong></td>
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<td>use accepted scientific formats, conventions, representations, terminology and understandings appropriately and in context to present information and develop ideas and opinions</td>
<td>present the results of their science investigations in an appropriate format and using explanations and evidence that supports their thinking, and making explicit links to relevant science concepts</td>
<td>collect scientific data and information with precision and present a variety of graphs, tables, and other representations from popular science (journals, hands on investigations)</td>
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<td><strong>Matter</strong></td>
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<tr>
<td>investigate the effect of several forces on the motion and energy of an object</td>
<td>use Newton’s Laws to explain the behaviour of a variety of objects</td>
<td>work with established scientific laws and theories to predict the behaviour of objects (e.g. equations of motion) including quantitative calculations</td>
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<td>define and use terms associated with chemical changes e.g. change, reaction, energy</td>
<td>understand that there is a variety of arguments for and against the production and use of particular substances</td>
<td>critically analyse the implications of how interacting systems and competing interests impact on local and global issues, including sustainability e.g. how the implications for political, social, environmental and economic systems of a proposed new development</td>
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<td><strong>Energy and force</strong></td>
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<td>express that when energy is transferred and transferred it is also conserved</td>
<td>show an understanding of relevant scientific concepts when describing energy transfers and transformations e.g. kinetic energy, potential energy, electromagnetic spectrum, heat loss</td>
<td>design and conduct ethical investigations that mitigate for the effects of less easily controlled variables (e.g. making measurements on human subjects) or call for imaginative, creative approaches, working with precision and rigor</td>
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<td><strong>Living things</strong></td>
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<td>consider and discuss some of the possible human and environmental impacts of industrial processes e.g. pollution, energy consumption</td>
<td>research the functions and use of selected groups of chemicals, describe the effect of these on people and the environment and consider possible substitutes e.g. fluoride, CFCs, agricultural chemicals, petrochemicals, asbestos</td>
<td>present convincing, well-reasoned analyses, which are persuasive and supported by appropriately processed data and information, and relevant references from a variety of sources, selecting formats that are appropriate to their data and nominated audiences</td>
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<td>explore the consequences of changes to the atmosphere (e.g. global warming, hole in the ozone layer) resulting from natural and human activities</td>
<td>determine the general causes and characteristics of major events in the Earth’s past e.g. plate tectonics, CO2, changes, species disappearance, early humans</td>
<td>critically analyse the implications that their findings have for society</td>
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<td><strong>Science by standard – Science Standard five</strong></td>
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<td>use scientific language, concepts and models, including SI units, chemical symbols, formulae and equations, appropriately</td>
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<td>use the particle model to explain the properties of materials and the changes they undergo</td>
<td>understand and explain that familiar chemical substances can be grouped into families that have characteristic chemical properties e.g. acids, metals, hydrocarbons</td>
<td>use scientific language, concepts and models, including SI units, chemical symbols, formulae and equations, appropriately</td>
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<td>explore how complex organisms depend on interacting body systems to meet their needs e.g. relationship between the circulatory and respiratory system</td>
<td>conduct investigations which will collect data to confirm or disprove their hypotheses, including conducting controlled investigations, and working with more complex data e.g. collect multiple data sets</td>
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<td>describe ways in which patterns of activity that have, or are likely to, occur on Earth and in space may impact on living things e.g. solar flares, volcanic islands, break up of Glaciers / Pangea Pangaea</td>
<td>investigate how climate change and the effects of human activities may impact on life e.g. acidification of lakes, sea level changes, extinction of animal species</td>
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<td>use simple patterns of inheritance that operate in simple organisms and apply the likelihood that certain combinations will occur</td>
<td>research explore the consequences of changes to the atmosphere (e.g. global warming, hole in the ozone layer) resulting from natural and human activities</td>
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<td>investigate and explain the factors that affect a particular life process e.g. enzymes, hormones, physical factors in the environment</td>
<td>investigate and explain how and why functioning and behaviour of living things changes in response to variations in internal and external conditions e.g. Alzheimer’s disease, Tasmanian devil facial tumour disease, HPV processes</td>
<td>critically analyse the implications that their findings have for society</td>
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