

## Science

In Science, standards for assessing and reporting on student achievement are introduced at Level 3. The learning focus statements for Levels 1 and 2 provide advice about learning experiences that will assist students to work towards the achievement of the standards at Level 3.

### Science – Progressing towards Level 3

#### Progression Point 2.25

*At 2.25, the work of a student progressing towards the standard at Level 3 demonstrates, for example:*

#### Science knowledge and understanding

- awareness of similarities and differences between materials in a group
- awareness of the living (biotic) and non-living (abiotic) components of the environment
- knowledge of everyday changes related to matter, space, energy and time; for example, the melting of ice to form water, storm damage, personal use of resources, use of magnets to open and close doors, use of pushes and pulls to change the shape of objects

#### Science at work

- recording of observations made during teacher-directed experiments involving measurement and the collection and recording of data
- recognition of simple patterns evident in collected data

#### Progression Point 2.5

*At 2.5, the work of a student progressing towards the standard at Level 3 demonstrates, for example:*

#### Science knowledge and understanding

- sorting of materials using basic criteria such as size, shape, colour and weight, and awareness that different criteria will result in different groupings
- knowledge of interactions that are observed occurring between living (biotic) and non-living (abiotic) components of the environment
- knowledge of how change related to matter, space, energy and time may be of benefit to society; for example, the use of heating and cooling in cooking, use of brakes in bicycles, personal responsibility in litter reduction, use of electromagnets, use of pushes and pulls to make objects move and stop

#### Science at work

- recording of observations made over time, subsequent predictions, and their testing in teacher-guided experiments

#### Progression Point 2.75

*At 2.75, the work of a student progressing towards the standard at Level 3 demonstrates, for example:*

#### Science knowledge and understanding

- classification of a range of materials as solids, liquids and gases, with reference to the observable properties of the materials
- understanding of events which may affect the sustainability of interactions occurring between living (biotic) and non-living (abiotic) components of the environment
- understanding of how change related to matter, space, energy and time may both benefit and harm society; for example, forest destruction and regeneration in bushfires, the risks and benefits of space travel, personal and community action in recycling programs, the effect of magnets on navigation, forces at work in cars, buses and trains

#### Science at work

- generation of questions about situations and phenomena which lead to collaborative planning, designing, conducting and reporting on experiments

**Progression Point 2.25**

*At 2.25, the work of a student progressing towards the standard at Level 3 demonstrates, for example:*

- awareness of safety procedures undertaken during experiments
- awareness of science activities occurring in the local community

**Progression Point 2.5**

*At 2.5, the work of a student progressing towards the standard at Level 3 demonstrates, for example:*

- reporting of observations and experiments, using science-specific language to record what went well and where difficulties were encountered
- recognition of trends evident in collected data
- use of specific safety procedures during experiments
- knowledge of the science involved in a social issue or problem

**Progression Point 2.75**

*At 2.75, the work of a student progressing towards the standard at Level 3 demonstrates, for example:*

- reporting of experiments, using science-specific language to record variables and characteristics of a fair test
- understanding of patterns and related trends evident in collected data
- understanding and recording of required safety procedures during experiments
- understanding of how the work of a particular scientist has benefited society

**Science – Level 3****Science knowledge and understanding**

At Level 3, students classify a range of materials such as solids, liquids and gases according to observable properties, and demonstrate understanding that this system of classification of substances is sometimes problematic. Students describe examples of reversible and non-reversible changes in substances.

Students identify the actions of forces in everyday situations. They use the words *push* and *pull* in discussing how things can be moved and stopped. They identify forms of energy and energy transformations in the everyday world. They use appropriate scientific vocabulary to describe and explain their observations and investigations.

Students identify and describe the structural features of living things, including plants and animals. They identify how these features operate together to form systems which support living things to survive in their environments. They distinguish between biotic and abiotic factors in their environment and describe interactions that occur between them. They describe natural physical and biological conditions, and human influences in the environment, which affect the survival of living things. They describe the relationship between day and night and the rotation of the Earth. Students explain how features of the landscape are altered by processes of weathering and erosion.

**Science at work**

At Level 3, students plan, design, conduct and report collaboratively on experiments related to their questions about living and non-living things and events. They select and use simple measuring equipment, use a range of appropriate methods to record observations, and comment on trends. They describe the concept of a fair test and identify the variables associated with an experiment. They develop fair tests to make comparisons and explain how they have controlled experimental variables.

Students describe safety requirements and procedures associated with experiments. They explain how scientific knowledge is used, or could be used, to solve a social issue or problem. They describe aspects of the work of scientists and how this has contributed to science knowledge.

**Science – Progressing towards Level 4**
**Progression Point 3.25**

*At 3.25, the work of a student progressing towards the standard at Level 4 demonstrates, for example:*

**Science knowledge and understanding**

- awareness of the characteristics and effects of change in chemical, physical, biological, earth and/or space science contexts; for example, dissolving bicarbonate of soda in vinegar, the effect of gravity on objects on Earth, growing plants in a greenhouse, use of Earth resources
- awareness of the connections between concepts related to matter, space, energy and/or time
- knowledge of the components of systems; for example, organs of the digestive system, layers within and surrounding the Earth, organisms in a food chain, lenses in a periscope

**Progression Point 3.5**

*At 3.5, the work of a student progressing towards the standard at Level 4 demonstrates, for example:*

**Science knowledge and understanding**

- comparison of the effects of change in chemical, physical, biological, earth and/or space science contexts; for example, the changing proportions of reacting materials on the nature of products, floating and sinking, forces that require contact such as in hitting a ball, mining operations
- knowledge of the connections between concepts related to matter, space, energy and/or time
- understanding of the relationships that exist between components of systems; for example, comparison of the role of the small and large intestine in digestion, solar/lunar eclipses, energy requirements of organisms in a food chain, double pump action of the heart

**Progression Point 3.75**

*At 3.75, the work of a student progressing towards the standard at Level 4 demonstrates, for example:*

**Science knowledge and understanding**

- knowledge of the consequences of change in terms of cause and effect applied in chemical, physical, biological, earth and/or space science contexts; for example, volcanic activity, effect of forces that do not always require contact (such as magnetism), global warming, rehabilitation of mine sites
- knowledge of the connections between concepts applied in an everyday context related to matter, space, energy and/or time
- understanding of how a system and/or its components adapt to change; for example, changes in the respiratory system in response to exercise, the effect of predators on a food chain, construction and modification of a solar barbecue for improved efficiency

**Science at work**

- planning and reporting of experiments, including statements of purpose, lists of materials and equipment, and labelled diagrams that explain procedures
- systematic collection of data
- application of safe and ethical procedures in performing experiments, including responsible handling of standard equipment and materials

**Science at work**

- design and reporting of experiments, including description of purpose, labelled diagrams and symbols that explain procedures, and justification for equipment used
- systematic collection of data to enable reasonable conclusions to be drawn

**Science at work**

- design and reporting of experiments, including statement of purpose, labelled diagrams and symbols that explain procedures, and justification for the type of data collected and equipment used
- systematic collection and analysis of data to identify relationships between variables and draw valid conclusions

**Progression Point 3.25**

*At 3.25, the work of a student progressing towards the standard at Level 4 demonstrates, for example:*

- construction of a simple model, following teacher directions, that illustrates a scientific concept
- knowledge of a sustainable practice undertaken at home
- knowledge of the social impact of science; for example, refrigeration, antibiotic development

**Progression Point 3.5**

*At 3.5, the work of a student progressing towards the standard at Level 4 demonstrates, for example:*

- application of safe and ethical procedures in performing experiments, including responsible handling of specialised equipment and materials
- with teacher guidance, design and construction of a simple model, that illustrates a scientific concept
- knowledge of sustainable practices that have been undertaken recently at home and in the local environment
- comparison of how people in a wide range of occupations and cultures use science in their work and leisure

**Progression Point 3.75**

*At 3.75, the work of a student progressing towards the standard at Level 4 demonstrates, for example:*

- application of safe and ethical procedures, including risk management plans for handling of equipment and materials
- design and construction of a simple model, including annotations, that illustrates understanding of a scientific concept
- knowledge of sustainable practices which could be undertaken in the future at home and in the local environment
- understanding of how the work of a scientist may have both positive and negative outcomes for society

## Science – Level 4

### Science knowledge and understanding

At Level 4, students explain change in terms of cause and effect. They identify the characteristics of physical and chemical changes. They describe how substances change during reactions. They identify and compare the properties of the new or changed material/s with those of the original material/s. Students explain the role of chemical change in the production of new materials. They qualitatively describe changes in motion in terms of the forces present.

Students apply the terms *relationships*, *models* and *systems* appropriately as ways of representing complex structures. They identify and explain the connections between systems in the human body and their various functions. They identify and explain the relationships that exist within and between food chains in the environment. Students use everyday examples to illustrate the transforming and transferring of energy. They explain how the Earth and the Moon operate as a simple system within the larger solar system. They describe the composition of layers within the Earth. They explain the function of the layers of the Earth's atmosphere.

### Science at work

At Level 4, students analyse a range of science-related local issues and describe the relevance of science to their own and other people's lives. They explain how sustainable practices have been developed and/or are applied in their local environment. They describe the contributions Australian scientists have made to improve and/or change science knowledge.

Students design their own simple experiments to collect data and draw conclusions. They describe the purpose of experiments they undertake, including a statement of ethical considerations, and relate this purpose to the nature of the data that is collected. They design and build simple models and write an account of the science that is central to explanation of the model. They use diagrams and symbols to explain procedures used when reporting on their investigations.

Students approach data collection systematically, and analyse data qualitatively in terms of errors of measurement. They use a range of simple measuring instruments and materials, and demonstrate understanding of their personal responsibility in using them. They identify and describe safety requirements and procedures associated with experiments and the use of standard equipment. Students use the terms *relationships* and *cause and effect* when discussing and drawing conclusions from the data they collect.

**Science – Progressing towards Level 5**
**Progression Point 4.25**

*At 4.25, the work of a student progressing towards the standard at Level 5 demonstrates, for example:*

**Science knowledge and understanding**

- awareness of change over time in scientific ideas within chemical, physical, biological, earth and/or space science contexts
- knowledge of the function/s of the components of systems; for example, trophic levels in ecosystems, simple machines, series and parallel circuits, cellular organelles
- awareness of how models are used to explain scientific phenomena and processes related to matter, space, energy and/or time; for example, the use of the particle model of matter to explain the behaviour of materials, the development of a geological time scale, the use of prototypes to test engine performance

**Science at work**

- planning and reporting of experimental investigations involving measurement, including justification of procedures and equipment used
- knowledge and application of basic safety procedures required for laboratory and field investigations

**Progression Point 4.5**

*At 4.5, the work of a student progressing towards the standard at Level 5 demonstrates, for example:*

**Science knowledge and understanding**

- knowledge of factors which have impacted on the development of scientific ideas over time within chemical, physical, biological, earth and/or space science contexts
- knowledge of the relationships between components of systems, including understanding of changes over time; for example, the impact of extinction on ecosystem populations, gear systems in regulating force and motion, electron flow comparisons in series and parallel circuits, rusting of iron alloys, the effect of cancer cells on a human being
- use and limitations of models and laws of science to explain scientific phenomena and processes related to matter, space, energy, and/or time; for example, limitations of the particle model when considering the freezing of water, use and limitations of the Law of Conservation of Mass in predicting quantities of products in chemical reactions

**Science at work**

- design and reporting of experimental investigations and simulations involving measurement, including analysis of accuracy of results
- selection and application of appropriate safety procedures required for laboratory and field investigations

**Progression Point 4.75**

*At 4.75, the work of a student progressing towards the standard at Level 5 demonstrates, for example:*

**Science knowledge and understanding**

- comparison of alternative viewpoints about existing scientific ideas within chemical, physical, biological, earth and/or space science contexts
- analysis of the impact of factors which cause change in living and non-living systems over short and long periods of time; for example, urbanisation impacts on ecosystems, the water cycle, rock formation, disease vectors, use of catalysts in chemical reactions, use of renewable and non-renewable energy resources
- application of models and laws of science to familiar and unfamiliar situations related to matter, space, energy and/or time; for example, modelling of the geological layers of the Earth to predict tsunamis and earthquakes, use of the Law of Conservation of Energy in making predictions about sustainable use of natural resources

**Science at work**

- inclusion of designs and reports of experimental investigations and simulations involving measurement, including identification of procedures and equipment which would improve accuracy of results

**Progression Point 4.25**

*At 4.25, the work of a student progressing towards the standard at Level 5 demonstrates, for example:*

- systematic and accurate collection and recording of experimental data
- group construction of a model of a device, and identification of their own role in its construction
- understanding of factors which may affect attitudes to a scientific idea or issue of interest

**Progression Point 4.5**

*At 4.5, the work of a student progressing towards the standard at Level 5 demonstrates, for example:*

- accurate analysis and interpretation of collected and recorded experimental data, consistent with aims
- evaluation of their own role in the making of a group-constructed operating model of a device, and comment on its effectiveness
- understanding of different perspectives and attitudes involved in a scientific idea or issue of interest, presented through models, images or diagrams

**Progression Point 4.75**

*At 4.75, the work of a student progressing towards the standard at Level 5 demonstrates, for example:*

- selection and application of safety procedures related to the use of technical equipment and chemicals in laboratory and field investigations, including risk management
- comment on the validity of conclusions drawn from experimental data
- analysis of group effectiveness in the construction annotated operating model of a device, with annotations and suggestions for device refinement
- balanced argument in addressing a scientific idea or issue of interest to an audience



### Science – Level 5

#### Science knowledge and understanding

At Level 5, students use the particle model to explain structure and properties of matter, chemical reactions and factors that influence rate. They explain the structure and function of cells and how different cells work together.

Students explain the relationships, past and present, in living and non-living systems, in particular ecosystems, and human impact on these systems. They analyse what is needed for living things to survive, thrive or adapt, now and in the future. They explain how the observed characteristics of living things are used to establish a classification system.

Students use everyday examples of machines, tools and appliances to show how the thermodynamic model describes energy and change, and force and motion. They use time scales to explain the changing Earth and its place in space. Students distinguish ideas about the Universe that have a scientific basis from those that do not. They use physical and theoretical models to investigate geological processes.

#### Science at work

At Level 5, students demonstrate safe, technical uses of a range of instruments and chemicals, and of procedures for preparation and separation. They design investigations that include measurement, using standard laboratory instruments and equipment and methods to improve accuracy in measurement. They make systematic observations and interpret recorded data appropriately, according to the aims of the study.

Students justify their choice of instruments and the accuracy of their measurements, commenting on the reliability of the procedures, the measurements used, and the conclusions drawn against the prediction or hypothesis investigated. They use appropriate diagrams and symbols when reporting on their investigations.

Students make and use models and images from computer software to interpret and explain observations. In field work, they demonstrate use of basic sampling procedures and represent relationships in ecosystems graphically.

Students use simulations to predict the effect of changes in an ecosystem. They work effectively in a group to use science ideas to make operating models of devices. Students identify, analyse and ask their own questions in relation to scientific ideas or issues of interest.

**Science – Progressing towards Level 6**
**Progression Point 5.25**

*At 5.25, the work of a student progressing towards the standard at Level 6 demonstrates, for example:*

**Science knowledge and understanding**

- knowledge, including understanding of symbols, of the energy involved in everyday changes in chemical, physical, biological, earth and/or space science contexts; for example, the operation of diodes and capacitors in electronic circuits, reactions which occur in vehicle air bags
- awareness of links across related areas of science in developing a capacity to solve science-related problems; for example, description of the biology, chemistry and physics concepts involved in synchrotron science
- awareness of the development over time of a scientific concept related to matter, space, energy and/or time, including evidence and technology used to refine understanding of the concept; for example, theories of atomic structure

**Progression Point 5.5**

*At 5.5, the work of a student progressing towards the standard at Level 6 demonstrates, for example:*

**Science knowledge and understanding**

- qualitative knowledge, including understanding of symbols and equations, of the way energy may be responsible for change in chemical, physical, biological, earth and/or space science contexts; for example, use of vehicle air bags and restraints in controlling motion, the effects of forces
- knowledge of the qualitative application of concepts across related areas of science to manage or solve science-related problems; for example, brain-imaging techniques used in neuroscience involving psychology, biology and physics concepts
- presentation of alternative theories about a scientific concept related to matter, space, energy and/or time, and the evidence used to support each theory; for example, particle and wave models of light, origins of the Universe

**Progression Point 5.75**

*At 5.75, the work of a student progressing towards the standard at Level 6 demonstrates, for example:*

**Science knowledge and understanding**

- quantitative knowledge, including understanding of symbols and equations, of the way energy may be responsible for change in chemical, physical, biological, earth and/or space science contexts; for example, calculations comparing current and voltage in different circuits, calculation of velocity and acceleration in analysis of road safety data, determination of percentage recovery of copper through recycling
- quantitative application of concepts across related areas of science to manage or solve science-related problems; for example, resource monitoring and management involving chemistry and earth science concepts
- illustration of a scientific concept related to matter, space, energy and/or time, which has been developed through scientific collaboration, including presentation and comparison of the knowledge and technology which contributed to the development of the concept; for example, the structure of DNA, Human Genome Project

**Progression Point 5.25**

*At 5.25, the work of a student progressing towards the standard at Level 6 demonstrates, for example:*

**Science at work**

- development of an experimental design which includes a given hypothesis, and the justified use of procedures, equipment, electronic components and instruments, as appropriate
- application of safety procedures in carrying out investigations, using provided Material Safety Data Sheets (MSDS)
- reporting which includes identification of sources of experimental errors and comments related to the supporting or disproving of hypotheses
- development and use of a model or visual aid to illustrate the development of scientific ideas over time; for example, the preservation of food
- awareness of different approaches to developing scientific knowledge or solving a particular scientific problem

**Progression Point 5.5**

*At 5.5, the work of a student progressing towards the standard at Level 6 demonstrates, for example:*

**Science at work**

- an experimental design which includes a hypothesis, and a consideration of the use of procedures, equipment, electronic components and instruments in obtaining reliable data
- selection and application of appropriate safety procedures to investigations, with reference to appropriate Material Safety Data Sheets (MSDS)
- reporting which includes use of symbols and balanced chemical equations to summarise chemical reactions, units of measurement, identification of the nature of experimental errors, and comments related to the supporting or disproving of hypotheses
- development and use of a working model or visual aid to illustrate differences between scientific concepts; for example, mechanism of neutralisation and precipitation reactions
- identification of 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

**Progression Point 5.75**

*At 5.75, the work of a student progressing towards the standard at Level 6 demonstrates, for example:*

**Science at work**

- an experimental design which includes a hypothesis, and the justified use of procedures, equipment, electronic components and instruments in obtaining reliable data
- application of safety procedures to investigations, including risk assessment and use of Material Safety Data Sheets (MSDS) information
- reporting which includes use of atomic symbols and balanced chemical equations to summarise reaction changes, comments related to the supporting or disproving of hypotheses and predictions made, and evaluation of experimental design and methodology
- development and use of a working model or visual aid to illustrate a scientific process; for example, the role of DNA in genetic inheritance
- comparison of different approaches to solving and communicating scientific problems of broad community concern, including a description of the impact of mass media communications

**Science – Level 6****Science knowledge and understanding**

At Level 6, students explain the behaviour and properties of materials in terms of their constituent particles and the forces holding them together. They explain how similarities in the chemical behaviour of elements and their compounds and their atomic structures are represented in the way the periodic table has been constructed. They use the periodic table to write electronic configurations for a range of elements representative of the major groups and periods in the periodic table. They use atomic symbols and balanced chemical equations to summarise chemical reactions, including neutralisation, precipitation and combustion. They identify and classify the sources of wastes generated, and describe their management, within the community and in industry. They use a specific example to explain the sustainable management of a resource.

Students explain change in terms of energy in a range of biological, chemical and physical contexts. They demonstrate the link between natural selection and evolution. They explain the role of DNA and genes in cell division and genetic inheritance. They explain how the coordination and regulatory functions within plants and animals assist them to survive in their environments. They explain how the action of micro-organisms can be both beneficial and detrimental to society. Students apply concepts of geological time to elaborate their explanations of both natural selection and evolution, and the origin and evolution of the Universe. They give both qualitative and quantitative explanations of the relationships between force, mass and movement.

**Science at work**

At Level 6, students describe the science base of science-related occupations in their local community. They use the relevant science concepts and relationships as one dimension of debating contentious and/or ethically based science-related issues of broad community concern. They demonstrate an awareness of the ways in which scientific vocabulary is used incorrectly in the mass media, distinguishing between the intended meaning of such terms and their meaning in non-scientific contexts. They provide two examples of the work of scientists that demonstrate different approaches to developing scientific knowledge or solving a scientific problem.

Students formulate their own hypotheses and plan and conduct investigations in order to prove or disprove them. They use chemicals (including biomaterials), equipment, electronic components and instruments responsibly and safely. They select appropriate equipment and measurement procedures that will ensure a high degree of reliability in data collected and enable valid conclusions to be drawn. They construct working models and visual aids that demonstrate scientific ideas. They present experimental results using appropriate data presentation formats, and comment on the nature of experimental errors. They use Material Safety Data Sheets (MSDS) and risk assessment to evaluate the safety of their investigations. They evaluate the appropriateness of the experimental design and methodology used to investigate their predictions.

**Science – Progressing beyond Level 6**
**Progression Point 6.25**

*At 6.25, the work of a student progressing beyond the standard at Level 6 demonstrates, for example:*

**Science knowledge and understanding**

- quantitative knowledge of scientific phenomena, supported by second-hand data, including the relevant links between matter, space, energy and/or time
- knowledge of how developing technologies have extended the boundaries of scientific knowledge and endeavour

**Science at work**

- participation in investigations that test qualitative predictions related to scientific phenomena
- design, testing and development of a new or modified product/invention that attempts to provide a response to a science-related problem
- use of experimental and theoretical evidence to persuade an audience of the validity of alternative solutions in response to a science issue

**Progression Point 6.5**

*At 6.5, the work of a student progressing beyond the standard at Level 6 demonstrates, for example:*

**Science knowledge and understanding**

- quantitative understanding of scientific phenomena, supported by first-hand data, including details of the relevant links between matter, space, energy and/or time
- understanding of how emerging areas of science have grown from accumulated knowledge and experiences in science

**Science at work**

- participation in investigations that test quantitative predictions related to scientific phenomena
- evaluation of a new or modified product/invention that attempts to provide a response to a science-related problem, including suggestions for refinement
- use of experimental and theoretical evidence to justify proposals for responses to a science-related problem or issue

**Progression Point 6.75**

*At 6.75, the work of a student progressing beyond the standard at Level 6 demonstrates, for example:*

**Science knowledge and understanding**

- application of the quantitative relationships between matter, space, energy and/or time to theoretical and/or practical situations and/or problems
- exploration, based on evidence, models and theories currently available, of how science may develop in the future and where new knowledge may emerge over time

**Science at work**

- quantitative modelling of scientific phenomena to test predictions based on collected qualitative and quantitative data
- following feedback, refinement of a new or modified product/invention that attempts to provide a solution to a science-related problem
- evaluation of different perspectives associated with a science issue, including first-hand experimental evidence, and presentation of alternative solutions and a justified personal stance on the issue