

## **Stages 4-5 Science Syllabus (organised for cut and paste programming)**

File: 45syl4cp.doc = 4-5 syllabus for cut and paste

This file is a typed version of syllabus pages 20 – 37, including *objectives*, *outcomes*, *core* and *optional content*. The optional content for the *knowledge and understanding domain* has been listed after the stage 5 core content statements for each outcome. Each core content statement has its full reference number included so that the reference is not lost in programming.

*Suggestion: Keep this file as a master copy – copy it for each unit you are writing.*

### **PFA's**

**Objective: A student will gain knowledge and understanding of the history of science**

4.1 identifies historical examples of how scientific knowledge has changed people's understanding of the world.

5.1 explains how social factors influence the development and acceptance of scientific ideas.

4/5.1a identify some of the scientific ideas that different cultures have contributed to science throughout history

4/5.1b describe, using examples, ideas developed by different cultures to explain the world around them

4/5.1c describe some models and theories that have been considered in science and then modified or rejected as a result of available evidence

4/5.1d discuss examples where societal, religious or ethical values have had an impact on scientific developments

4/5.1e describe historical cases where developments in science have led to the development of new technologies

4/5.1f describe historical cases where developments or improvements in technology have transformed science.

**Objective: A student will gain knowledge and understanding of the nature and practice of science**

4.2 uses examples to illustrate how models, theories and laws contribute to an understanding of phenomena.

5.2 describes the processes that are applied to test and validate models, theories and laws.

4/5.2a evaluate the importance of using creativity, curiosity, objectivity and logical reasoning in describing phenomena in their surroundings, stimulating investigations about phenomena and devising and testing hypotheses

4/5.2b distinguish between scientific argument and economic or legal argument

4/5.2c apply scientific processes to test the validity of ideas and theories

4/5.2d describe how an idea can gain acceptance in the scientific community as either theory or law

4/5.2e use examples which show that scientists isolate a set of observations, identify trends and patterns and construct hypotheses or models to explain these

4/5.2f give examples that demonstrate the benefits and limitations of using models

4/5.2g identify that the nature of observations made depends upon the understanding that the observer brings to the situation.

**Objective: A student will gain knowledge and understanding of applications and uses of science**

4.3 identifies areas of everyday life that have been affected by scientific developments.

### 5.3 evaluates the impact of applications of science on society and the environment.

- 4/5.3a identify and describe examples of scientific concepts and principles that have been used in technological developments
- 4/5.3b discuss, using examples, the positive and negative impacts of applications of recent developments in science
- 4/5.3c identify and describe examples where technological advances have impacted on science
- 4/5.3d give reasons why society should support scientific research.

**Objective: A student will gain knowledge and understanding of the implications of science for society and the environment**

### 4.4 identifies choices made by people with regard to scientific developments

#### 5.4 discuss evidence supporting different viewpoints.

- 4/5.4a discuss viewpoints about some issues with a major scientific component
- 4/5.4b give examples to show that different societal groups may use or weight criteria differently to make a decision about an issue involving a major scientific component
- 4/5.4c identify choices that need to be or have been made when considering whether to use particular scientific advances
- 4/5.4d analyse reasons why different cultures or groups within a society may have different views in relation to scientific issues
- 4/5.4e discuss the place of ethical considerations in scientific practice and in applications of science.

**Objective: A student will gain knowledge and understanding of current issues, research and developments**

### 4.5 describe areas of current scientific research.

#### 5.5 analyses how current research might affect people's lives.

- 4/5.5a describe some recent scientific contributions made by male and female scientists, including Australians, and discuss the effect of their contributions
- 4/5.5b evaluate the potential impact of some issues raised in the mass media that require some scientific understanding
- 4/5.5c identify scientific skills that can be useful in a broad range of careers
- 4/5.5d identify possible career paths in science.

## DOMAIN

**Objective: A student will gain knowledge and understanding of models, theories and laws and structures and systems.**

### 4.6 identifies and describes energy changes and the action of forces in common situations.

#### law of conservation of energy

- 4.6.1a identify situations or phenomena in which different forms of energy are evident
- 4.6.1b use models to describe different forms of energy
- 4.6.1c identify objects that possess energy because of their motion (kinetic) or because of other properties (potential)
- 4.6.1d qualitatively account for the total energy involved in energy transfers and transformations.

#### Newton's Laws-forces

- 4.6.2a identify changes that take place when particular forces are acting
- 4.6.2b use the term 'field' to describe forces acting at a distance.

#### electrical energy

- 4.6.3a associate electricity with energy transfer in a simple circuit
- 4.6.3b construct and draw circuits to show transfer of energy

**sound energy**

4.6.4a describe sound as a form of energy requiring a medium for propagation.

**light energy**

4.6.5a describe light as a form of energy not requiring a medium for propagation.

**heat energy**

4.6.6a identify processes of heat transfer by conduction, convection and radiation

4.6.6b describe how the transfer of heat can be controlled.

**frictional force**

4.6.7a describe friction as a contact force which opposes motion

4.6.7b identify everyday situations where friction acts.

**electrostatic force**

4.6.8a describe ways in which objects acquire an electrostatic charge

4.6.8b identify everyday situations where the effects of electrostatic forces can be observed

4.6.8c describe the behaviour of charges when they are brought close to each other.

**magnetic force**

4.6.9a describe the behaviour of magnetic poles when they are brought close to each other

4.6.9b identify everyday situations in which magnets, electromagnets and magnetic strips are used.

**gravitational force**

4.6.10a identify that all objects exert a force of gravity on all other objects in the universe.

## 5.6 applies basic physical models, theories and laws to situations involving energy, force and motion.

**the wave model**

5.6.1a identify waves as carriers of energy

5.6.1b qualitatively describe features of waves including frequency, wavelength and speed

5.6.1c give examples of different types of radiation that make up the electromagnetic spectrum and identify some of their uses.

**Newton's Laws-motion**

5.6.2a describe quantitatively the relationship between force, mass and acceleration

5.6.2b explain qualitatively the relationship between distance, speed and time

5.6.2c relate qualitatively acceleration to a change in speed and/or direction as a result of a net force

5.6.2d analyse qualitatively common situations involving motion in terms of Newton's Laws.

**electrical energy**

5.6.3a design, construct and draw circuits containing a number of components

5.6.3b describe voltage, resistance and current using analogies.

5.6.3c describe quantitatively the relationship between voltage, resistance and current

5.6.3d compare advantages and disadvantages of series and parallel circuits

**light energy**

5.6.4a distinguish between the absorption, reflection, refraction and scattering of light and identify everyday situations where each occurs.

**nuclear energy**

5.6.5a identify that energy may be released from the nuclei of atoms

5.6.5b explain radioactivity in terms of release of particles and energy.

**gravitational force**

5.6.6a relate qualitatively the force of gravity between two objects to their masses and distance apart

5.6.6b distinguish between the terms 'mass' and 'weight'.

### **Optional content for stages 4 and 5 could provide students with opportunities to:**

**Law of conservation of energy**

- \* trace the development of our current ideas about the concept of energy
- \* trace the history of pendulum motion studies and its connection with timekeeping and setting standards of length
- \* distinguish between everyday and scientific meanings of work
- \* identify that when the amount of energy of a body changes, either work is done or heat energy is transferred.

**Newton's Laws: forces**

- \* describe characteristics of specific forces in terms of size and direction

- \* describe and use quantitatively the relationship between force, mass and acceleration
- \* apply Newton's Laws to space travel
- \* discuss the life, times and achievements of Newton.

#### **Wave models**

- \* discuss similarities and differences between transverse and longitudinal wave models
- \* relate the speed of light and sound to their frequency and wavelength
- \* compare different types of radiation making up the electromagnetic spectrum in terms of frequency, wavelength and energy
- \* design and describe ways of enabling or impeding energy transfer by waves
- \* describe quantitatively features of waves including frequency, wavelength. and speed using  $v=f$

#### **Newton's Laws: motion**

- \* explain the difference between speed and velocity
- \* describe the relationships between displacement, time, velocity and acceleration both qualitatively and quantitatively using equations of motion
- \* explain the relationship between velocity and direction of force acting to produce circular motion.

#### **Electrical energy**

- \* explain the relationship between voltage, resistance and current using Ohm's Law

#### **Light energy**

- \* describe how the structure of the eye allows vision

#### **Nuclear energy**

- \* discuss similarities and differences between nuclear fission and fusion.

### 4.7 describes observed properties of substances using scientific models and theories.

#### **the particle theory of matter**

- 4.7.1a identify that matter is made of particles that are continuously moving and interacting
- 4.7.1b describe expansion and contraction of materials in terms of a simple particle model
- 4.7.1c relate an increase or decrease in the amount of energy possessed by particles to changes in particle movement
- 4.7.1d describe diffusion in terms of the random movement of particles.

#### **properties of solids, liquids and gases**

- 4.7.2a relate properties of solids, liquids and gases to the particle theory of matter
- 4.7.2b identify when a physical change occurs by observing evaporation, condensation, boiling, melting and freezing
- 4.7.2c explain density using a simple particle model
- 4.7.2d relate increases or decreases in frequency of particle collisions to changes in pressure.

#### **change of state**

- 4.7.3a relate changes of state to the motion of particles as energy is removed or added
- 4.7.3b relate energy transfer and the particle model to melting and freezing point, condensation, evaporation and boiling.
- 4.7.4 elements to:
  - 4.7.4a classify elements as metals or non-metals according to their common characteristics
  - 4.7.4b identify internationally recognised symbols for common elements.

#### **mixtures**

- 4.7.5a identify some common mixtures
- 4.7.5b identify, using examples, the importance of water as a solvent
- 4.7.5c describe aqueous mixtures in terms of solute, solvent and solution
- 4.7.5d identify situations where the processes of filtration, sedimentation, sieving, distillation, chromatography, evaporation, condensation, crystallisation and magnetic attraction are appropriate to separate components of a mixture.

#### **compounds and reactions**

- 4.7.6a distinguish between elements and compounds
- 4.7.6b identify when a chemical, reaction is taking place by observing changes in temperature, the appearance of a new substance or the disappearance of an original substance
- 4.7.6c distinguish between compounds and mixtures.

5.7 relates properties of elements, compounds and mixtures to scientific models, theories and laws.

### atomic theory

- 5.7.1a describe features of and the location of protons, neutrons and electrons in the atom
- 5.7.1b distinguish between elements, using information about the numbers of protons, neutrons and electrons
- 5.7.1c identify properties of different substances that can be explained in terms of their subatomic structure
- 5.7.1d describe an appropriate model that has been developed to describe atomic structure.

### elements

- 5.7.2a identify the atom as the smallest unit of an element and distinguish between atoms and molecules
- 5.7.2b describe some relationships between elements using the Periodic Table

### compounds and reactions

- 5.7.3a identify that a new compound is formed by rearranging atoms rather than by creating matter
- 5.7.3b classify compounds into groups based on common chemical characteristics
- 5.7.3c construct word equations from observations and written descriptions of a range of chemical reactions
- 5.7.3d identify a range of common compounds using their common names and chemical formulae
- 5.7.3e qualitatively describe reactants and products in the following chemical reactions:
  - i) combustion
  - ii) corrosion
  - iii) precipitation
  - iv) acids on metals and carbonates
  - v) neutralisation
  - vi) decomposition
- 5.7.3f describe the role of indicators.

**Optional content for stages 4 and 5 could provide students with opportunities to:**

### Particle theory of matter

- \* identify that forces of cohesion, adhesion and repulsion may exist between particles
- \* discuss the general applicability of the particle theory to a wide range of physical quantities
- \* use simple examples of Physical and chemical changes to demonstrate that mass is conserved.

### Properties of solids, liquids and gases

- \* describe sublimation as a direct change of state from solid to gas and observe common examples
- \* give examples where different separation methods are employed to obtain useful substances

### Elements

- \* explain that an atom can combine with other atoms by gaining losing or sharing electrons
- \* sort metals into their order of activity

### Compounds and reactions

- \* use internationally recognised symbols to write the formulae for common compounds
- \* identify the characteristics that classify substances as either ionic or covalent compounds
- \* identify the characteristics of organic compounds
- \* identify common reactions involving organic compounds, including esterification and saponification
- \* identify the characteristics of acids and bases and salts
- \* balance a range of common chemical reactions

### Mixtures

- \* explain why crystallisation can be used as a method of purification or separation of substances
- \* relate physical and chemical properties of elements and compounds to the arrangement of their atoms

### Atomic theory

- \* trace the history of atomic theory
  - \* use models to describe the arrangement of electrons in the principal energy levels of common elements
  - \* describe the arrangement of electrons in the space around the nucleus
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## 4.8 describes features of living things.

### cell theory

- 4.8.1a identify that living things are made of cells
- 4.8.1b identify and describe the functions of:  
nucleus, cytoplasm, cell membrane, cell wall, chloroplast
- 4.8.1c identify that nutrients and oxygen move in and wastes move out of cells
- 4.8.1d distinguish between unicellular and multicellular organisms.

### classification

- 4.8.2a classify living things according to structural features and identify that they have patterns of similarities and differences
- 4.8.2b identify a range of plants and animals using simple keys
- 4.8.2c identify that some organisms produce their own food while others consume their 'food'.

### unicellular organisms

- 4.8.3a identify that most microorganisms have beneficial effects and some microorganisms have harmful effects on living things or the environment
- 4.8.3b explain that reproduction in unicellular organisms takes place by cell division.

### multicellular organisms

- 4.8.4a identify that there is a wide range of multicellular organisms, which includes flowering plants and humans
- 4.8.4b identify that tissues, organs and organ systems in multicellular organisms consist of different types of cells
- 4.8.4c explain why multicellular organisms require specialised organs and systems
- 4.8.4d identify the materials required by multicellular organisms for the processes of respiration and photosynthesis
- 4.8.4e describe the role of the root, stem and leaf in maintaining flowering plants as functioning organisms.

### humans

- 4.8.5a describe the role of the digestive, circulatory, excretory, skeletal and respiratory systems in maintaining humans as functioning organisms
- 4.8.5b describe the nutritional requirements for maintaining humans as functioning organisms.

## 5.8 relates the structure and function of living things to models, theories and laws.

### cell theory

- 4.8.5a explain that systems in multicellular organisms serve the needs of cells
- 4.8.5b identify the role of cell division in growth, repair and reproduction in multicellular organisms
- 4.8.5c identify that abnormal cell function may result in disease.

### the Watson-Crick model of DNA

- 5.8.2a explain the advantages of DNA replicating exactly
- 5.8.2b explain the advantages and disadvantages of DNA mutating
- 5.8.2c identify that information is transferred as DNA on chromosomes when cells reproduce themselves
- 5.8.2d identify that genes are part of DNA
- 5.8.2e identify the role of genes and environmental factors in determining the features of an organism.

### the theory of evolution and natural selection

- 5.8.3a discuss evidence that present-day organisms have developed from different organisms in the distant past
- 5.8.3b relate natural selection to the theory of evolution.

### humans

- 5.8.4a describe the role of, and interaction between, coordination systems in maintaining humans as functioning organisms
- 5.8.4b describe some responses of body systems to infectious and non-infectious diseases
- 5.8.4c relate the organs involved in human reproductive systems to their function.

### **Optional content for stages 4 and 5 could provide students with opportunities to:**

#### Cell theory

- \* identify those substances that are needed by living cells and explain why each is needed

- \* describe cell processes that transfer genetic information from generation to generation during cell reproduction
- \* identify the role of mitosis during the production of new cells for growth and replacement of damaged cells
- \* consider the role of osmosis in the movement of water in and out of the cell
- \* identify and describe the functions of mitochondria

#### **Classification**

- \* identify that living things can be divided into a number of major kingdoms
- \* discuss the concept of a species
- \* design simple keys to identify a range of living things.

#### **Multicellular organisms - humans**

- \* identify the separate components of the digestive, respiratory, excretory, circulatory, skeletal nervous and/or endocrine systems and describe the function of each
- \* consider the gaseous exchange systems of other species of animals
- \* describe the range of functions carried out by various endocrine (hormonal) glands in humans
- \* discuss the role of the endocrine system in the control of reproduction, including the control of the menstrual cycle
- \* discuss current health issues in Aboriginal communities, relating these to the physical and psychological impact on the wellbeing of Aboriginal peoples brought on by changes since the arrival of Europeans.

#### **Multicellular organisms - plants**

- \* identify the structure and function of the vascular tissues (xylem and phloem) in plants
- \* relate the location of the chloroplasts to their role in the process of photosynthesis.

#### **Watson-Crick model of DNA**

- \* identify the role of meiosis in producing specialised cells for reproduction
- \* explain why the same genetic information is not equally expressed in all cells
- \* explain the role of DNA in controlling cellular activity and producing proteins
- \* describe evidence to support the theory that genetic information is passed on from generation to generation.

#### **Theory of evolution by natural selection**

- \* examine Aboriginal Dreaming stories as descriptions of and reflections of megafauna of pre-ice age times
- \* discuss possible reasons for the evolution of Australia's unique flora and fauna
- \* research case studies of extinct species and species at risk of extinction
- \* describe the impact of mass extinction on species diversity.

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4.9 describes the dynamic structure of Earth and its relationship to other parts of our solar system and universe.

#### **the Newtonian model of the solar system**

- 4.9.1a describe qualitatively relative sizes, distances and movements of components of our solar system
- 4.9.1b describe relative movements of the planets, moons and sun
- 4.9.1c explain night and day in terms of Earth's rotation
- 4.9.1d explain the seasons in terms of the tilt of Earth's axis and its revolution around the sun.

#### **components of the universe**

- 4.9.2a describe some major features of the universe, including galaxies, stars, nebulae and solar systems
- 4.9.2b use appropriate scales to describe differences in sizes of, and distances between, structures making up the universe.

#### **the structure of Earth**

- 4.9.3a describe the inner structure of Earth in terms of core, mantle, crust, lithosphere and asthenosphere

#### **the atmosphere**

- 4.9.4a identify gases that comprise the greater percentage of air and explain the difference between atmosphere and space

4.9.4b describe the importance of atmospheric gases, including ozone and greenhouse gases, to life on Earth.

#### **the hydrosphere**

4.9.5a describe the water cycle in terms of the physical processes involved

4.9.5b describe the effect of the forces of the sun and moon on the hydrosphere.

#### **the lithosphere**

4.9.6a identify that minerals are basic building blocks of rocks

4.9.6b explain that the breaking down of rocks is related to physical and chemical changes

4.9.6c relate the formation of landforms to weathering, erosion and deposition

4.9.6d explain the formation of sedimentary rocks as compaction of sediment followed by chemical changes.

5.9 relates the development of the universe and the dynamic structure of Earth to models, theories and laws and the influence of time.

#### **the big bang theory**

5.9.1a discuss current scientific thinking about the origin of the universe

5.9.1b identify that some types of electromagnetic radiation are used to provide information about the universe

5.9.1c describe some of the difficulties in obtaining information about the universe.

#### **the theory of plate tectonics**

5.9.2a discuss evidence that suggests crustal plates move over time.

#### **components of the universe**

5.9.3a relate some major features of the universe to theories about the formation of the universe

5.9.3b describe some changes that are likely to take place during the life of a star.

#### **natural events**

5.9.4a identify that geological history can be interpreted from the formation, by sediments, of horizontal layers in which the oldest are at the base and the youngest at the top

5.9.4b describe conditions under which fossils form

5.9.4c relate the fossil record to the age of Earth and the time over which life has been evolving

5.9.4d relate movements of Earth's plates to convection currents in the asthenosphere and to gravitational forces

5.9.4e explain how earthquakes, volcanic activity and new landforms result from interactions at plate boundaries

5.9.4f explain some impacts of natural events including cyclones, volcanic eruptions and earthquakes on the atmosphere, hydrosphere, lithosphere and/or biosphere.

#### **Optional content for stages 4 and 5 could provide students with opportunities to:**

##### **Newtonian model of the solar system**

- \* *relate the model of the solar system to the observed sky*
- \* *examine information collected to assist in predicting events such as appearances of comets, eclipses and other solar system phenomena*
- \* *collate information gained from planetary research to support theories on the formation of the solar system*
- \* *compare and contrast the planetary geology found within the solar system*
- \* *research the historical development of the present model of the solar system, including the work of Copernicus, Galileo and Newton.*

##### **Components of the universe**

- \* *explain how different cultures have interpreted constellations*
- \* *relate colours of stars to their age, distance from Earth and size*
- \* *explain why quasars have provided evidence of a changing universe*
- \* *compare time scales used to describe features in the solar system, including orbits of moons and planets*
- \* *discuss the impact of Voyager probes and the Hubble Space Telescope on knowledge and understanding of the universe.*

##### **Theory of plate tectonics**

- \* *explain how information from seismic activity has helped to produce a model to describe Earth's structure*
- \* *discuss the contributions of scientists who provided models to explain processes affecting Earth's structure and behaviour.*

### **Big bang theory**

- \* *compare the big bang theory with other theories of the development of the universe*
- \* *consider interactions between various features of the universe and hypotheses on past and future development in the universe*
- \* *investigate the ways in which different societies have described changes in the universe observed over recorded time*
- \* *describe evidence used to support estimates of time in the universe.*

### **Atmosphere**

- \* *discuss some methods used to obtain information about changes in the atmosphere*
- \* *relate changes in atmospheric condition to weather phenomena and energy transfer processes*
- \* *describe the history and application of the idea of air pressure.*

### **Hydrosphere**

- \* *compare physical features of the oceanic waters at different depths and temperatures.*

### **Lithosphere**

- \* *describe how weathering and erosion have led to different soil types*
- \* *distinguish between sedimentary, igneous and metamorphic rocks and identify common examples of each*
- \* *identify relationships between heat energy, friction and pressure and relate these to the formation of metamorphic and igneous rocks.*

### **Natural events**

- \* *research evidence which supports the concept that Earth's surface and atmosphere have changed over the history of Earth*
- \* *describe major changes in the physical history of some of the major natural features of Earth and relate these to a time scale.*

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**Objective: A student will gain knowledge and understanding of interactions**

#### **4.10 identifies the factors affecting survival of organisms in an ecosystem**

##### **ecosystems**

- 4.10a describe some adaptations of living things to factors in their environment
- 4.10b describe how producers, consumers and decomposers in Australian ecosystems are related, using food chains and food webs
- 4.10c describe the roles of photosynthesis and respiration in ecosystems
- 4.10d discuss some effects of bushfires, drought and flood on Australian ecosystems.

#### **5.10 assesses human impacts on the interaction of biotic and abiotic features of the environment**

##### **ecosystems**

- 5.10a distinguish between biotic and abiotic features of the local environment
- 5.10b describe the importance of cycles of materials in ecosystems
- 5.10c describe some impacts of human activities on ecosystems
- 5.10d discuss strategies used to balance human activities and needs in ecosystems with conserving, protecting and maintaining the quality of the environment.

**Optional content for stages 4 and 5 could provide students with opportunities to:**

##### **Ecosystems**

- \* *discuss the Convention on Biodiversity with particular reference to Articles 8 and 10*
- \* *identify factors that affect the size of populations of organisms, including: competition for resources; Predators; birth and death rates*
- \* *research how Aboriginal belief systems relate to environmental management*
- \* *describe how the land management practices and techniques of Aboriginal and non-Aboriginal peoples have changed the environment*

- \* *discuss evidence for and against relating global warming to changes in weather patterns including El Nino and La Nina.*
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4.11 identifies resources used by humans and where they are found, and describes ways in which they are exploited.

#### **natural resources**

- 4.11.1a distinguish between natural and made resources
- 4.11.1b give examples of resources from living things and resources extracted from the air, earth and oceans
- 4.11.1c identify fossil fuels and describe some of their uses.

5.11 analyses the impact of human resource use on the biosphere to evaluate methods of conserving, protecting and maintaining Earth's resources.

#### **energy resources**

- 5.11.1a discuss the importance of energy as a resource and identify renewable and nonrenewable sources of energy
- 5.11.1b identify properties that make some natural resources economically important and describe their uses.

#### **waste from resource use**

- 5.11.2a relate pollution to contamination by unwanted substances
- 5.11.2b identify excessive use of fossil fuels as a contributing factor to a greenhouse effect.

**Optional content for stages 4 and 5 could provide students with opportunities to:**

#### **Resources**

- \* *discuss economic and environmental impacts of mining and exploration*
  - \* *identify differences in properties of the components of selected mixtures that allow these mixtures to be separated into their components.*
  - \* *evaluate costs and benefits of various sources of energy, including those available to remote communities*
  - \* *research Aboriginal peoples' uses of natural materials, including ochres and the use of heat to change colour, natural dyes, artifacts and weapons, shelter and housing, and cloth and string production*
  - \* *compare advantages and disadvantages of producing and using synthetic materials*
  - \* *identify a variety of synthetic materials and relate their properties to their uses, eg plastics and ceramics.*
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4.12 identifies, using examples, common simple devices and explains why they are used.

#### **technology**

- 4.12a discuss technological developments that have extended the ability of scientists to collect information about, and monitor events in, the natural and physical worlds
- 4.12b identify a variety of energy transformations in everyday devices involving either electrical, sound, light and/or heat energy.

5.12 describes scientific principles underlying some common technologies.

#### **technology**

- 5.12a identify that simple machines make tasks easier or more convenient
- 5.12b identify some advantages of levers, pulleys, gears and inclined planes
- 5.12c describe some everyday uses and effects of electromagnetic radiation, including applications in communication technology
- 5.12d discuss, using examples, how developments in electronics have changed technology, and identify some applications

- 5.12e give examples of medical and industrial uses of nuclear energy and discuss the benefits and problems associated with these uses
- 5.12f describe some benefits and problems and some of the social and ethical issues of using biotechnology
- 5.12g describe ways in which technology has increased the variety of materials.

**Optional content for stages 4 and 5 could provide students with opportunities to:**

**Technology**

- \* analyse various simple machines in terms of energy input and output and work done
- \* examine the human body and relate movement to the concept of simple machines
- \* trace the history of the development of particular devices or technologies such as circuitry through to microcircuitry
- \* describe some traditional technologies used and developed by different indigenous peoples.

**Objective: A student will gain skills in planning investigations.**

- 4.13 clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem.
- 5.13 identifies a problem and independently produces an appropriate investigation plan.

**identify data sources**

- 4/5.13.1a describe a problem, hypothesis or question that can be tested or researched
- 4/5.13.1b propose possible sources of data and/or information relevant to the investigation
- 4/5.13.1c identify what type of information or data needs to be collected
- 4/5.13.1d justify why particular types of data or information are to be collected
- 4/5.13.1e identify the appropriate units to be used in collecting data
- 4/5.13.1f recommend the use of an appropriate technology or strategy for collecting data or gathering information
- 4/5.13.1g formulate a means of recording the data to be gathered or the information to be collected.

**plan first-hand experiences**

- 4/5.13.2a identify variables that need to be kept the same if first-hand data is to be collected
- 4/5.13.2b specify the dependent and independent variables when planning controlled experiments
- 4/5.13.2c describe a logical procedure for undertaking a simple or controlled experiment
- 4/5.13.2d establish an appropriate timeline for an investigation.

**choose equipment or resources**

- 4/5.13.3a identify advantages and limitations of using particular laboratory equipment for a specific task
- 4/5.13.3b select appropriate equipment (including safety equipment) and/or resources to perform the task
- 4/5.13.3c describe ways to reduce the risk to themselves and others when working in the laboratory or field

**Objective: A student will gain skills in conducting investigations.**

- 4.14 follows a sequence of instructions to undertake a first-hand investigation
- 5.14 undertakes first-hand investigations independently with safety and competence

**perform first-hand investigations**

- 4/5.14a follow the planned procedure when performing an investigation
- 4/5.14b use time and resources effectively
- 4/5.14c safely and efficiently construct, assemble and manipulate identified equipment
- 4/5.14d record data using the appropriate units
- 4/5.14e evaluate and modify experimental procedures
- 4/5.14f demonstrate the use of safe and hygienic work practices including the correct use of safety equipment

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- 4.15 uses given criteria to gather first-hand data
  - 5.15 gathers first-hand data accurately

**gather first-hand information**

- 4/5.15a make and record observations and measurements accurately over a number of trials
- 4/5.15b use a range of data collection technologies and strategies independently

- 4.16 access information from identified secondary sources
- 5.16 access information from a wide variety of secondary sources

**gather information from secondary sources**

- 4/5.16a use a range of sources, including CD-ROMs and the Internet, to access information
- 4/5.16b use key words, skimming and scanning techniques to identify appropriate information
- 4/5.16c extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio/visual resources
- 4/5.16d summarise information from identified oral and written secondary sources.

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**Objective: A student will gain skills in communicating information and understanding**

- 4.17 evaluates the relevance of data and information
- 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources

**process information**

- 4/5.17a collate information from a number of sources
- 4/5.17b distinguish between relevant and irrelevant information
- 4/5.17c check the reliability of gathered data and information by comparing them with observations or information from other sources
- 4/5.17d organise data using a variety of methods including diagrams, tables, spreadsheets and databases
- 4/5.17e critically analyse the accuracy of scientific information presented in mass media
- 4/5.17f identify trends, patterns, relationships and contradictions in data and information
- 4/5.17g apply mathematical concepts to assist analysis of data and information

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- 4.18 with guidance, presents information to an audience to achieve a particular outcome.
  - 5.18 selects and uses appropriate forms of communication to present information to an audience.

**present information**

- 4/5.18a select, and use appropriately, a discussion, explanation, procedure, exposition, recount, report, response or experimental record for oral or written presentation
- 4/5.18b select and use an appropriate medium to present data and information
- 4/5.18c select and use an appropriate method to acknowledge sources of information
- 4/5.18d use symbols to express relationships, including mathematical ones, and appropriate units for physical quantities
- 4/5.18e use drawings, diagrams, graphs, tables and flow charts to show relationships and present information clearly and/or succinctly
- 4/5.18f select and draw the appropriate type of graph (from column graph, histogram, divided bar, sector or line graph) or diagram to convey information and relationships clearly and accurately.

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**Objective: A student will gain skills in developing scientific thinking and problem-solving techniques.**

- 4.19 draws conclusions based on information available
- 5.19 uses critical thinking skills in evaluating information and drawing conclusions

**think critically**

- 4/5.19a justify inferences in light of gathered information
- 4/5.19b identify data which support or discount a hypothesis, a question being investigated
- 4/5.19c predict outcomes and generate plausible explanations directly related to observations made
- 4/5.19d make generalisations in relation to a relevant set of observations or experimental results
- 4/5.19e anticipate and/or respond to problems as they arise in practical situations
- 4/5.19f use models, including mathematical ones, to explain phenomena or make predictions
- 4/5.19g use cause and effect relationships to explain ideas

4.20 uses an identified strategy to solve problems

5.20 selects and uses appropriate strategies to solve problems

**solve problems**

- 4/5.20a identify the nature of a presented problem
- 4/5.20b describe different strategies that could be employed to solve an identified problem
- 4/5.20c use identified strategies to develop a range of possible solutions to a particular problem
- 4/5.20d evaluate the appropriateness of different strategies for solving an identified problem

4.21 uses creativity and imagination to suggest plausible solutions to familiar problems.

5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions.

**use creativity and imagination**

- 4/5.21a seek evidence to support claims
- 4/5.21b evaluate evidence for reliability and validity
- 4/5.21c produce creative solutions for problems
- 4/5.21d propose ideas that demonstrate coherence and logical progression
- 4/5.21e apply critical thinking in the consideration of proposals
- 4/5.21f formulate cause and effect relationships.

**Objective: A student will gain skills in working individually and in teams.**

4.22 complete a variety of individual and team tasks with guidance.

5.22 independently plans, implements and evaluates the effectiveness of a variety of tasks as an individual and as a team member.

**work individually**

- 4/.22.1a independently plan and conduct investigations, communicate information and understanding and solve problems
- 4/5.22.1b set and work to realistic timelines and goals
- 4/5.22.1c accept responsibility for maintenance of a safe working environment for themselves and others
- 4/5.22.1d evaluate the effectiveness of their performance in completing tasks

**work in teams**

- 4/5.22.2a identify the specific roles needed when working in a team
- 4/5.22.2b match the tasks to the team members according to the requirements of the task and the skills of the individual
- 4/5.22.2c negotiate and allocate individual roles to members of the team
- 4/5.22.2d accept specific roles in a team while planning and conducting investigations, communicating information and understanding and solving problems
- 4/5.22.2e set and work to realistic timelines and goals as a team
- 4/5.22.2f accept personal responsibility for maintenance of a safe working environment for the team
- 4/5.22.2g monitor progress of the team towards completion of a task

4/5.22.2h evaluate the process used by the team and effectiveness of the team in completing the task.

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**Objective: A student will develop positive attitudes towards, and values about, themselves, others, learning as a lifelong process, science and the environment.**

4/5.23 demonstrates confidence and a willingness to make decisions and to take responsible actions

- 4/5.23a develop a positive view of themselves and their capabilities
- 4/5.23b exhibit self-direction in their own learning
- 4/5.23c initiate and persevere with activities to completion to achieve a reasonable end point
- 4/5.23d demonstrate a willingness to make decisions and to take responsibility for their actions

4/5.24 respects different viewpoints and is honest and fair in dealing with others

- 4/5.24a be honest and open in their dealings with others
- 4/5.24b respect the rights and property of others
- 4/5.24c work cooperatively in groups
- 4/5.24d show flexibility and responsiveness to ideas and evidence
- 4/5.24e demonstrate a commitment to safe personal and community practices in the home and workplace
- 4/5.24f appreciate the need to assess opinions and values within the community

4/5.25 recognises the relevance and importance of lifelong learning

- 4/5.25a acknowledge the continued impact of science in many aspects of everyday life
- 4/5.25b realise that the knowledge base of society grows continually
- 4/5.25c retain a healthy curiosity about the world around them

4/5.26 recognises the role of science in providing information about issues being considered and in increasing an understanding of the world around them

- 4/5.26a value a scientific problem-solving approach
- 4/5.26b experience satisfaction in applying the processes of science
- 4/5.26c show awareness that scientists must be accountable for their actions
- 4/5.26d appreciate that scientific information should be disseminated objectively
- 4/5.26e appreciate that scientific theories can only be judged on the basis of scientific evidence
- 4/5.26f appreciate the need for careful assessment of science reports in the media

4/5.27 acknowledges their responsibility to conserve, protect and maintain the environment for future generations

- 4/5.27a appreciate and be curious about the nature and behaviour of people and the environment
- 4/5.27b demonstrate a commitment to conserving and improving the quality of society and the environment.