NSW Education Standards Authority

Science 7–10 (2023): Working scientifically processes guide

NESA acknowledges Traditional Owners and Custodians of Country throughout NSW and pays respect to Elders past and present. NESA recognises Aboriginal Peoples' continuing Cultures and Connections to lands, waters, skies and Community.

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Purpose

The Working scientifically processes are an integral component of the *Science 7–10 Syllabus* (2023) and are embedded in the outcomes and content. Students learn to work scientifically by using these processes in an interconnected way through regular participation in a range of practical experiences.

Through Working scientifically, students extend their understanding of the nature of science and how scientific ideas, explanations and concepts develop through the processes of scientific inquiry. They learn to understand the unique interdisciplinary nature of science and the importance of scientific evidence in making informed decisions.

The *Science 7–10: Working scientifically processes guide* is designed to support teachers in embedding Working scientifically processes in their planning. The guide provides teachers with activities linked to Working scientifically processes and focus areas. Some students with disability may require adjustments to access scientific investigations and engage in Working scientifically processes.

The appendices include examples and conventions related to different representations that are used in Science 7–10, the structure of a practical written report for a scientific investigation, and an example of a method for a scientific investigation.

Stage 4: Working scientifically processes mapping to focus areas

Outcomes	Observing the Universe	Forces	Cells and classification	Solutions and mixtures	Living systems	Periodic table and atomic structure	Change	Data science 1
Observing **SC4-WS-01** uses scientific tools and instruments for observations	✓		✓				✓	
Questioning and predicting **SC4-WS-02** identifies questions and makes predictions to guide scientific investigations		✓			✓			
Planning investigations **SC4-WS-03** plans safe and valid investigations				✓			✓	
Conducting investigations **SC4-WS-04** follows a planned procedure to undertake safe and valid investigations	✓		✓	✓			✓	
Processing data and information **SC4-WS-05** uses a variety of ways to process and represent data		✓			✓	✓		
Analysing data and information **SC4-WS-06** uses data to identify trends, patterns and relationships, and draw conclusions		✓				✓		✓
Problem-solving **SC4-WS-07** identifies problem-solving strategies and proposes solutions		✓		✓				✓
Communicating **SC4-WS-08** communicates scientific concepts and ideas using a range of communication forms			✓		✓			

Stage 5: Working scientifically processes mapping to focus areas

Outcomes	Energy	Disease	Materials	Environmental sustainability	Genetics and evolutionary change	Reactions	Waves and motion	Data science 2
Observing **SC5-WS-01** selects and uses scientific tools and instruments for accurate observations	✓					✓		
Questioning and predicting **SC5-WS-02** develops questions and hypotheses for scientific investigation						✓		
Planning investigations **SC5-WS-03** designs safe, ethical, valid and reliable investigations			✓			✓		
Conducting investigations **SC5-WS-04** follows a planned procedure to undertake safe, ethical, valid and reliable investigations	✓					✓	✓	
Processing data and information **SC5-WS-05** selects and uses a range of tools to process and represent data					✓		✓	
Analysing data and information **SC5-WS-06** analyses data from investigations to identify trends, patterns and relationships, and draws conclusions		✓		✓				✓
Problem-solving **SC5-WS-07** selects suitable problem-solving strategies and evaluates proposed solutions to identified problems	✓		✓	✓				✓
Communicating **SC5-WS-08** communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms		✓	✓		✓			✓

Stage 4: Examples and explanations of Working scientifically processes

Outcomes	Observing the Universe	Forces	Cells and classification	Solutions and mixtures	Living systems	Periodic table and atomic structure	Change	Data science 1
Observing SC4-WS-01	✓		✓				✓	

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Make observations using the senses to compare properties of objects, living things and events	▪ Conduct an investigation to observe and identify the similarities and differences of structural features within and between groups of organisms (Cells and classification)	Use the senses to make observations of the features of animals and plants. For animals, use: ▪ sight to observe the number and the shape of features, such as the tail, legs, ears and eyes ▪ touch to observe the texture of features, such as fur, scales and feathers ▪ hearing to observe calls ▪ smell to observe scats. For plants, use: ▪ sight to observe leaf shape and petal number and placement ▪ touch to observe the texture of bark and leaf surfaces ▪ hearing to observe the sounds plants make moving in the wind ▪ smell to observe the scent of flowers or leaves. See Figure 33: Example of a botanical sketch.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Demonstrate competency when using scientific equipment to make observations	▪ Conduct a practical investigation to observe and compare prepared slides of specialised cells (Cells and classification)	Draw and label parts of a microscope. Use safe handling techniques to mount prepared slides and to focus on the cells. Compare and draw observations of the cells at different magnifications. See Figure 17: Example of a microscopy diagram – transverse section.
▪ Make relevant observations and measure quantities, including length, mass, temperature and volume	▪ Compare and contrast the accuracy and reliability of observations made using the senses with those obtained using measuring equipment (Observing the Universe)	Use the senses to estimate measurements including the length of the classroom, the volume of a water bottle, the mass of a pencil case or the temperature of various schoolyard surfaces. Discuss the variability of results as a class. Use equipment such as tape measures, measuring cylinders, digital scales and thermometers to make measurements. Compare the estimated measurements with those made using equipment. Ensure that proper safety protocols are followed, particularly when handling unfamiliar scientific equipment.
▪ Make a series of observations and measurements that are appropriate to answer a question that has been posed	▪ Undertake experiments to identify the indicators of physical and chemical changes (Change)	Pose a question such as, 'What is the difference between a physical change and chemical change?'. Make observations about physical changes, such as wax melting, hand sanitiser evaporating from the skin, or water droplets condensing on a cold drink. Observe chemical changes, including: ▪ precipitation from the reaction of calcium chloride with aqueous sodium carbonate ▪ the formation of a gas from the reaction of calcium carbonate with dilute hydrochloric acid ▪ the production of heat energy from the reaction of magnesium with dilute hydrochloric acid.

Outcomes	Observing the Universe	Forces	Cells and classification	Solutions and mixtures	Living systems	Periodic table and atomic structure	Change	Data science 1
Questioning and predicting SC4-WS-02		✓			✓			

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Identify questions and problems that can be investigated scientifically	▪ Investigate factors that lead to a species becoming endangered or extinct to explain why Australia has some of the world's highest rates of species population decline and extinction (Living systems)	Conduct an online search for "Australian biodiversity" to locate a reliable site. View data and information on the website about threatened species. Identify questions about the factors that lead to population decline, including invasive species, agricultural activity, climate change and natural disasters, such as fire and flood. Discuss possible scientific interventions to improve the recovery of an Australian threatened species, such as the Regent Honeyeater (*Anthochaera phrygia*). See Figure 13: Example of a multiple line graph.
▪ Make predictions based on scientific knowledge and observations	▪ Analyse force diagrams to make predictions (Forces)	Explain how to interpret and construct free body diagrams to represent forces acting on observed objects. Analyse force diagrams to determine net force and make predictions about resultant motion. See Figures 21 to 25 (Free body diagrams)

Outcomes	Observing the Universe	Forces	Cells and classification	Solutions and mixtures	Living systems	Periodic table and atomic structure	Change	Data science 1
Planning investigations SC4-WS-03				✓			✓	

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Identify the independent, dependent and controlled variable(s)	▪ Conduct a practical investigation and select appropriate equipment to measure the density of water and other substances, and record the results in a table to compare the calculated density with SI data (Solutions and mixtures)	Conduct a practical investigation to measure the mass and volume of water and other substances. Record the results in a table. For each measurement, identify the independent variable as the substance (for example, water, oil, iron or carbon) and the dependent variable as the density of each substance calculated using $\rho\rho = \frac{mm}{VV}$ (from the Science 7–10 Data Book). Control the variables by using: ▪ a scale to measure mass ▪ a ruler or graduated cylinder to measure the volume of each substance ▪ a calculator to calculate data. Compare measured densities with published data. See Results table

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Identify the type of data that needs to be collected in a range of investigations	▪ Describe the initial and final changes that are observed in a chemical reaction, including writing a word equation to represent a chemical reaction (Change)	Observe a range of chemical reactions and identify the type of data to be recorded. For the reaction of magnesium ribbon and dilute hydrochloric acid in a test tube, qualitative observations may include: ▪ seeing the malleable, shiny metal strip of magnesium before the reaction, and then noting that it is no longer visible after the reaction ▪ feeling the outside of the test tube as it changes from room temperature before the reaction to a warmer temperature after the reaction. Quantitative data may include: ▪ the temperature change of the solution ▪ the volume of gas produced. A word equation for the reaction is: mmmmmmmmmmmmmmmmmm + hyyyyyyyyyyhllyyyymmyy mmyymmyy → mmmmmmmmmmmmmmmmmm yyhllyyyymmyymm + hyyyyyyyymmmmmm
▪ Outline the method and equipment needed to undertake an investigation	▪ Investigate what substances dissolve in water and discuss findings using key terms, including soluble, insoluble, solubility, solute, solvent and solution (Solutions and mixtures)	Develop a method to investigate what substances dissolve in water, including: ▪ what equipment to use ▪ what data to record ▪ any safety considerations. Identify the dependent, independent and controlled variables. See Appendix 3: Method to investigate the solubility of substances See the Science 7–10 glossary for definitions of key terms.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Outline steps to manage safety risks before, during and after an investigation	▪ Use practical investigations and representations to illustrate energy transformations in a system (Change)	Outline possible risks and mitigation strategies for an investigation, such as the observation of a burning tealight candle to see how energy can transform from stored chemical energy into heat and light energy. Create a table that includes: ▪ risks, such as burns caused by the candle's flame or melting wax ▪ risk mitigation, such as keeping materials clear of a burning candle, tying hair back and wearing safety glasses. See Safety risks and mitigation in Appendix 3: Method to investigate the solubility of substances.

Outcomes	Observing the Universe	Forces	Cells and classification	Solutions and mixtures	Living systems	Periodic table and atomic structure	Change	Data science 1
Conducting investigations **SC4-WS-04**	✓		✓	✓			✓	

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Employ safe work practices and manage risks using work health and safety (WHS) practices.	▪ Undertake experiments to identify the indicators of physical and chemical changes (Change)	Create a risk mitigation table for investigations with magnesium ribbon after reviewing common hazard symbols. Conduct investigations to demonstrate physical and chemical changes involving magnesium ribbon, such as: ▪ burning the magnesium to show combustion ▪ breaking magnesium ribbon into pieces ▪ adding dilute hydrochloric acid to magnesium ribbon in a test tube to show a chemical reaction. Create a table that includes: ▪ risks, such as skin or eye irritation from acid ▪ risk mitigation, such as wearing safety glasses, using the lowest effective concentration and volume of materials, and disposing of materials safely. See Safety risks and mitigation in Appendix 3: Method to investigate the solubility of substances.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Assemble and use appropriate equipment and resources to perform an investigation	▪ Conduct an investigation to observe and identify the similarities and differences of structural features within and between groups of organisms (Cells and classification)	Assemble and use appropriate equipment and resources to observe and identify the structural features of organisms. Appropriate equipment and resources may include: ▪ microscopes, slides and stains to observe cellular features ▪ dichotomous keys to identify organisms ▪ magnifying glasses to investigate small features that are hard to see or not visible to the naked eye ▪ probes, tweezers, and scalpels to dissect stems, roots, insects or fish ▪ rulers and scales to measure length and mass ▪ models of organisms to allow detailed observations and interactions.
▪ Follow the planned procedure, including the measurement and control of variables	▪ Conduct and document a practical investigation to measure the solubility of different solutes in water, and present data using tables and relevant graphs (Solutions and mixtures)	Follow a procedure to measure the solubility of different solutes in water, such as salt, sugar, copper sulphate or vinegar. The independent variable is the solute, and the dependent variable is the mass of the solute that will dissolve in a specific volume of water. Control the variables by using the same: ▪ amount of water ▪ water temperature ▪ amount of stirring. Record the results in a table and present them in a column graph. See Figure 8: Example of a column graph.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Record observations and measurements accurately, using correct units for physical quantities	▪ Investigate and observe energy changes in different chemical reactions (Change)	Investigate energy changes in chemical reactions using equipment that allows for accurate measurements. For example, use a data logger or thermometer to measure the temperature increase of a test tube of hydrochloric acid when a piece of magnesium is dropped in it, or how the temperature of the resultant solution decreases after a reaction with vinegar and sodium bicarbonate. Record the temperature at accurate time intervals, in seconds, and the initial and final temperatures in Kelvin (K) or degrees Celsius (°C). See Results table
▪ Use a wide range of reliable secondary sources and acknowledge their sources	▪ Investigate the similarities between Aboriginal and Torres Strait Islander accounts and mainstream scientific explanations about the phases of the Moon and how the phases affect tides (Observing the Universe)	Introduce a variety of reliable secondary sources to explore the phases of the Moon and their impact on tides. These sources could include NASA, *National Geographic* magazine, the Bureau of Meteorology (BoM), ABC and SBS programs, or the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS). Emphasise that reliable sources are created by people with appropriate knowledge and are shared on respected platforms. Acknowledge these sources respectfully, especially when drawing from Cultural Knowledge, to honour intellectual and cultural ownership in a way that aligns with standards of academic integrity and cultural respect.

Outcomes	Observing the Universe	Forces	Cells and classification	Solutions and mixtures	Living systems	Periodic table and atomic structure	Change	Data science 1
Processing data and information SC4-WS-05		✓			✓	✓		

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Extract information from texts, diagrams, flow charts, tables, databases, graphs and multimedia resources	▪ Examine secondary-source data on the factors that change populations, including the introduction of a new species to an ecosystem, to identify trends, patterns and relationships, and draw conclusions (Living systems)	Extract information from a range of sources and representations to identify trends, patterns and relationships, and draw conclusions about the factors that change populations. Texts can provide context, diagrams can explain population dynamics, and flow charts can show the cycles in ecosystems. Tables organise data, while databases consolidate large datasets. Explanatory graphs show the relationships between different factors and population levels. Multimedia resources combine many resources to create engaging explanations. See Figure 13: Example of a multiple line graph.
▪ Use a range of representations to organise data, including graphs, keys, models, diagrams, tables and spreadsheets	▪ Conduct a practical investigation to test the effect of distance on the action of a magnet (Forces)	Draw a diagram of the apparatus required to test the effect of distance on the action of a magnet. Record measurements in a table and graph the results with a scatter plot. Compare the observed results to models of magnets and magnetic field strength. See Figure 2: Example of a scatter plot.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Select the type of graph best suited to represent various single datasets and justify this choice	▪ Investigate the interactions of biotic and abiotic factors in an ecosystem (Living systems)	Conduct an investigation to measure how the number of birds observed on school grounds changes over time. This represents one interaction of a biotic factor (birds) and an abiotic factor (time) in an ecosystem (the school). Display the data in a compound column graph or percentage column graph. See Figure 9: Example of a compound column graph and Figure 10: Example of a percentage column graph.
▪ Calculate the mean and range of a dataset	▪ Conduct a practical investigation on the effects of a range of direct and indirect forces (Forces)	Investigate the effect of a direct force, for example friction from a spring balance pulling a mass across different types of surfaces, such as carpet, tiles and a lab bench. Repeat trials to produce a dataset of friction forces and surfaces. Calculate the mean and range of the friction force to produce a column graph of the mean friction force for each surface. See Figure 8: Example of a column graph.
▪ Convert between units of measurement	▪ Conduct a series of investigations to identify and compare the physical properties of metals, non-metals and metalloids (Periodic table and atomic structure)	Conduct a series of investigations to identify the physical properties of metals, non-metals and metalloids. Calculate the density of substances using the formula $\rho\rho = \frac{mm}{VV}$ from the Science 7–10 Data Book. Convert between grams (g) and kilograms (kg) for mass; millimetres (mm), centimetres (cm) and metres (m) for length; degrees Celsius (°C) and Kelvin (K) for temperature; and millilitres (mL) and centimetres cubed (cm^3) for volume. Graph the data to compare the properties. See Figure 8: Example of a column graph.

Outcomes	Observing the Universe	Forces	Cells and classification	Solutions and mixtures	Living systems	Periodic table and atomic structure	Change	Data science 1
Analysing data and information **SC4-WS-06**		✓				✓		✓

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Assess the reliability of gathered data and information by comparing it to observations and information from other sources, including published scientific writing	▪ Conduct repeated experimental trials to calculate and compare the mean and range of data collected by different groups to discuss the accuracy and reliability of experimental data (Data science 1)	In groups, students use a thermometer to record the daily air temperature at school for one week. Calculate the mean and range of the combined class data to determine the accuracy and reliability of the results. Compare the class analysis to Bureau of Meteorology (BoM) readings for the local area. See Figure 14: Example of a box plot.
▪ Identify patterns and relationships in graphs, keys, models, diagrams, tables and spreadsheets	▪ Outline patterns and relationships found in the periodic table, including reactivity (Periodic table and atomic structure)	Access the Science 7–10 Data Book and tabulate melting point and boiling point data for period 3 elements. Create a scatter plot of the data and identify the relationship between the position of the element in the periodic table, and its melting and boiling point. See Figure 2: Example of a scatter plot.
▪ Identify data which supports or refutes a testable statement being investigated or a proposed solution to a problem	▪ Formulate and investigate scientific questions that can be addressed with data (Data science 1)	Conduct a survey to identify the favourite foods of a class or year group. Identify the type of data to be collected to enable a valid conclusion.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Use scientific understanding to identify relationships and draw conclusions based on students' data and secondary sources	▪ Define weight force as the mass x the acceleration due to gravity (mm) $FF = mmmm$ (Forces)	Measure the mass of a student's pencil case using an electronic balance. Calculate the weight force of the pencil case using $FF = mmmm$. Use secondary sources to find mm on other planets, then calculate the pencil case's weight force on those planets. Create a scatter plot of the pencil case's weight force against mm on the other planets. See Advice on numeracy and Figure 2: Example of a scatter plot.
▪ Propose inferences based on presented information and observations	▪ Explain how the properties of some common elements, compounds and alloys relate to their use(s) (Periodic table and atomic structure)	Observe the properties of aluminium as foil and as formed objects, such as drink cans. Include properties such as lustre, malleability, conductivity, hardness and density. Infer how these properties inform the use of aluminium in cans, utensils, and airplane and automotive parts.
▪ Evaluate the method used to investigate a question or solve a problem, including evaluating the quality of the data collected and identifying possible improvements to the investigation	▪ Conduct a practical investigation to construct electromagnets and compare their strength (Forces)	Develop a method to test the strength of electromagnets created from provided materials. Conduct the investigation and make judgments about the reliability and accuracy of the results, the precision of the data collected and the validity of the method. Suggest changes to the method to enable more accurate comparisons to be made about the strength of the electromagnets.

Outcomes	Observing the Universe	Forces	Cells and classification	Solutions and mixtures	Living systems	Periodic table and atomic structure	Change	Data science 1
Problem-solving SC4-WS-07		✓		✓				✓

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Identify problems and devise possible strategies or solutions	Examine the digital footprint created by different online activities to recognise the importance of engaging safely with digital systems (Data science 1)	Access a reliable eSafety website to gather information about the misuse of digital footprints created by online data collection, such as through digital cookies, social media, online banking, use of transport cards and music streaming. Collaboratively devise solutions to the problem of the misuse of online data.
▪ Use identified strategies to suggest possible solutions to a familiar problem	Compare the properties of dilute, concentrated, saturated and supersaturated solutions (Solutions and mixtures)	Develop a solution to the problem of making pasta cook faster in a pot of salted boiling water. Conduct a series of investigations by varying the concentration of salt in the water, to investigate changes in boiling point. Concentrations of salt may be 5% w/w, 10% w/w, 20% w/w or 30% w/w where w/w means weight per weight.
▪ Use given evaluation criteria to select optimal solutions to problems	Investigate how simple machines, such as levers and pulleys, are used to change the magnitude of force needed when performing a task (Forces)	Determine a range of problems that could be solved using simple machines to change the magnitude of force, such as lifting a student with a broken leg or changing a car tyre. Develop criteria for how to select an optimal solution to the problem, including ease of use, durability and cost.
▪ Identify cause-and-effect relationships and develop models to explain phenomena	Plan an investigation to measure and graph the temperature of water to identify the changes of state as heated over time (Solutions and mixtures)	Predict how the state of water will change when heated over time. Conduct the investigation and graph the results. Explain the graphs and draw conclusions using the particle model. See Figure 1: Example of a scientific diagram.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Evaluate the suitability of different strategies for solving an identified problem using given criteria	Investigate how simple machines can solve everyday issues (Forces)	Use apparatus, such as a ramp, pulley, lever or wheel and axle, to perform a task. For example: ▪ safely lowering a broken branch from a tree ▪ creating a framework to lower eggs from a height ▪ demonstrating how water moves from a dam up to a storage tank at the top of a water tower. Use criteria with considerations, such as safety, time and available materials, to evaluate the suitability of the strategies used to perform the task.

Outcomes	Observing the Universe	Forces	Cells and classification	Solutions and mixtures	Living systems	Periodic table and atomic structure	Change	Data science 1
Communicating SC4-WS-08			✓		✓			

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Present findings and ideas in a range of communication forms, including using relevant scientific terms, diagrams and graphical representations, as appropriate to audience and purpose	Conduct an investigation to observe and record the similarities and differences between different cells, including fungi, bacteria, plant and animal cells, using microscopes and/or images obtained from microscopes (Cells and classification)	Conduct an investigation to observe cells using microscopes and published images. Record observations using diagrams, images or audio recordings. Compare the features of different cells and document the results using tables or Venn diagrams. See Figure 16: Example of a microscopy diagram – tangential section
▪ Create written texts to communicate scientific concepts, ideas or investigations using conventional scientific text structures	Create written texts to explain how energy pyramids show the amount of energy or matter at each trophic level (Living systems)	Refer to advice on writing to create written texts using text structures such as numbered headings and complex sentences. Explanation can include details, such as the changes in energy, and the names and quantities of organisms, at each trophic level.

Stage 5: Examples and explanations of Working scientifically processes

Outcomes	Energy	Disease	Materials	Environmental sustainability	Genetics and evolutionary change	Reactions	Waves and motion	Data science 2
Observing SC5-WS-01	✓					✓		

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Select and use equipment correctly, including digital technologies, to make observations to increase the accuracy of measurements appropriate to the task	Conduct an investigation to determine the relationship between voltage (V), current (I) and resistance (R), as described by Ohm's law (V = IR) (Energy)	Construct parallel and series circuits using apparatus or a computer simulation and draw the circuits using the symbols shown in the Science 7–10 Data Book. Use a voltmeter and ammeter to measure voltage, and a multimeter to compare the accuracy of measurements. Validate Ohm's law by determining the relationship between voltage, current and resistance. See Advice on numeracy.
▪ Make a series of observations with precision	Identify pH as the measure of acidity, and compare the pH of a range of common substances to the pH of pure water (Reactions)	Use a range of indicators, such as those listed in the Science 7–10 Data Book, to measure the pH of a range of common substances. For example, lemon juice, purified water, vinegar and milk of magnesia. Compare the precision of the observations with the precision of using natural indicators such as red cabbage or beetroot.

Outcomes	Energy	Disease	Materials	Environmental sustainability	Genetics and evolutionary change	Reactions	Waves and motion	Data science 2
Questioning and predicting SC5-WS-02						✓		

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Formulate questions or hypotheses that can be investigated scientifically	Conduct a practical investigation to test a measurable hypothesis, with a cause-and-effect relationship, that predicts changes to the rate of a chemical reaction, and graph data that communicates the investigation findings in a scientific report (Reactions)	Formulate a hypothesis for a reaction of ethanoic acid with sodium bicarbonate, such as 'the volume of gas produced will decrease when the concentration of ethanoic acid decreases'. Conduct the investigation and collect data on concentration (the independent variable) and the volume of gas (the dependent variable). Graph the data and communicate findings in a scientific report that includes a conclusion linking the observed results with the hypothesis.
▪ Predict outcomes based on observations and scientific knowledge	Conduct a practical investigation to demonstrate the law of conservation of mass in a chemical reaction (Reactions)	Predict the outcome of a reaction between ethanoic acid and sodium bicarbonate based on scientific knowledge of the law of conservation of mass. Observe the reaction in a closed system using a balloon over a conical flask resting on an electronic balance.

Outcomes	Energy	Disease	Materials	Environmental sustainability	Genetics and evolutionary change	Reactions	Waves and motion	Data science 2
Planning investigations SC5-WS-03			✓			✓		

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Describe the purpose of an investigation	Conduct an investigation to observe and compare the physical and chemical properties of ionic, covalent and metallic substances, and explain how these relate to their uses (Materials)	Investigations of the substances may include tests for physical properties like conductivity, solubility, hardness and comparisons of melting and boiling points. Chemical properties may be investigated by reacting the substances with acids or bases. The results of these investigations can be used to explain how the observed physical and chemical properties relate to the use of the substances. For example, covalent substances like methane have relatively low boiling points and may be used in their gaseous form for combustion.

<table>
<tr><th>Working scientifically content point</th><th>Related focus area content point</th><th>Explanation/examples</th></tr>
<tr><td>Explain the use of variables and experimental controls in a valid scientific investigation</td><td>Investigate and explain how concentration, surface area, temperature and catalysts affect the rate of reactions (Reactions)</td><td>Valid scientific investigations test the effect of changing one variable – the independent variable. In separate reactions, the independent variables could be:
concentration
surface area
temperature
the use of a catalyst.
The rate of reaction would be the measured dependent variable.
Experimental controls could be a ‘control’, such as a baseline reaction to enable comparisons against all other results, or controlled variables, such as the same volume of reactants. All other factors are kept consistent for all reactions, such as using the same:
volume of reactants
measuring devices
glassware.
See Advice on numeracy.</td></tr>
<tr><td>Assess the types of data that need to be collected in a range of investigation types</td><td>Investigate and explain how mass is conserved in closed systems (Reactions)</td><td>An investigation of the conservation of mass may include the reaction of diluted acetic acid and sodium bicarbonate in a conical flask with a balloon sealing the system.
The types of data collected may include quantitative data, such as mass, temperature, volume and pH.
Qualitative data may be obtained by:
observing the gas production
observing the change to the colour of an indicator
touching the flask to feel for a change in temperature.</td></tr>
</table>

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Select and explain investigation methods, including fieldwork and laboratory experimentation, to collect reliable data	Determine the quantity and types of polymers found in the environment by undertaking a physical survey of the local area (Materials)	Collaboratively determine sampling methods in a physical survey to identify and record reliable data. For example, use transects and quadrats to count the types of discarded plastics (such as, straws, bottle tops, water bottles and snack packets) in a local area, like a beach, to estimate the total number. Analyse the types and number of plastics and determine whether the sampling methods could reliably create valid results.
▪ Identify risks, consider ethical issues and select suitable materials and technologies for a range of investigations	Investigate a chemical or nuclear reaction used in industry to produce an important product (Reactions)	Research or connect with a local industry and investigate the various chemicals manufactured at plants across Australia. Possible chemicals to investigate include: ▪ sodium hydroxide ▪ methanol ▪ polymers such as polyethylene ▪ solutions used in wastewater treatment ▪ chemicals used in any other industrial processes on a local, national or global level, that are of interest to students. Use secondary sources to investigate: ▪ the industrial chemical reaction ▪ the reaction conditions ▪ the product or products, and their importance to society ▪ the environmental and safety considerations.
▪ Assess the types of data that need to be collected in a range of investigation types	Conduct an investigation to determine the biodegradability of different packaging materials (Materials)	Plan and conduct an investigation into the biodegradability of different packaging materials. Record results then modify the investigation based on recorded evidence about the conditions needed for packaging materials to biodegrade, including presence of water, pH levels, time, material surface area and temperature.

Outcomes	Energy	Disease	Materials	Environmental sustainability	Genetics and evolutionary change	Reactions	Waves and motion	Data science 2
Conducting investigations SC5-WS-04	✓					✓	✓	

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Implement safe work practices and manage risks	Construct circuits and draw circuit diagrams that contain several components to show the flow of electricity through a complete circuit (Energy)	Complete a risk mitigation assessment and document the results in a table before constructing electrical circuits. The table may include: ▪ risks, such as: – burns from sparks due to short circuits – burns or electric shocks from wires ▪ risk mitigations, such as: – switching off the circuit when it is not in use – managing load to avoid short circuits – using minimum current – checking for damage to the circuit – connecting circuits correctly. See Safety risks and mitigation in Appendix 3: Method to investigate the solubility of substances.
▪ Assemble, construct and manipulate identified equipment to perform the investigation	Determine the features of reactions by conducting synthesis, decomposition, displacement and neutralisation reactions (Reactions)	Safely and collaboratively assemble, construct and manipulate the equipment required to conduct synthesis, decomposition, displacement and neutralisation reactions. Use appropriate glassware and measuring devices in the laboratory to enable the collection of valid data.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Follow the planned procedure and identify and respond to errors if they occur	Use pH indicators or meters to measure the pH change of neutralisation reactions (Reactions)	Predict the results of a range of neutralisation reactions, such as: $HHHHll\ (mmaa) + NNmmNNHH\ (mmaa) \rightarrow NNmmHHll\ (mmaa) + HH_2NN\ (ll)$ Use indicators listed in the ‘Acid to base indicators’ table in the [Science 7–10 Data Book] to observe the colour of the reactants and products. Compare observed results to predictions to identify possible errors and make adjustments to the method as required.
▪ Systematically and accurately collect and record data, information, evidence and findings	Investigate the properties of light, including absorption, reflection, refraction and scattering (Waves and motion)	Conduct investigations into the properties of light using ray boxes, mirrors and different media, or interactive materials, such as a simulation. Follow a planned procedure that includes calibrated equipment and accurately collect qualitative and quantitative data about absorption, reflection, refraction and scattering. Record data using a table, chart or a collaborative online document.
▪ Extract information from a wide range of reliable secondary sources and acknowledge these sources using an accepted referencing style	Investigate and outline the impact of material selection on the transfer of sound energy in Aboriginal and/or Torres Strait Islander Peoples’ traditional musical and communication instruments (Waves and motion)	Extract information from a range of reliable resources about the different materials and designs used by Aboriginal and/or Torres Strait Islander Peoples to make cultural instruments for communication, such as clapsticks or Emu callers. Explore any options and ask local Aboriginal Community members to demonstrate. Emphasise that reliable sources are created by people with the appropriate knowledge and are shared on respected platforms. Acknowledge these sources respectfully, especially when drawing from Cultural Knowledge, to honour intellectual and cultural ownership in a way that aligns with standards of academic integrity and cultural respect.

Outcomes	Energy	Disease	Materials	Environmental sustainability	Genetics and evolutionary change	Reactions	Waves and motion	Data science 2
Processing data and information SC5-WS-05					✓		✓	

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Select and use a range of representations to organise data and information, including graphs, keys, models, diagrams, tables and spreadsheets	Investigate, using evidence, how the complexity and diversity of organisms have changed over geological timescales (Genetics and evolutionary change)	Conduct a secondary-sourced investigation using a range of sources to collect data and information about the evolutionary changes of organisms over time. This may include information about increases in the complexity of parts of organisms, such as eyes, or increases in the diversity of organisms, such as those that can fly. Use a range of representations, such as the geological timescale provided in the Science 7–10 Data Book, graphs of rock strata, and tree diagrams, to organise data and information. See Figure 32: Example of a rock strata diagram.
▪ Select and extract information from texts, diagrams, flow charts, tables, databases, graphs and multimedia resources	Discuss the nature of scientific discovery by comparing the contributions of scientists involved in the discovery of the double helix structure of DNA (Genetics and evolutionary change)	Process data and information from multiple sources and in a variety of formats to understand the contributions of different scientists, such as Levene, Chargaff, Franklin and Watson to our understanding of the structure and function of DNA.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Calculate a range of descriptive statistics using SI units	Conduct an investigation to analyse the relationships between distance, time, speed, displacement and velocity (Waves and motion)	Investigate and compare the walking and running speeds of class members over a given distance, to collect and analyse a class dataset. Record data using SI units listed in the Science 7–10 Data Book, such as m, s and ms^{-1}, and create a scatter plot of the results to show the trends and patterns in the relationships between distance, time, speed, displacement and velocity See Figure 2: Example of a scatter plot.
▪ Identify data which supports or refutes questions, hypotheses and proposed solutions to problems	Discuss how scientists developed and refined the theory of evolution, and explain why an understanding of the origins of species is important (Genetics and evolutionary change)	Identify data used by scientists that supports the theory of evolution. This may include comparative anatomy, biogeographical distribution or speciation. Explain the importance of data in developing scientific theories, and how understanding the origin of the species may lead to greater awareness of current issues, such as the loss of biodiversity.
▪ Describe specific ways to improve the quality of data collected in an investigation	Investigate and describe how amplitude and frequency affect the pitch and volume of sound (Waves and motion)	Use tuning forks to change and measure the amplitude and frequency of sound waves to see how these affect pitch and volume. The quality of the data may be affected by ambient noise or the validity of conclusions may be affected by the incorrect use of tuning forks or measuring devices. Reducing sources of error and making comparisons with observations from a computer simulation can improve the quality of data collected to enable valid conclusions.

Outcomes	Energy	Disease	Materials	Environmental sustainability	Genetics and evolutionary change	Reactions	Waves and motion	Data science 2
Analysing data and information SC5-WS-06		✓		✓				✓

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Describe patterns and trends, including inconsistencies in data and information	Investigate how data, or its analysis and interpretation, can be distorted to manipulate findings that support specific viewpoints (Data science 2)	Conduct an investigation to collect bivariate data to observe trends and patterns. For example, as the number of jumping jacks increases so does the heart rate. Investigate collection and analysis methods that may distort the data. For example, only sampling male students or athletes, incorrectly measuring heart rate or truncating an axis can exaggerate differences in the data.
▪ Describe relationships between variables	Investigate data to determine what trends are evident in the world's climate (Environmental sustainability)	Access data and analysis from reliable online sources about climate change in Australia. Identify key variables from the data, including global surface temperature, atmospheric CO_2 concentration, rising sea levels, or the frequency of extreme weather events. Create graphs to identify trends in these variables over time, or scatter plots to identify relationships between the variables, such as correlation. See Figure 11: Example of a column graph with trendline and Figure 2: Example of a scatter plot.
▪ Assess the validity and reliability of first-hand data	Explain how the natural greenhouse effect influences global climate (Environmental sustainability)	Conduct a practical investigation to model the greenhouse effect to show how heat can be trapped by carbon dioxide in the atmosphere. Assess the reliability of the results, and the validity of using first-hand data to model global climatic effects. Explanations can be supported by terminology from the Science 7–10 glossary.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Use graphed data from investigations to extrapolate or interpolate information to make predictions	Investigate data relating to a common non-infectious disease affecting Australians today (Disease)	Interpret tabulated and graphical data that display rates of a specific non-infectious disease, such as Type 2 diabetes, a type of cancer, heart disease or stroke. Extrapolate or interpolate information from the graphs to predict the impacts of factors contributing to the disease. See Figure 4: Example of interpolation of a scatter plot and Figure 5: Example of extrapolation of a scatter plot.
▪ Use knowledge of scientific concepts to draw conclusions that are consistent with evidence	Analyse data on global emissions and atmospheric temperatures to explain the enhanced greenhouse effect and its impact on climate and ecosystems (Environmental sustainability)	Access and analyse data from reliable online sources about climate change in Australia to draw conclusions that are consistent with evidence that changes in atmospheric CO_2 have enhanced the greenhouse effect. Describe trends and patterns in data, and the relationships between variables, and assess the validity and reliability of data related to arctic ecosystems, ocean ecosystems and/or Australian ecosystems. See Figure 11: Example of a column graph with a trendline.
▪ Synthesise data and information to develop evidence-based arguments	Investigate technological advances developed in Australia to address disease, disorders or physical trauma in the human body (Disease)	Analyse data and information about a technological advance to make evidence-based conclusions about its efficacy. For example, technological advances developed in Australia to address disease, disorders or physical trauma in the human body include: ▪ Fiona Wood's spray-on skin technique to treat burns and skin damage ▪ the work of Monash Vision Group (MVG) on the bionic eye ▪ the Malaria Vaccine Project at Griffith University, Queensland.
▪ Evaluate conclusions and evidence, including identifying sources of uncertainty and possible alternative explanations	Explain the evidence and reasoning used to support conclusions about claims, using data from investigations (Data science 2)	Access data from reliable online sources about food standards in Australia to compare the claim that the nutritional value of organic crops is better than the nutritional value of conventionally produced crops. Identify sources of uncertainty in the processing, analysis and representation of the data. Explain how the uncertainty impacts conclusions about this claim.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Analyse the validity of information from secondary sources	Analyse data that shows the relationship between industrialisation and the rise in global temperatures (Environmental sustainability)	Access a variety of reliable online sources, including the websites of Australian government departments and international climate research groups, to source data about global temperatures over time. Use a scaffold to analyse the validity of the information from the sources, including considerations relating to the credibility or bias of the author, the accuracy of evidence, the currency of data and links to other sources. Organise data to identify patterns and trends, and draw conclusions about the relationship between industrialisation and the rise in global temperatures. See Figure 11: Example of a column graph with a trendline.

Outcomes	Energy	Disease	Materials	Environmental sustainability	Genetics and evolutionary change	Reactions	Waves and motion	Data science 2
Problem-solving SC5-WS-07	✓		✓	✓				✓

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Select suitable strategies and implement them to solve an identified problem	Explain how to improve energy efficiency in energy transfers and transformations (Energy)	Research and propose solutions on how to improve the energy efficiency of the school, such as the use of more efficient lighting. Develop a model that outlines the implementation of the solutions to test them and determine their effectiveness.
▪ Develop evaluation criteria relevant to identified problems	Evaluate the advantages and disadvantages of using renewable and non-renewable sources of energy to generate electricity, including efficiency, economical and technological considerations (Energy)	Access reliable online resources, such as Australian government departments responsible for energy production and use, to develop criteria for evaluating different renewable and non-renewable sources of energy to ensure the reliability of future electricity generation. The evaluation criteria may include consideration of the efficiency of the sources and the technological, economic and environmental impacts of their use.
▪ Assess the solutions proposed based on the relevant evaluation criteria	Identify the advantages and limitations of methods used to reduce greenhouse gas emissions (Environmental sustainability)	Create a chart to compare the methods used to reduce greenhouse gas emissions. These may include using: ▪ renewable energy sources ▪ carbon capture strategies ▪ modified agricultural practices. Use criteria that consider economic, technological, environmental and social factors to evaluate the best methods to use in New South Wales.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Use cause-and-effect relationships and models to explain ideas and make predictions	Investigate case studies to explain the effect of bioaccumulation of microplastics in the environment (Materials)	Develop models to represent microplastic bioaccumulation in food chains. Use the models to explain the impact of bioaccumulation and predict the effect of preventing microplastics entering the food chain.
▪ Evaluate different approaches used to solve problems	Discuss alternatives to the current resource use, including how to reduce, reuse and recycle (Environmental sustainability)	Evaluate the different approaches used to reduce material sent to landfill, including replacing single-use plastics with biodegradable alternatives. Assess the impacts of sustainable agricultural practices or adopting a plant-based diet on resource use. See Figure 26: Example of a flow chart showing a process
▪ Evaluate claims using scientific knowledge and findings from investigations	Assess the environmental impacts of materials that are used as alternatives to those derived from crude oil (Materials)	Use scientific knowledge and findings from investigations to evaluate claims about the environmental impacts of producing and using alternative materials to those derived from crude oil, such as bioplastics, bamboo textiles and plant-based cleaning products.

Outcomes	Energy	Disease	Materials	Environmental sustainability	Genetics and evolutionary change	Reactions	Waves and motion	Data science 2
Communicating SC5-WS-08		✓	✓		✓			✓

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Present scientific arguments using evidence, correct scientific language and terminology, as appropriate to audience and purpose	Analyse data about immunisation programs and the occurrence of infectious diseases to identify trends, patterns and relationships, and document conclusions in a written text (Disease)	Access large datasets about immunisation coverage from reliable online sources such as Australian government sites. Use a digital spreadsheet to organise the data and apply statistical analysis techniques to identify trends and patterns in graphical representations. Create a written text presenting an evidence-based argument about the relationship between immunisation programs and outbreaks of infectious diseases.
▪ Create written texts to communicate scientific investigations, explain scientific theories and principles, structure a scientific argument, and evaluate findings in light of scientific knowledge	Evaluate the environmental impact of extracting and using a named resource and document findings in a written scientific report (Materials)	Create a written scientific report using published data to evaluate the impact of extracting and using coal in a local region. The report may cover the effects on: ▪ groundwater ▪ air quality ▪ the rehabilitation of sites ▪ heavy metal contamination ▪ biodiversity. The report may include subheadings to sequence information and a structure that includes the purpose of the report, background information, key points and evidence, and the evaluation of evidence.

Working scientifically content point	Related focus area content point	Explanation/examples
▪ Recognise that scientific texts develop arguments by encouraging the reader to adopt a specific perspective and positioning them to accept the authority of a text	Investigate how scientific knowledge is verified and refined by scientists through hypothesis testing and peer review (Data science 2)	Access online resources and scientific texts about the impact of sports-related concussion on participants. Identify hypotheses that have been tested and presented as arguments. Use a scaffold to determine the: ▪ credibility of the author(s) ▪ accuracy of information ▪ purpose of the text ▪ currency of data and analysis. Identify any bias(es) in the evidence presented.

Appendix 1: Representations in Science 7–10

This appendix includes a range of representations to organise data and information.

Scientific diagram

A scientific diagram is a clear and simple visual representation showing how apparatus for an investigation is set up. It can be used as a guide to reproduce an investigation.

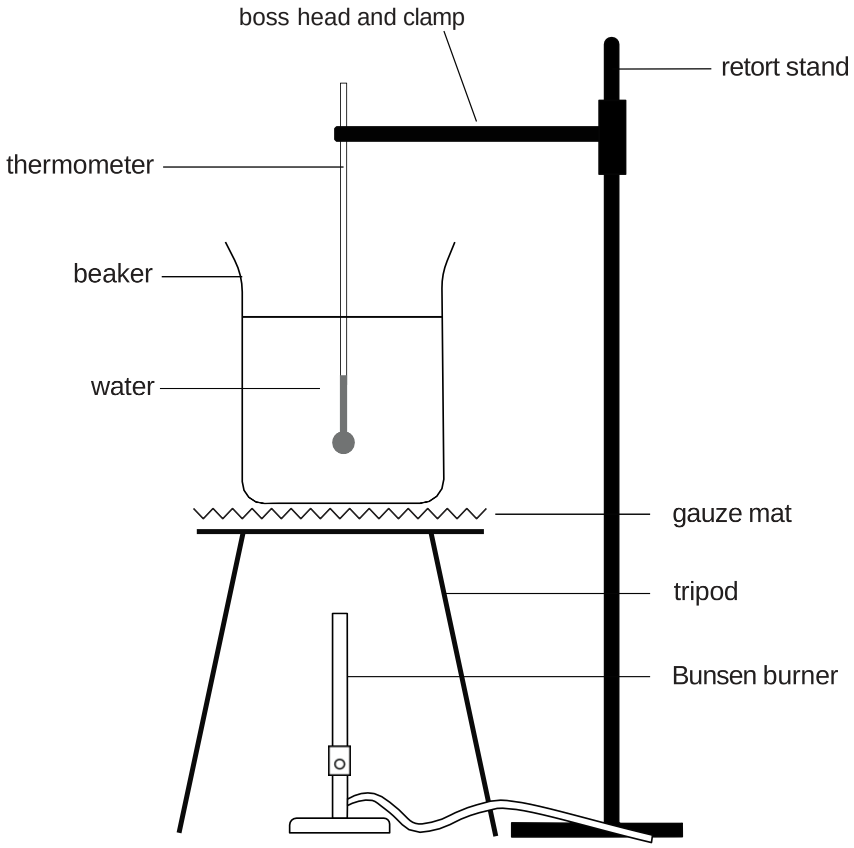


Figure 1: Example of a scientific diagram

Image long description: Scientific line diagram of a beaker that is three-quarters full of water, resting on a gauze mat on a tripod. It sits above a Bunsen burner with a hose. A thermometer is suspended at mid-depth in the water. The thermometer is held in place by a boss head and clamp, which are attached to a retort stand next to the beaker on the tripod.

Conventions

- Straight lines are drawn in pencil with a ruler.
- Simple 2-dimension outline of apparatus with no shading.
- Labelled by writing scientific names of all equipment and connecting them to the relevant image in the diagram via straight lines.

Results table

A results table is used to record the results of an investigation. It may contain quantitative or qualitative data.

Table 1: Time for an object to reach the end of an inclined plane

Release position on ramp (m)	Time to reach end of ramp (s)			
	Trial 1	Trial 2	Trial 3	Average time
0.2	0.61	0.49	0.58	0.56
0.4	0.82	0.92	0.66	0.80
0.6	0.98	0.98	1.07	1.01
0.8	1.11	1.22	1.12	1.15
1.0	1.25	1.31	1.37	1.31

Conventions

- The first column heading shows the independent variable and unit.
- Subsequent column headings show dependent variables and the unit.
- The table may include columns for the results of numerical analysis, such as average or density calculations.
- The units for variables are included in the header rows only.

Scatter plot

A scatter plot is used to observe the relationship between dependent and independent variables. It may include a line of best fit to show a trend.

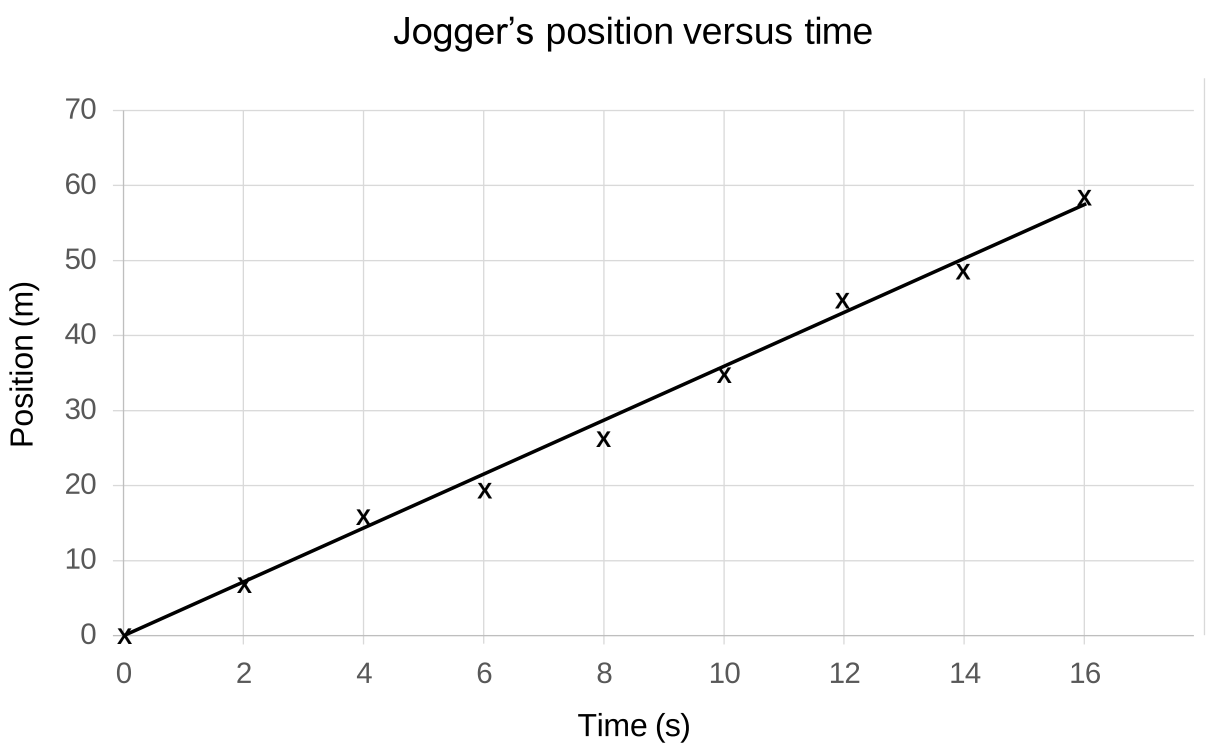


Figure 2: Example of a scatter plot

Image long description: Scatter plot titled 'Jogger's position versus time'. Evenly spaced vertical and horizontal gridlines start at zero in the lower left-hand corner. Horizontal lines are counted in multiples of 10 to a maximum of 70. The horizontal lines are attached to the y-axis, which is labelled 'Position (m)'. Vertical lines are counted in multiples of 2 to a maximum of 16. Vertical lines are attached to the x-axis, which is labelled 'Time (s)'. A solid, straight line of best fit is drawn diagonally from the origin to a point at 16 seconds and approximately 57 metres. Data points plotted at each time interval starting from zero are marked with an 'x' and appear just above or below the line of best fit.

Conventions

- The title indicates the relationship being shown.
- The x-axis represents the independent variable.
- The y-axis represents the dependent variable.
- Axes are labelled with measurement (unit).
- Data points are plotted with 'x' symbol.
- A straight line of best fit is drawn with a ruler.

Combined scatter plot

A combined scatter plot enables comparisons of multiple dependent variables.

Concentration of introduced and indigenous plant species compared to the distance from a disturbed area

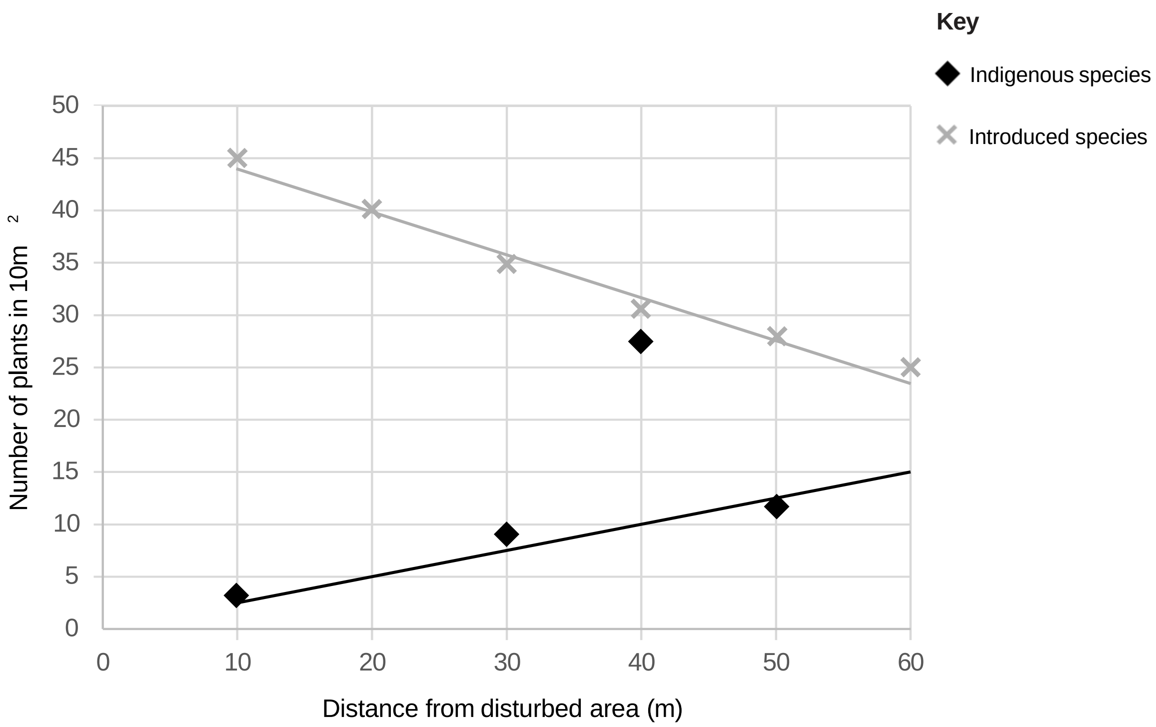


Figure 3: Example of a combined scatter plot

Image long description: Combined scatter plot consisting of evenly spaced vertical and horizontal gridlines, starting at zero in the lower left-hand corner. Horizontal lines are counted in multiples of 5 to a maximum of 50. The horizontal lines are attached to the y-axis, which is labelled 'Number of plants in 10 m^2'. Vertical lines are counted in multiples of 10 to a maximum of 60. The vertical lines are attached to the x-axis, which is labelled 'Distance from disturbed area (m)'. Two solid straight lines of best fit are drawn diagonally. The lighter shaded line is drawn sloping downwards from a point at $(10, 44)$ to a point at $(60, 23)$. A darker line is drawn sloping upwards from a point at $(10, 3)$ to a point at $(60, 15)$. Data points plotted at distance intervals starting at 10 m are marked with an 'x' for the lighter line and with a diamond symbol for the darker line. A key to the right of the plotted area labels the darker diamond data points 'Indigenous species' and the lighter 'x' datapoints 'Introduced species'.

Conventions

- The title indicates the relationship being shown.
- The x-axis represents the independent variable.
- The y-axis represents the dependent variable.
- Axes are labelled with measurement (unit).
- Data points are plotted with 'x' and another symbol.
- A straight line of best fit is drawn with a ruler.
- A key links the subject/s of the data with symbols used to plot data points.

Interpolation

Interpolation is the estimation of values based on trends in measured variables.

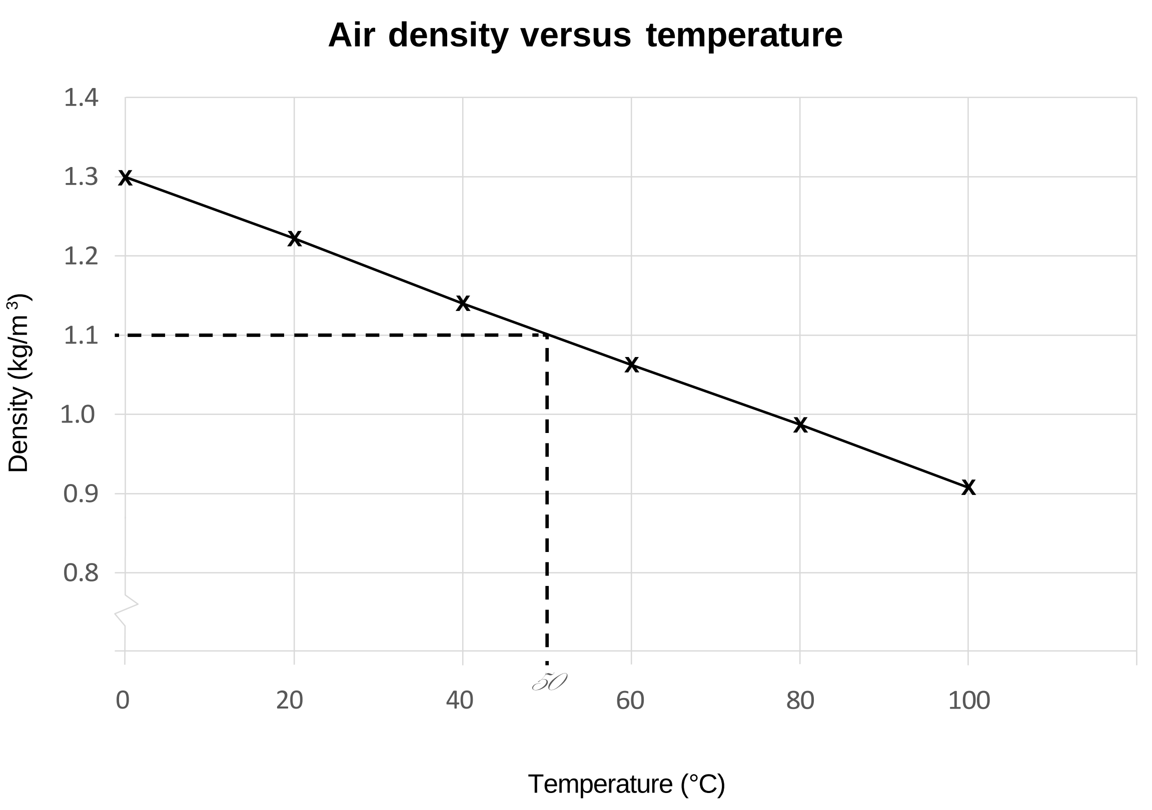


Figure 4: Example of interpolation of a scatter plot

Image long description: Scatter plot titled 'Air density versus temperature'. Evenly spaced horizontal lines are counted in multiples of 0.1 from 0.8 to a maximum of 1.4. The horizontal lines are attached to the y-axis, which is labelled 'Density (kg/m^3)' and has a discontinuity marker from 0 to 0.8. Vertical lines are counted in multiples of 20 to a maximum of 100. The vertical lines are attached to the x-axis, which is labelled 'Temperature (°C)'. A solid, straight line of best fit is drawn diagonally, sloping downwards from $(0, 1.3)$ to $(100, 0.91)$. Data points plotted at each temperature interval starting from zero are marked with a x and appear just above or below the line of best fit. A vertical dashed line joins the line of best fit to the x-axis at the position marking 50°C. A horizontal dashed line joins the line of best fit to the y-axis at 1.1kg/m^3.

Conventions

- Values that are not measured are estimated.
- This is only valid for estimated variables within the plotted range of measurements.
- A dotted line is drawn with a ruler from a point on either the x or y axis to the line of best fit, and then directly across or down to a point on the other axis. The two points where the dotted line joins both axes are the corresponding estimated values.

Extrapolation

Extrapolation is the estimation of values based on trends in measured variables.

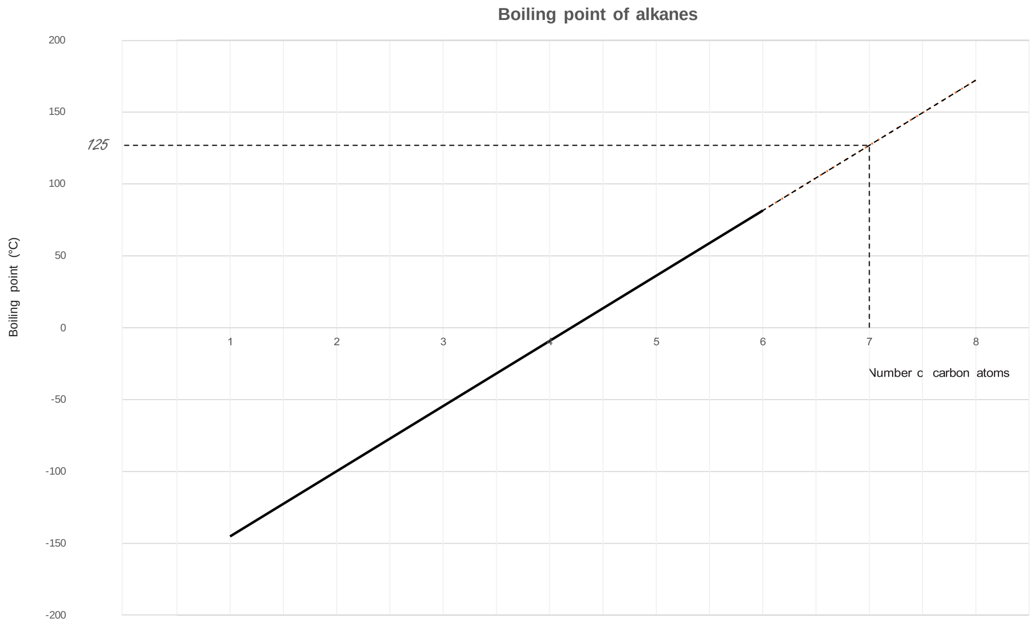


Figure 5: Example of extrapolation of a scatter plot

Image long description: Scatter plot titled 'Boiling point of alkanes'. Evenly spaced horizontal lines are counted in multiples of 50 from -200 to a maximum of $+200$. The horizontal lines are attached to the y-axis, which is labelled 'Boiling point (°C)'. Every second vertical line is labelled in multiples of 1 from zero to a maximum of 8. Vertical lines are attached to the x-axis, which is labelled 'Number of carbon atoms'. A solid straight line of best fit is drawn diagonally, sloping upwards from $(1, -148)$ to $(6, 80)$ and continuing as a dashed line with the same slope to $(8, 172)$. A vertical dashed line joins the dashed line of best fit to the x-axis at the position marking 7 carbon atoms. A horizontal dashed line joins the dashed line of best fit to the y-axis at the position labelled 125°C.

Conventions

- Values that are outside a plotted range of measurements are estimated.
- This is only valid for data that follows a consistent trend.
- A dotted line is drawn with a ruler from a point on either the x or y axis to the **extended** line of best fit, and then directly across or down to a point on the other axis. The two points where the dotted line joins both axes are the corresponding estimated values.

Incorrect graphs

When a graph is not drawn correctly it can cause data to be misinterpreted. Two examples of incorrect graphs, each with common errors, are shown below.

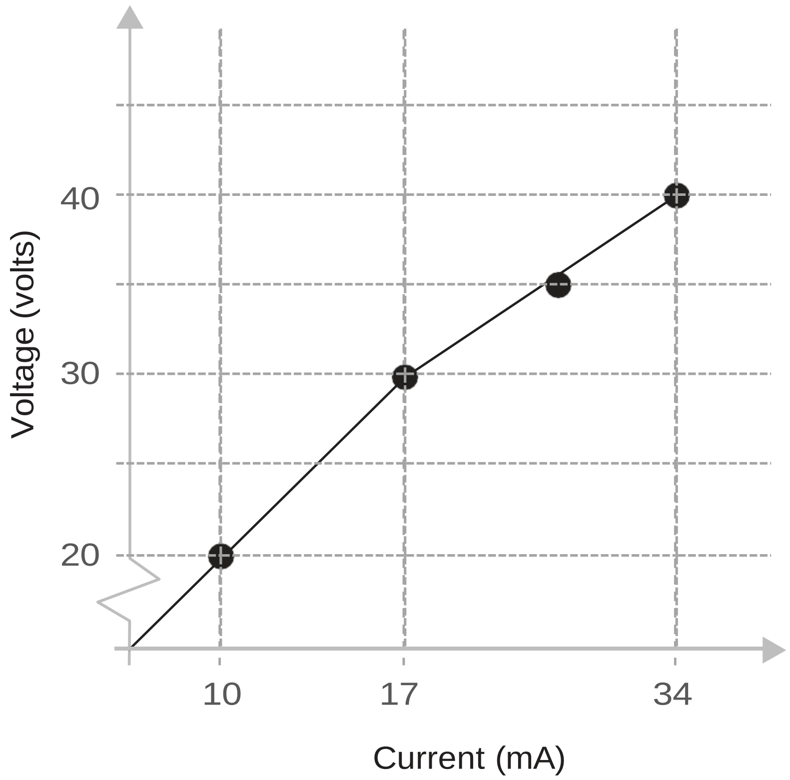


Figure 6: First example of an incorrect graph

Image long description: Scatter plot with no title. Every second horizontal line is labelled, in multiples of 10 from 20 to 40. The horizontal lines are attached to the y-axis, which is labelled 'Voltage (volts)' and has a discontinuity marker from 0 to 20. Vertical lines are not evenly spaced and are labelled 10, 17 and 34 from the origin. The vertical lines are attached to the x-axis, which is labelled 'Current (mA)'. A line is drawn to connect the origin to $(17, 30)$ through $(10, 20)$ and then to continue with a change in gradient to connect to $(34, 40)$. Four data points are plotted using a dot.

Graph errors (first example)

- The title is missing.
- The x-axis scale divisions are inconsistent.
- The y-axis is not labelled with the correct unit of measurement
- Data points are not plotted with 'x' symbol.
- The line of best fit does not have a constant gradient.
- The location of $(0,0)$ is not at the intersection of the x and y axis and zero is not marked on either axis.

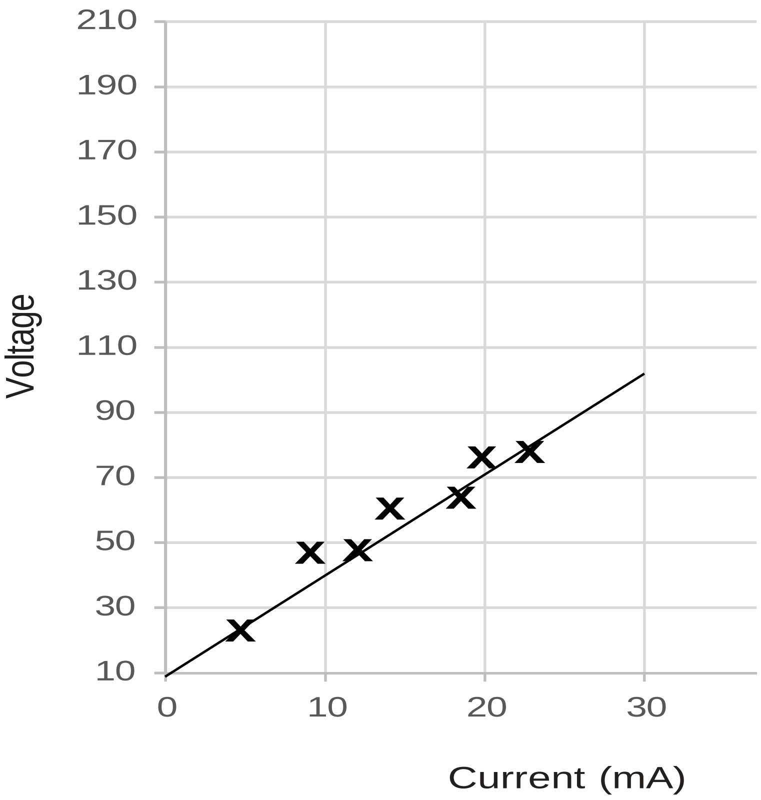


Figure 7: Second example of an incorrect graph

Image long description: Scatter plot with no title. Evenly spaced horizontal lines are labelled from 10 at the origin, counting by 20 to a maximum of 210. The horizontal lines are attached to the y-axis, which is labelled 'Voltage'. Vertical lines are evenly spaced and are labelled in multiples of 10 from zero to 50. The vertical lines are attached to the x-axis, which is labelled 'Current (mA)'. A solid straight line of best fit is drawn from the junction of the x-axis and y-axis to $(30, 100)$ on the graph. Seven data points, labelled 'x', are clustered around the line, with 4 points above the line, one below the line and 2 on the line of best fit.

Graph errors (second example)

- The title is missing.
- The axes are labelled inconsistently, with the y-axis missing the unit symbol.
- The line of best fit does not represent a trend.
- The y-axis does not start at $(0,0)$.
- The scale should be adjusted so plotted points fill more of the grid space.

Column graph

A column graph enables comparisons of qualitative independent variables.

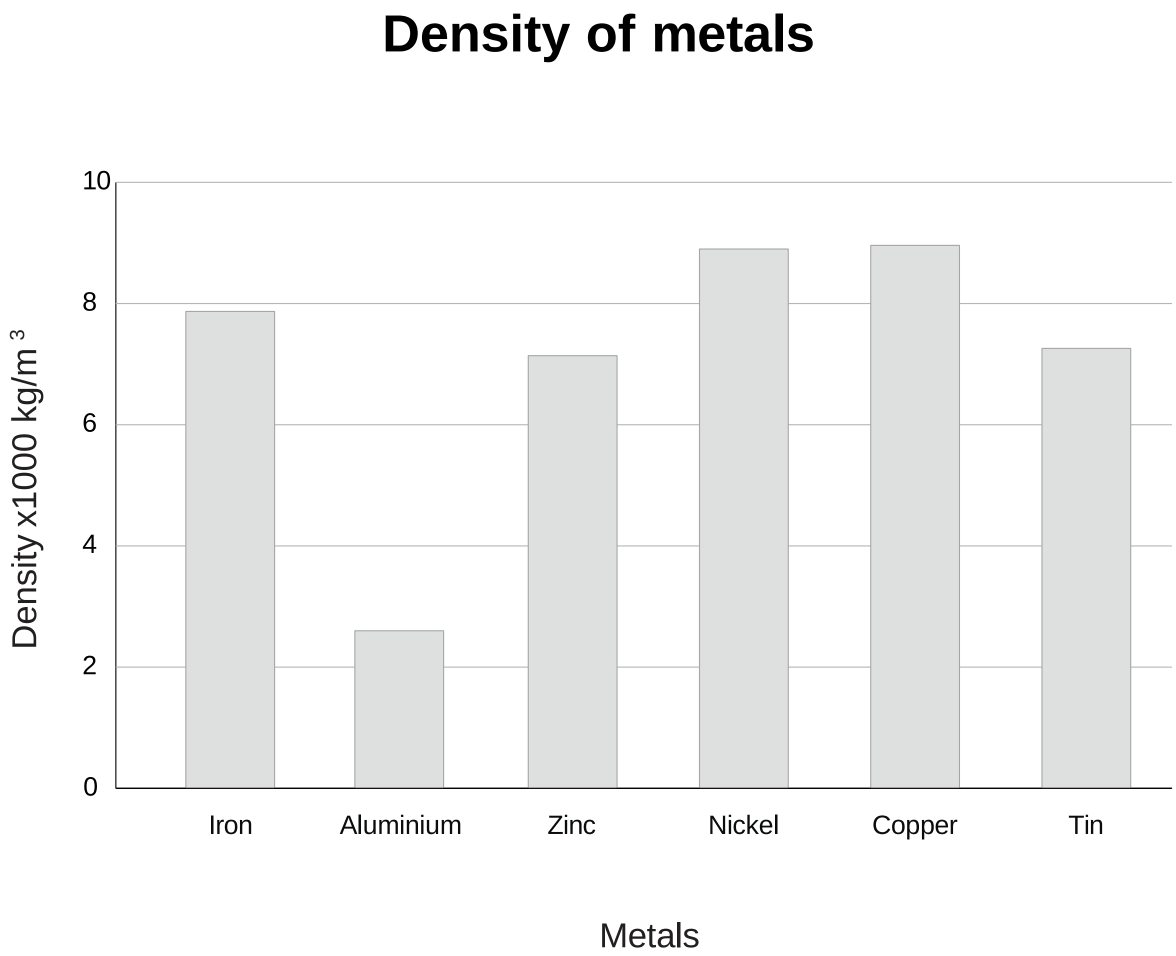


Figure 8: Example of a column graph

Image long description: Column graph titled ‘Density of metals’. The x-axis lists the metals iron, aluminium, zinc, nickel, copper and tin. The y-axis, which represents density, is labelled ‘Density x 1000 kg/m^3’ and ranges from 0 to 10 (in thousands of kg/m^3). Each metal has a corresponding vertical bar indicating its density. Iron, nickel and copper have similarly high densities, all close to 8,000 to 9,000 kg/m^3. Aluminium has the lowest density, at around 2,700 kg/m^3, while zinc and tin fall in the mid-range between 5,000 and 7,000 kg/m^3.

Conventions

- The title indicates the relationship being shown.
- The x-axis represents the independent variable.
- The y-axis represents the dependent variable.
- Axes are labelled with the appropriate units of measurement and names.
- Columns are drawn with a ruler and may be shaded or coloured.
- Columns are equal in width and evenly spaced.

Compound column graph

A compound column graph shows the proportions of measured variables in a measured total.

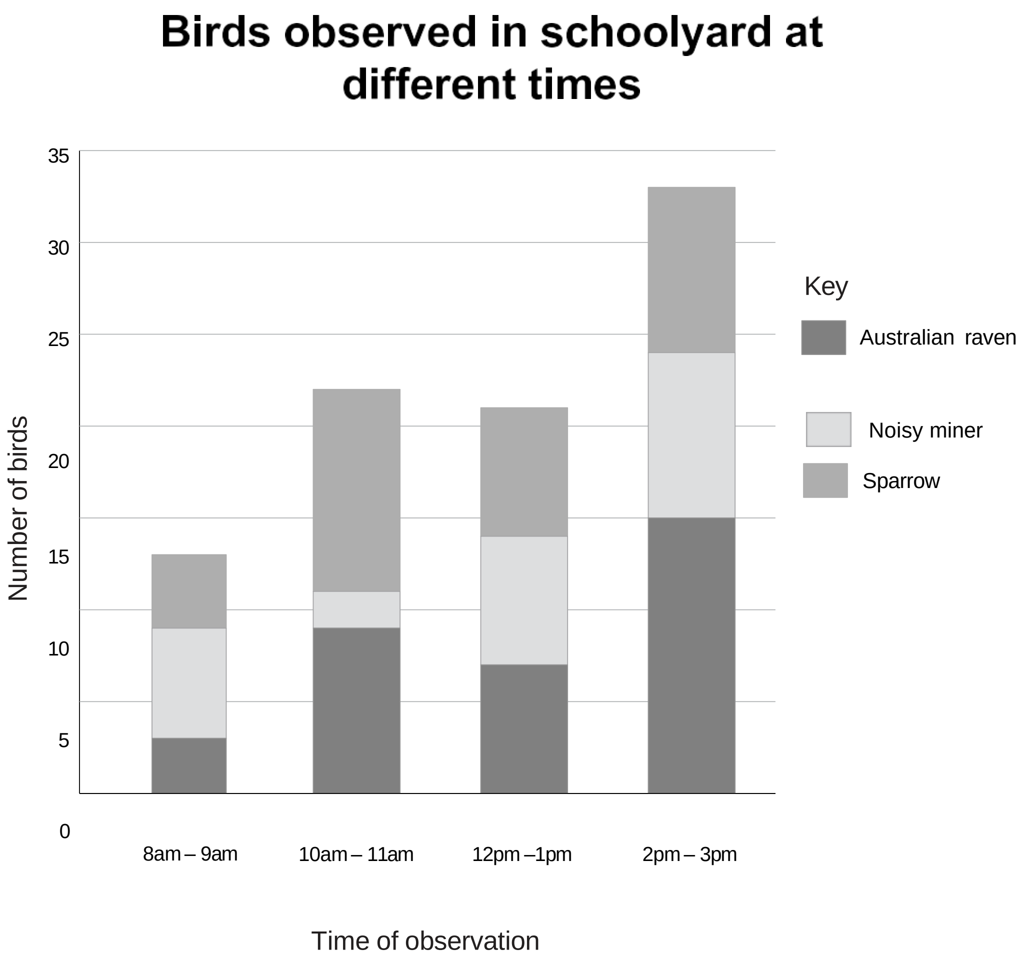


Figure 9: Example of a compound column graph

Image long description: Compound column graph, titled 'Birds observed in schoolyard', showing the number of birds observed at different times of the day. The x-axis represents 4 time intervals of one hour between 8 am and 3 pm. The y-axis represents the number of birds observed, ranging from 0 to 35. Three bird species are represented in the stacked bars: Australian raven, Noisy miner, and Sparrow. The height of the bars shows that the number of observed birds fluctuates throughout the day, peaking between 2 pm and 3 pm when about 35 birds are observed. Shading in the bars corresponding to each bird species shows how the composition of species varies across time intervals.

Conventions

- The title indicates the relationship being shown.
- The x-axis represents the independent variable.
- The y-axis represents the dependent variable.
- Axes are labelled with quantity (unit) if appropriate.
- Columns are drawn with a ruler and are shaded or coloured.
- Columns are equal in width and evenly spaced.
- The key links the column sections with the data points.
- The column height is the total of the measured variables.

Percentage column graph

A percentage column graph shows the proportion of measured variables equalling 100%.

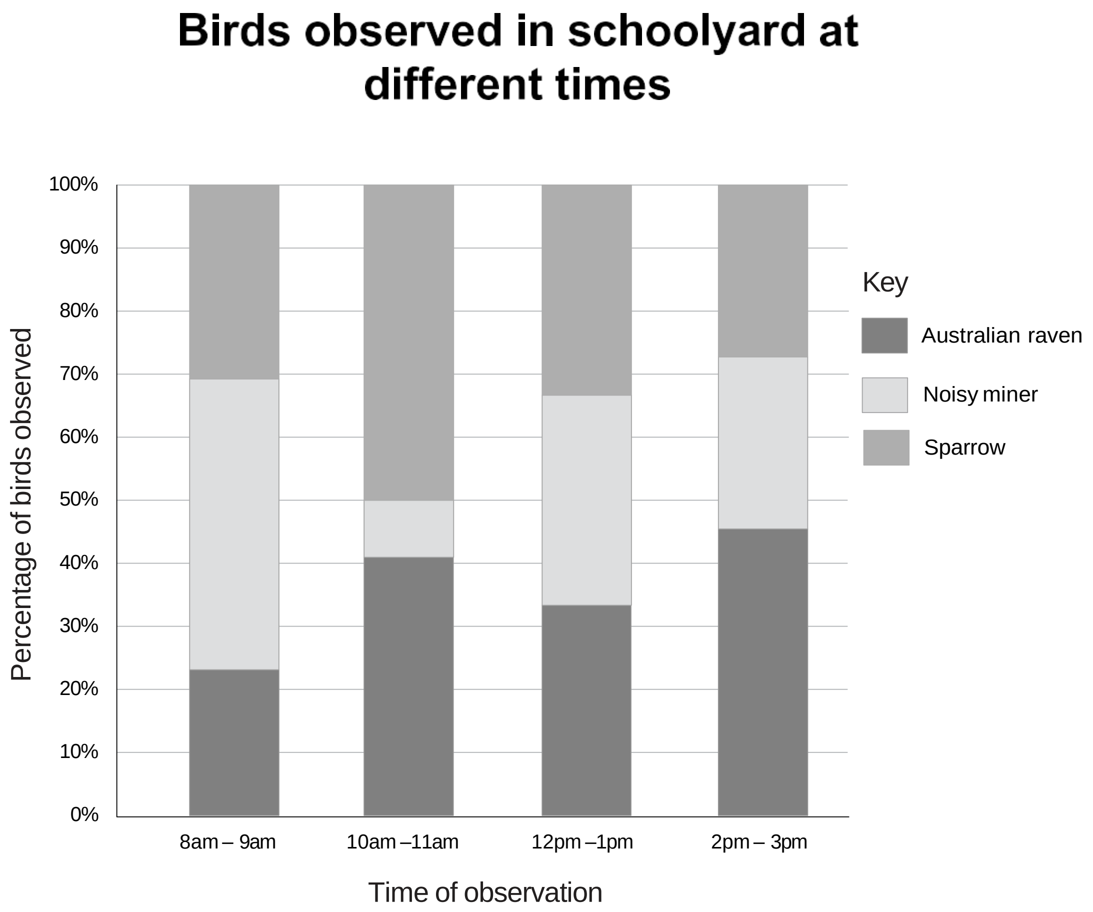


Figure 10: Example of a percentage column graph

Image long description: Percentage column graph, titled 'Birds observed in schoolyard', showing the percentages of birds observed at different times of the day. The x-axis represents 4 time intervals of one hour between 8 am and 3 pm. The y-axis represents the percentage of birds observed, ranging from zero to 100%. Three bird species are represented in the stacked bars: the Australian Raven, Noisy Miner and Sparrow. Shading in the bars corresponding to each bird species shows how the percentage composition of bird species varies across time intervals.

Conventions

- The title indicates the relationship being shown.
- The x-axis represents the independent variable.
- The y-axis represents the dependent variable.
- Axes are labelled with measurement (unit) if appropriate.
- Columns are drawn with a ruler and are shaded or coloured.
- Columns are equal in width and evenly spaced.
- The key links the column sections with the data points.
- The column height is divided into segments representing each variable's percentage contribution, with the total equalling 100%.

Column graph with a trendline

A column graph with a trendline highlights patterns and predicts possible future trends.

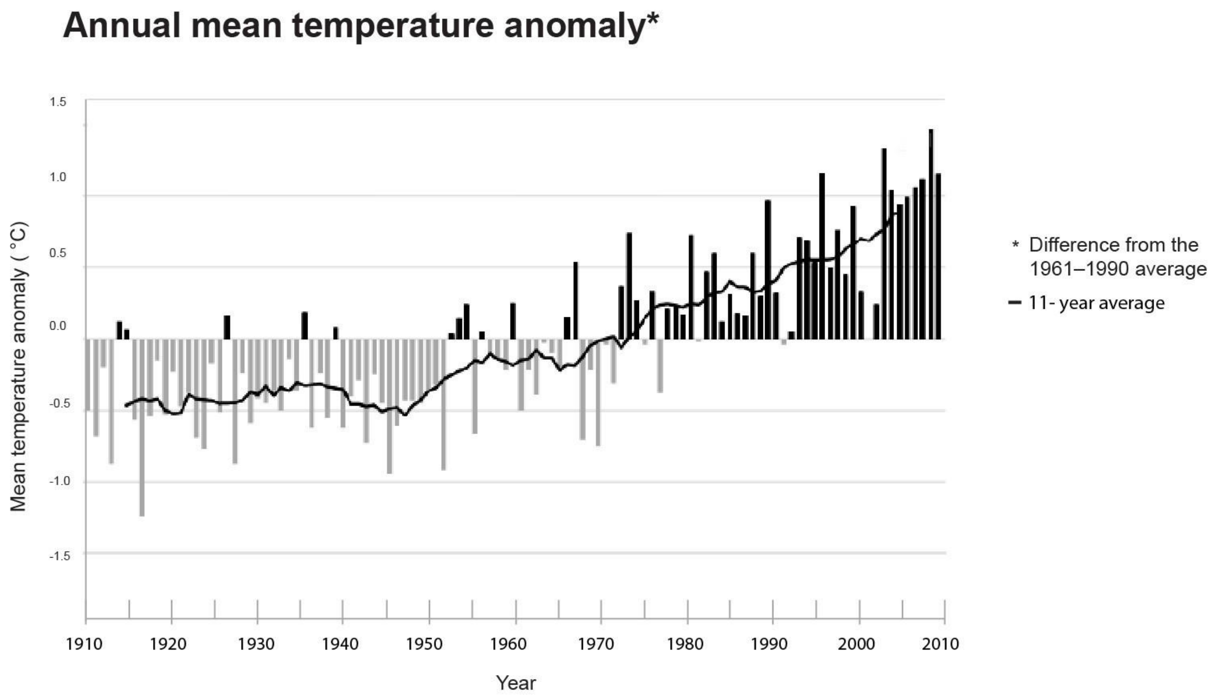


Figure 11: Example of a column graph with a trendline

Image long description: Column graph, titled 'Annual mean temperature anomaly', shows annual mean temperatures and their recorded deviation from the baseline (0.0), which is stated as the average of temperatures between 1961 and 1990. The x-axis is in years, starting at 1910 and ending at 2010. The y-axis is the 'mean temperature anomaly (°C)', ranging from −1.5 to +1.5 (°C). The vertical bars represent yearly temperature anomalies, with the dark bars indicating positive anomalies (warmer than the baseline) and light bars showing negative anomalies (cooler than the baseline). A steady upward trend in temperature anomalies is evident over the decades, particularly from the early 1980s, when the anomalies shift from negative to positive. A bold line traces the 11-year average, highlighting the overall warming trend. By 2010, the temperature anomaly reaches just over +1.0°C, indicating the average global temperature increase since 1910.

Conventions

- The title indicates the relationship being shown.
- The x-axis represents the independent variable.
- The y-axis represents the dependent variable.
- Axes are labelled with measurement (unit) if appropriate
- Columns are drawn with a ruler and are shaded or coloured.
- Columns are equal in width and evenly spaced.
- The height of each column represents the total of a measured variable.
- The trendline shows the data pattern.

Sector graph

A sector graph is a circular diagram that shows the proportions of measured variables in relation to a measured whole.

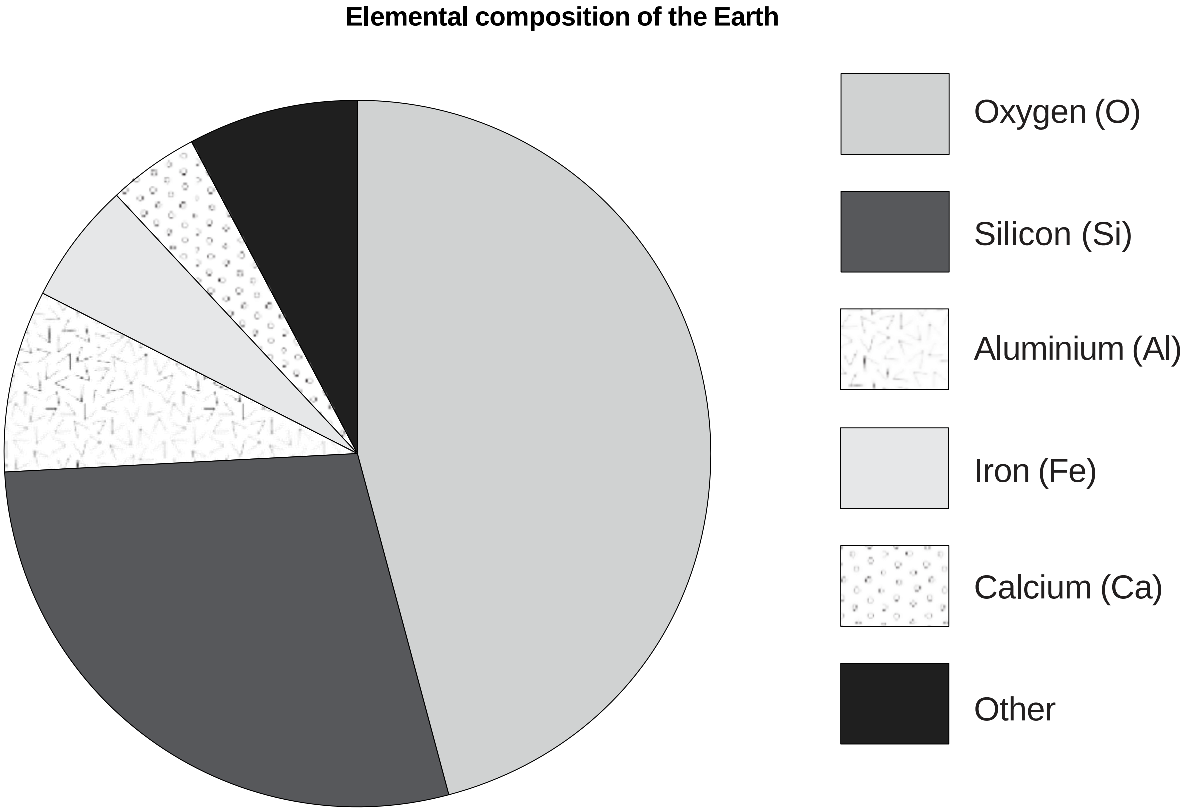


Figure 12: Example of a sector graph

Image long description: A sector graph, titled 'Elemental composition of the Earth'. A key with different patterns indicates which element accounts for which sections of the graph. Oxygen (O) makes up the largest portion of the Earth's composition (approximately 46%). Silicon (Si) accounts for approximately 28%, aluminium (Al) 8%, iron (Fe) 5% and calcium (Ca) 4%. Unspecified elements, referred to as 'other' in the key, account for approximately 9% of the chart.

Conventions

- The title indicates the relationship being shown.
- The larger the angle of segment, the greater the proportion of the variable within the whole.
- Colours and/or patterns in the key indicate which segment corresponds to which variable.

Multiple line graph

A multiple line graph compares 2 dependent variables to identify relationships.

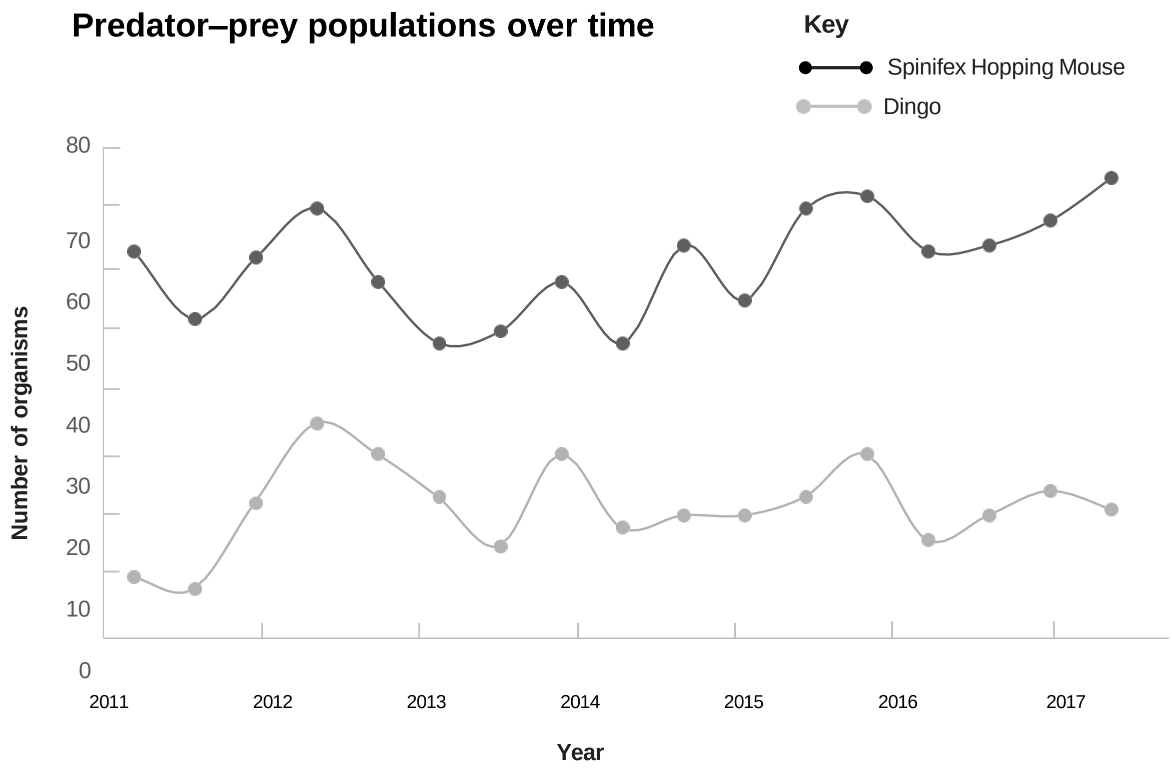


Figure 13: Example of a multiple line graph

Image long description: A multiple line graph, titled 'Predator–prey populations over time', compares the relationship between populations of Dingo (predator) and Spinifex Hopping Mouse (prey). The x-axis is labelled 'Year', with yearly increments from 2011 to 2017. The y-axis is labelled 'Number of organisms', with increments of 10 from zero to 80. A dark wavy line with plotted points represents Spinifex Hopping Mouse numbers over the period. It fluctuates between around 50 and 75. A light line shows Dingo numbers fluctuate between the 10 to 30 range over the period, peaking in 2012 at 35. While the 2 lines rise and fall at the same times for most of the period, plotted points for 2017 show a notable divergence with Spinifex Hopping Mouse numbers trending upwards and Dingo numbers trending downwards

Conventions

- The title indicates the relationship being shown.
- The x-axis represents the independent variable.
- The y-axis represents the dependent variable.
- Axes are labelled with measurement (unit) if appropriate.
- Plotted points are joined with a line.
- The key links the plotted points with the relevant variable.

Box plot

A box plot is a graphical, 5-number summary of a dataset. It includes the maximum and minimum data values, the lower and upper quartiles, and the median.

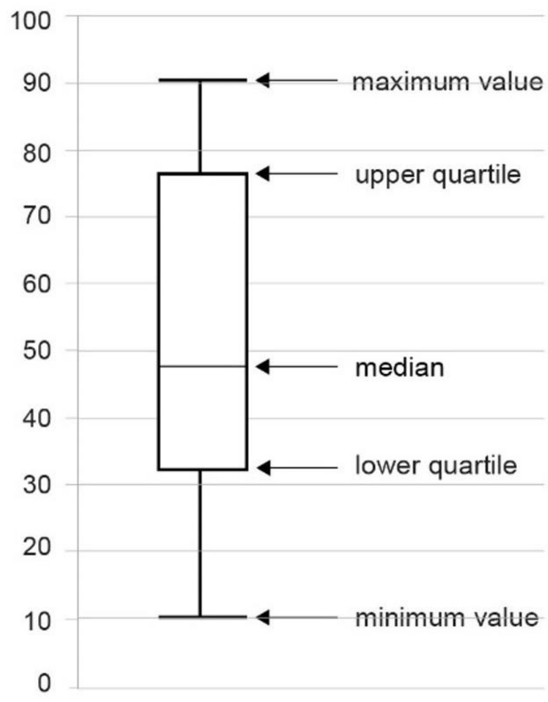


Figure 14: Example of a box plot

Image long description: A box plot with a maximum value at 90, an upper quartile ranging between 76 and 48, the median at 48, a lower quartile ranging between 48 and 32, and a minimum value at 10.

Conventions

- The title indicates the relationship being shown.
- The y-axis represents the dependent variable.
- The 'box' covers the middle 50% of scores between the upper and lower quartiles, representing the interquartile rang.

Precision accuracy chart

A precision accuracy chart compares the precision and accuracy of a set of data points.

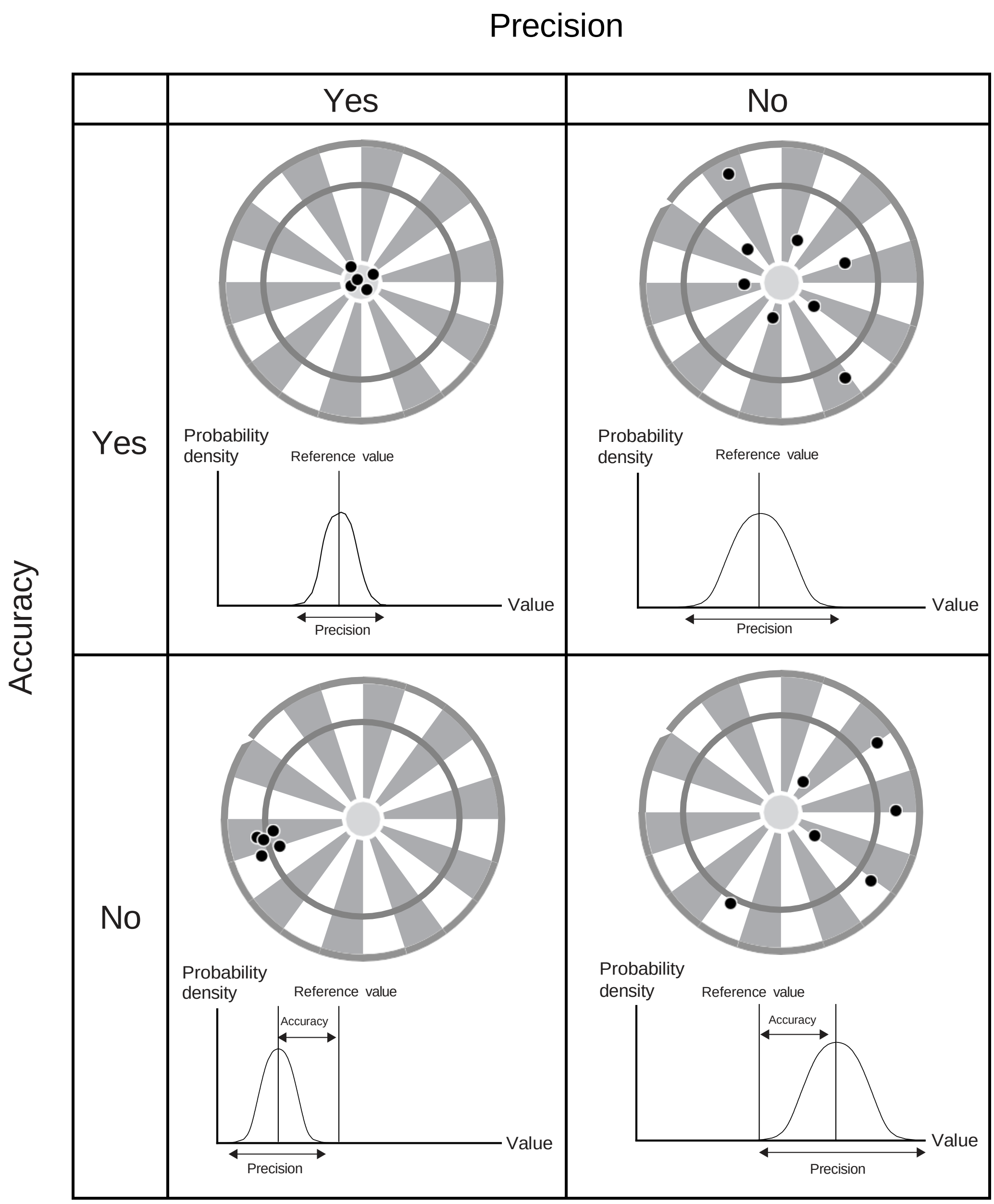


Figure 15: Example of a precision accuracy chart

Image long description: A 2 x 2 grid that is labelled ‘Accuracy’ on the left side and ‘Precision’ at the top. Both sides are split into 2 options: ‘Yes’ and ‘No’. Each of the 4 boxes in the grid has an image of a dartboard with 6 dots representing darts, and a probability density graph below the dartboard. The top left (‘Yes’/‘Yes’) box represents an example of ‘high accuracy/high precision’, with all darts clustered in the target, or bullseye, of the board. The top right (‘Yes’/‘No’) box represents ‘high accuracy/low precision’ as the darts are spread away from, not clustered around, the target. The bottom left (‘No’/‘Yes’) box represents ‘low accuracy/high precision’ as the darts are clustered away from the bullseye. The bottom right (‘No’/‘No’) box represents ‘low accuracy/low precision’ as the darts are widely scattered across the board, with most far away from the bullseye.

Conventions

- The dots represent data points.
- The bullseye (target) on the dartboard represents the reference value.
- Precise data points represent a reliable method.
- Accurate data points represent a valid investigation.

Microscopy diagram

A microscopy diagram is a labelled sketch of microscopic observations.

Epidermal onion cells tangential section x50

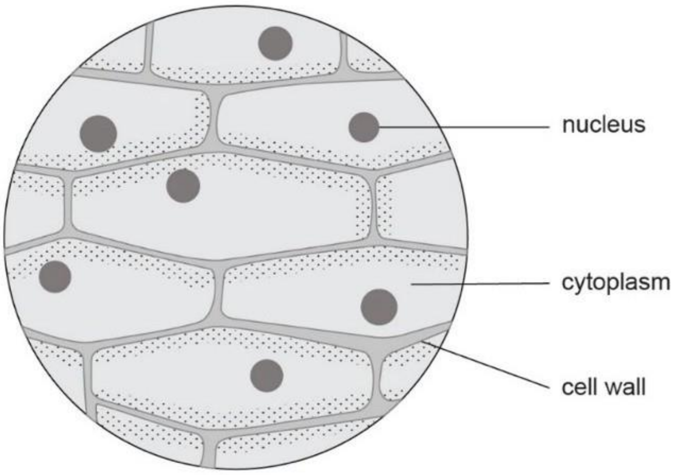


Figure 16: Example of a microscopy diagram – tangential section

Image long description: A round microscopy diagram of epidermal onion cells (as they would appear under a microscope). The plant cells are arranged in a grid structure, and each cell has a stretched hexagonal shape. Three parts of the image are labelled: the nucleus – which is a round, dark circle in each cell; the cell wall – the thin layer surrounding each cell; and the cytoplasm – the liquid that fills each cell.

Celery stalk transverse section x15

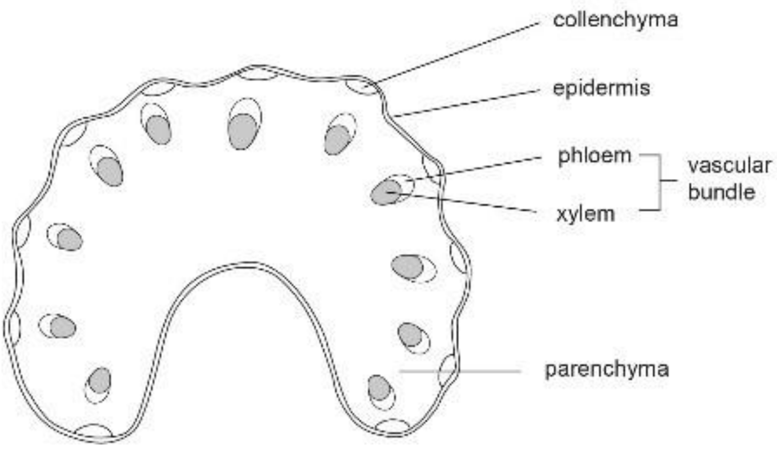


Figure 17: Example of a microscopy diagram – transverse section

Image long description: A microscopy diagram of a crescent-shaped celery stalk cross-section. The parts are labelled as : 'collenchyma' – eye-shaped cells at the inside edge of the celery cross-section; 'epidermis' – the thin layer surrounding the celery cross-section; 'parenchyma', the tissue of the celery that covers the internal space of the celery stalk; and 'vascular bundle' – which consists of a crescent-shaped 'phloem' and an egg-shaped 'xylem'. There are 11 phloem and xylem and together they form egg-like shapes that are evenly spread throughout the inside of the celery stalk.

Conventions

- The outline is drawn with a pencil.
- Labels are added as appropriate.
- Magnification is included.
- Section type is displayed (for example, ‘transverse section’ or ‘tangential section’).

Taxonomic hierarchy

A taxonomic hierarchy displays increasingly specific levels of classification of living things.

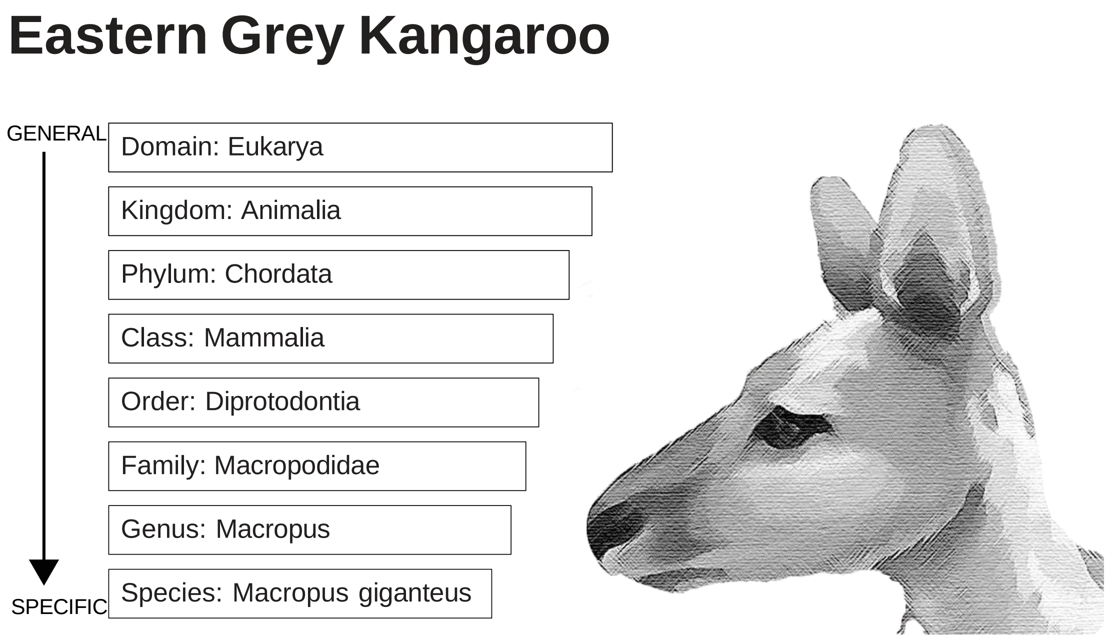


Figure 18: Example of a taxonomic hierarchy

Long description: A taxonomic hierarchy titled 'Eastern Grey Kangaroo', with 8 levels of classification arranged in boxes. Down the left side of the boxes, an arrow points downwards, indicating the level from 'General' to 'Specific'. In this description, the Eastern Grey Kangaroo is classified as belonging to: 'Domain: Eukarya', 'Kingdom: Animalia', Phylum: Chordata', 'Class: Mammalia', 'Order: Diprotodontia', 'Family: Macropodidae', 'Genus: Macropus' and 'Species: Macropus giganteus'. There is a drawing of an Eastern Grey Kangaroo's head, in profile, facing the taxonomic hierarchy pyramid

Dichotomous key

A dichotomous key is a tool for identifying and categorising organisms based on a process of responding to paired statements of observed mutually exclusive traits.

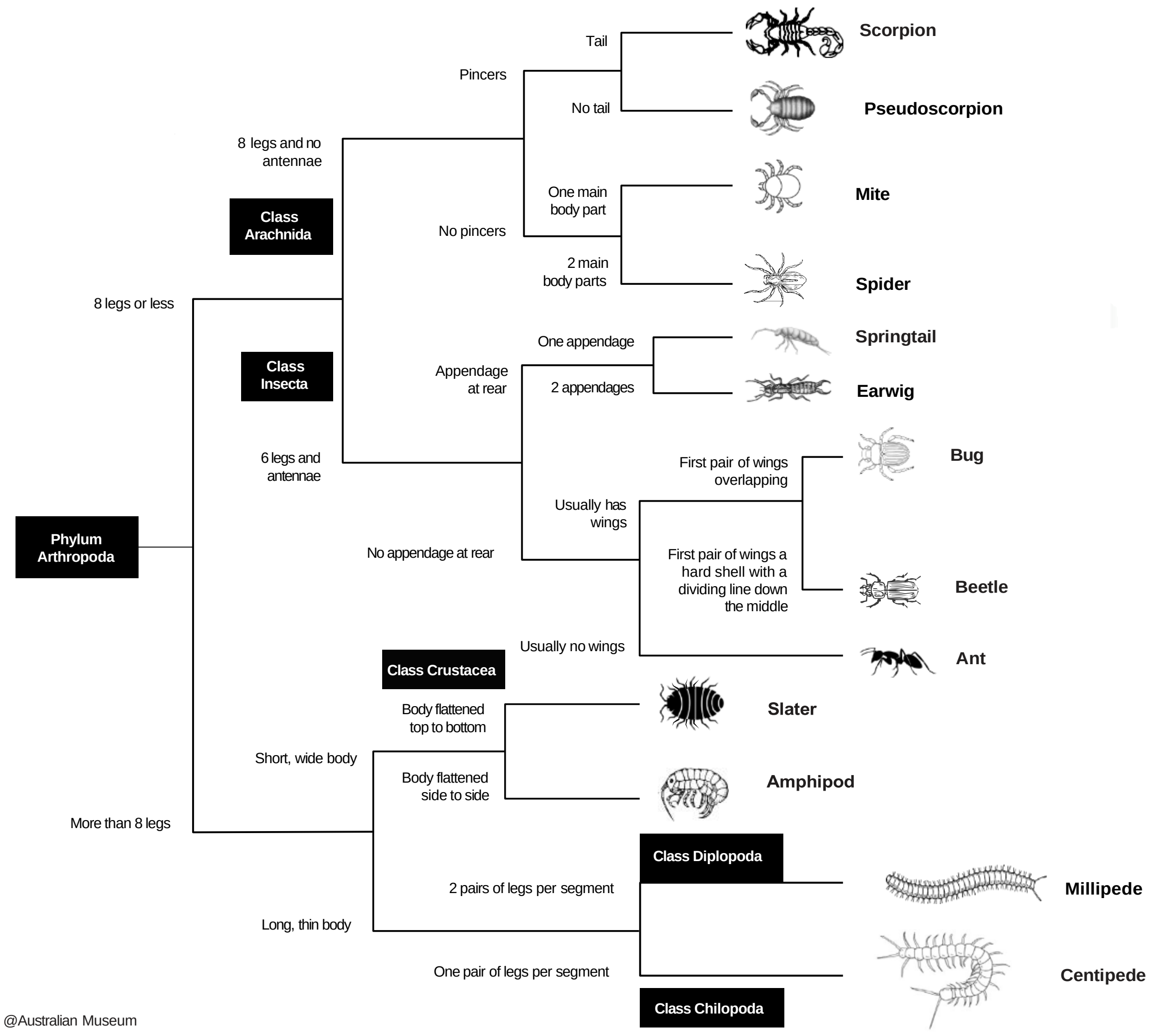


Figure 19: Example of a dichotomous key

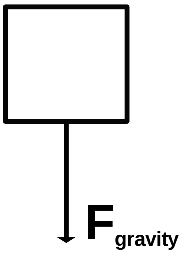
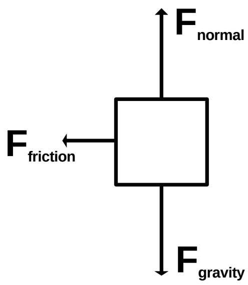
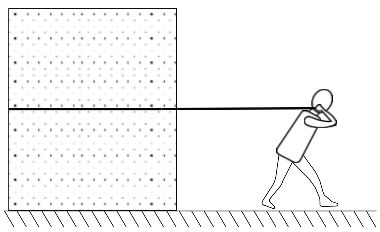
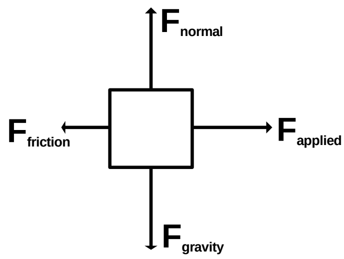
Image long description: A dichotomous key which shows how the physical features of invertebrates found in leaf litter can be used to identify them. The key includes text describing traits of the invertebrates used to make classification decisions. The most general group is labelled ‘Phylum Arthropoda’ and contains all the invertebrates listed. This group branches to ‘Class Arachnida’, ‘Class Insecta’, ‘Class Crustacea’, ‘Class Diplopoda’ and ‘Class Chilopoda’. Drawings of a scorpion, pseudoscorpion, mite, spider, springtail, earwig, bug, beetle, ant, slater, amphipod, millipede and centipede are shown as the final step to classify the invertebrates.

Conventions

- Junctions show choices based on features.
- Each organism can be uniquely identified using the branching choices.
- The ‘di-’ prefix in ‘dichotomous’ indicates 2 choices at each junction.

Free body diagrams

Free body diagrams show the forces acting in scenarios. They can be a simplified version of a labelled diagram.

Scenario (labelled diagram)	Description	Free body diagram	Resultant movement
 Figure 20: Diagram of a soccer player kicking a ball	A player is kicking a ball upwards.	 Figure 21: Free body diagram of a soccer player kicking a ball upwards	The ball continues moving upwards with decreasing speed until it reaches the top of its trajectory.
 Figure 22: Diagram of a cyclist riding a bike	A cyclist is coasting along a road.	 Figure 23: Free body diagram of a cyclist coasting along a road	The cyclist moves to the right with decreasing speed until they come to a stop.
 Figure 24: Diagram of a person dragging a box	A box is being dragged across the ground.	 Figure 25: Free body diagram of a box being dragged across the ground	A box moves to the right with increasing speed.

Conventions

- Free body diagrams simplify scenarios to represent only the forces acting.
- The arrow length represents the magnitude of the force.
- The arrow direction represents the direction in which the force is acting.
- Subscripts identify the type of force acting.

Flow chart

A flow chart represents steps in a process or procedure.

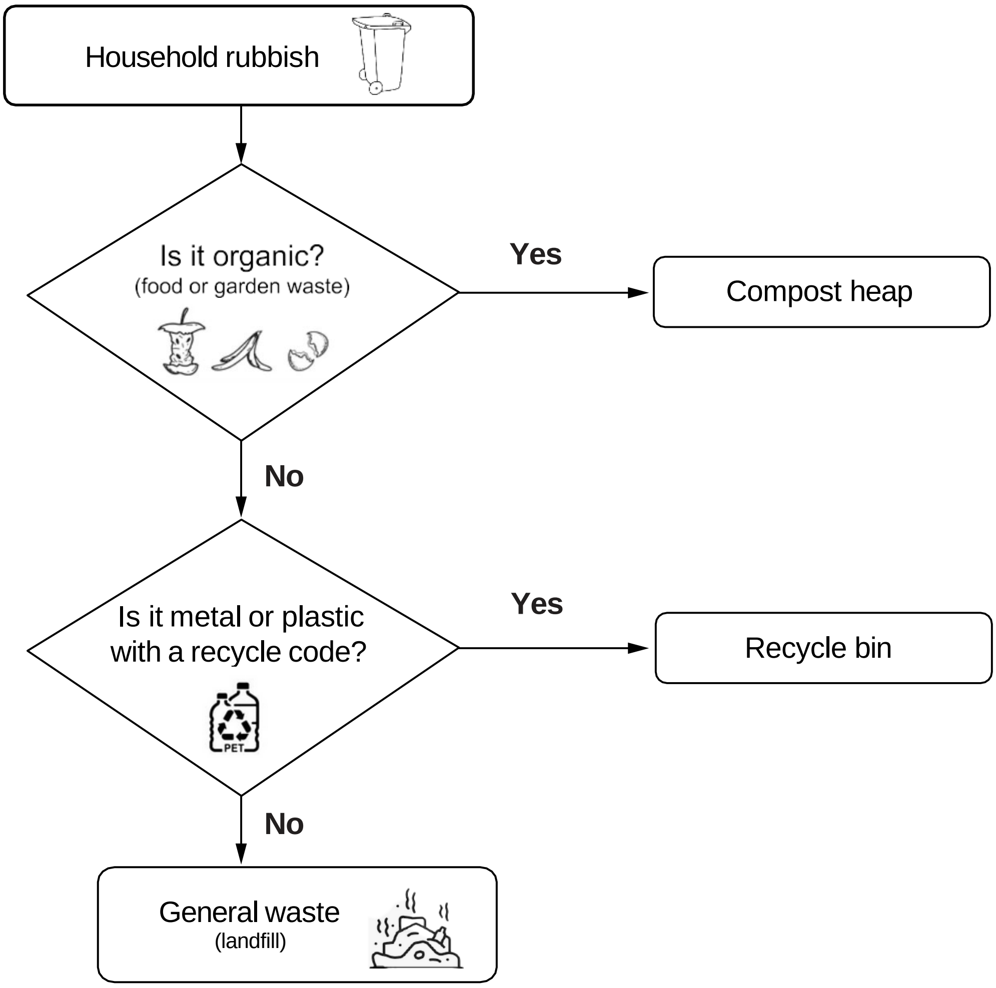


Figure 26: Example of a flow chart showing a process

Image long description: A flow chart starts with 'Household rubbish'. A down arrow points to 'Is it organic? (food or garden waste)'. A horizontal arrow labelled 'Yes' points to a final destination of 'Compost heap', and a down arrow labelled 'No' points to 'Is it metal or plastic with a recycle code?' and a drawing of bottles with a recycle symbol. A horizontal arrow labelled 'Yes' points to a final destination of 'Recycle bin', and a down arrow labelled 'No' points to 'General waste (landfill)'.

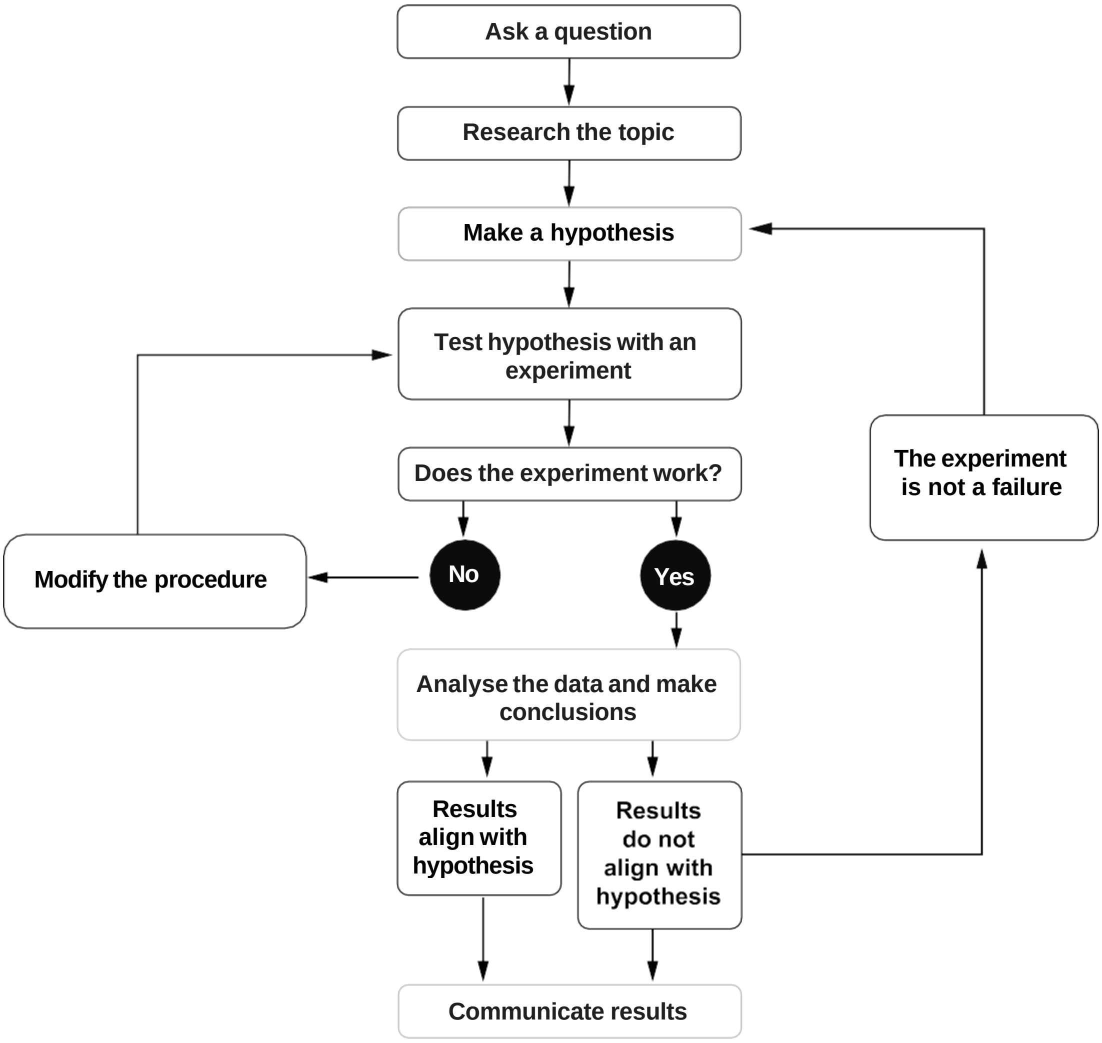


Figure 27: Example of a flow chart showing a procedure

Image long description: A flow chart starts with ‘Ask a question’. Downward arrows points to ‘Research the topic’, then ‘Make a hypothesis’, then ‘Test hypothesis with an experiment’ and finally ‘Does the experiment work?’. Here, arrows point downwards to circles labelled ‘No’ and ‘Yes’. From ‘No’, an arrow points horizontally to ‘Modify the procedure’, which leads back to ‘Test the hypothesis with an experiment’. ‘Yes’ points downwards to ‘Analyse the data and make conclusions’, with 2 arrows pointing downwards to ‘Results align with hypothesis’ and ‘Results do not align with hypothesis’. Both of these lead to a final destination of ‘Communicate results’, with arrows from ‘Results do not align with hypothesis’ also pointing upwards to ‘The experiment is not a failure’ and then ‘Make a hypothesis’.

Conventions

- The text in the shapes contains a specific action, function or outcome.
- Arrows show decision-making.
- The final shape represents the end of the process or procedure.

Venn diagram

A Venn diagram displays the commonalities and differences between 2 sets of information.

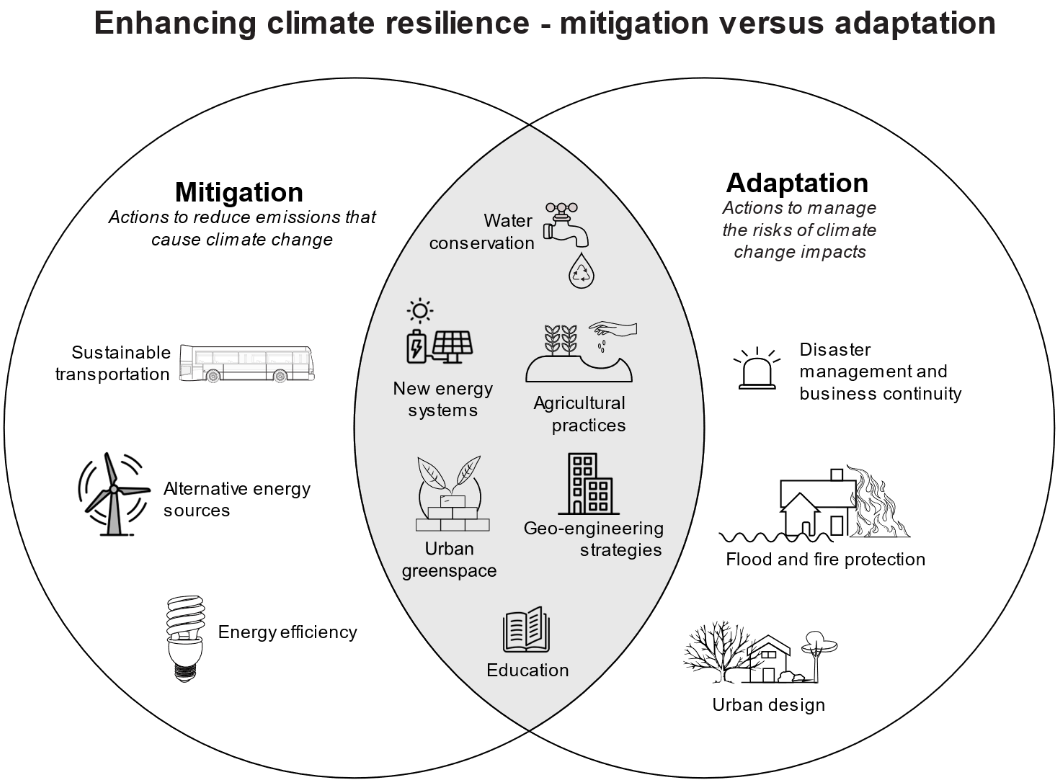


Figure 28: Example of a Venn diagram

Image long description: A Venn diagram titled ‘Enhancing climate resilience’, showing 2 overlapping circles. One circle is labelled ‘Mitigation: Actions to reduce emissions that cause climate change’. The other is labelled ‘Adaption: Actions to manage the risks of climate change impacts’. The ‘Mitigation’ circle includes the actions ‘Sustainable transportation’, ‘Alternative energy sources’ and ‘Energy efficiency’. The ‘Adaption’ circle includes the actions ‘Disaster management and business continuity’, ‘Flood and fire protection’ and ‘Urban design’. The section where the circles overlap includes the actions ‘Water conservation’, ‘New energy systems’, ‘Agricultural practices’, ‘Urban greenspace’, ‘Geo-engineering strategies’ and ‘Education’. Each actions is accompanied by a related drawing.

Conventions

- Each circle represents a dataset. The commonalities between the datasets are displayed in overlapping section.
- The title indicates the relationship between the datasets.

Polar-area diagram

A polar-area diagram shows variations in the significance of data over time.

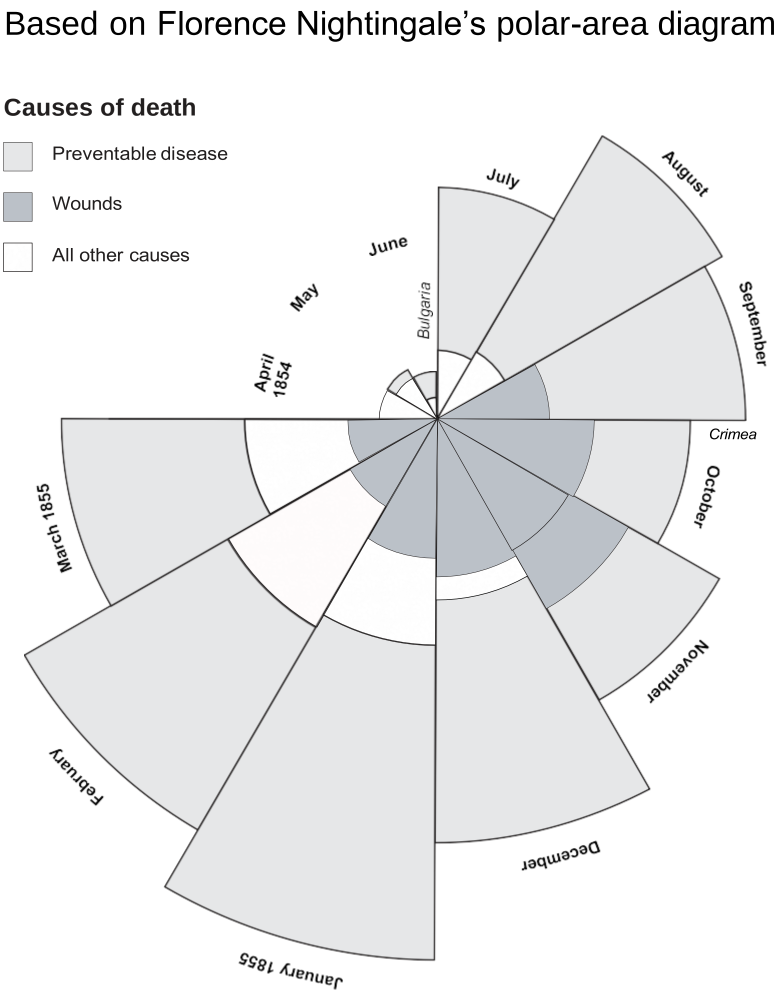


Figure 29: Example of a polar-area diagram

Image long description: A circular diagram titled 'Based on Florence Nightingale's polar area diagram', with a corresponding key to the left. The key lists causes of death including 'Preventable disease', 'Wounds' and 'All other causes'. The diagram has 12 segments of equal angles but varying size, labelled in a clockwise direction with months and years from April 1854 through to March 1855. The label 'Bulgaria' is between the segments for June and July 1854, and 'Crimea' is between September and October 1854. The segments are divided into shaded areas that correspond with the items in the key. 'Preventable disease' is represented by light shading. It accounts for the largest area in each segment, showing it consistently caused the most deaths. 'Wounds' and 'All other causes' were interchangeably the second most common cause of death. The fewest deaths occurred in June 1854, and most deaths in January 1885.

Conventions

- The segments represent equal time intervals.
- The area of the segments represents the magnitude of the data points.
- The shading represents the proportions of the variables.

Wave diagram

A wave diagram compares some features of transverse and longitudinal waves.

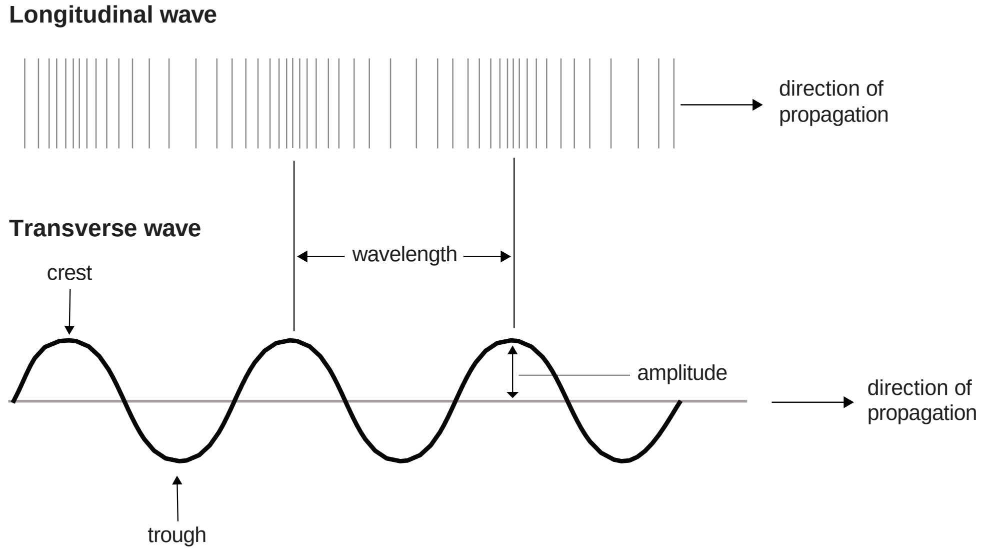


Figure 30: Example of a wave diagram

Image long description: A longitudinal wave is represented by a row of straight, vertical lines that are varying distances apart. An arrow next to line points to the right to indicate the direction of propagation. The 'wavelength" is indicated as the distance between a section with closely spaced lines to the subsequent section with closely spaced lines. A transverse wave is represented by one continuous wavy line, labelled with 'crest' at the top of a wave and 'trough' at the bottom of a wave. The 'amplitude' is labelled as the height of a crest or depth of a trough from a centre line, and the 'wavelength' as the distance between 2 crests or 2 troughs. An arrow pointing to the right shows the direction of propagation.

Conventions

- Waves are drawn using a pencil and are clearly labelled.
- A minimum of 2 wave cycles are represented.
- The diagram may include one or both wave types.

Sankey diagram

A Sankey diagram compares output and input energy to show proportion of useful energy transferred

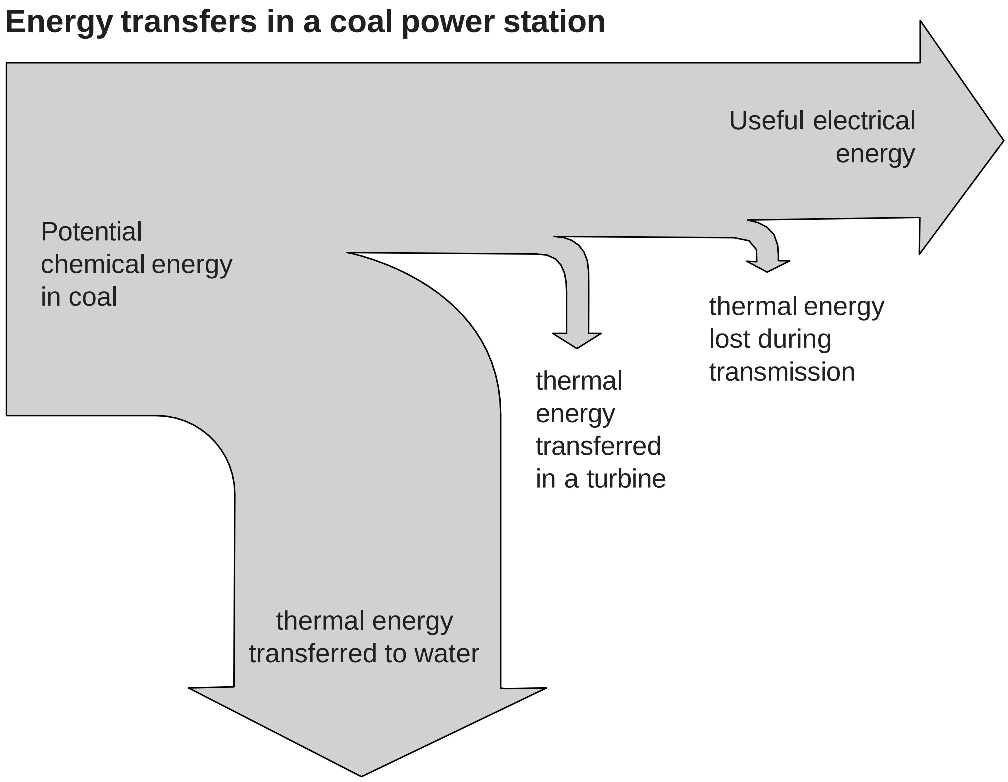


Figure 31: Example of a Sankey diagram

Image long description: A diagram of a segmented arrow labelled ‘Energy transfers in a coal power station’. The whole width of the arrow is labelled ‘potential chemical energy in coal’ and one segment of the arrow width points towards the right labelled “useful electrical energy”. Three remaining segments of the arrow width point downwards. The largest of these is labelled ‘thermal energy transferred to water’ with two smaller arrows labelled ‘thermal energy transferred in turbine’ and ‘thermal energy lost during transmission’.

Conventions

- The width of the arrows represents the proportion of the total energy in the system.
- Down arrows represent wasted energy.
- Straight arrows represent useful energy.
- Labels show energy transfers.

Rock strata diagram

A rock strata diagram compares the features of different layers of a section/s of earth's crust at one or a number of sites. The features may include fossil content and rock composition

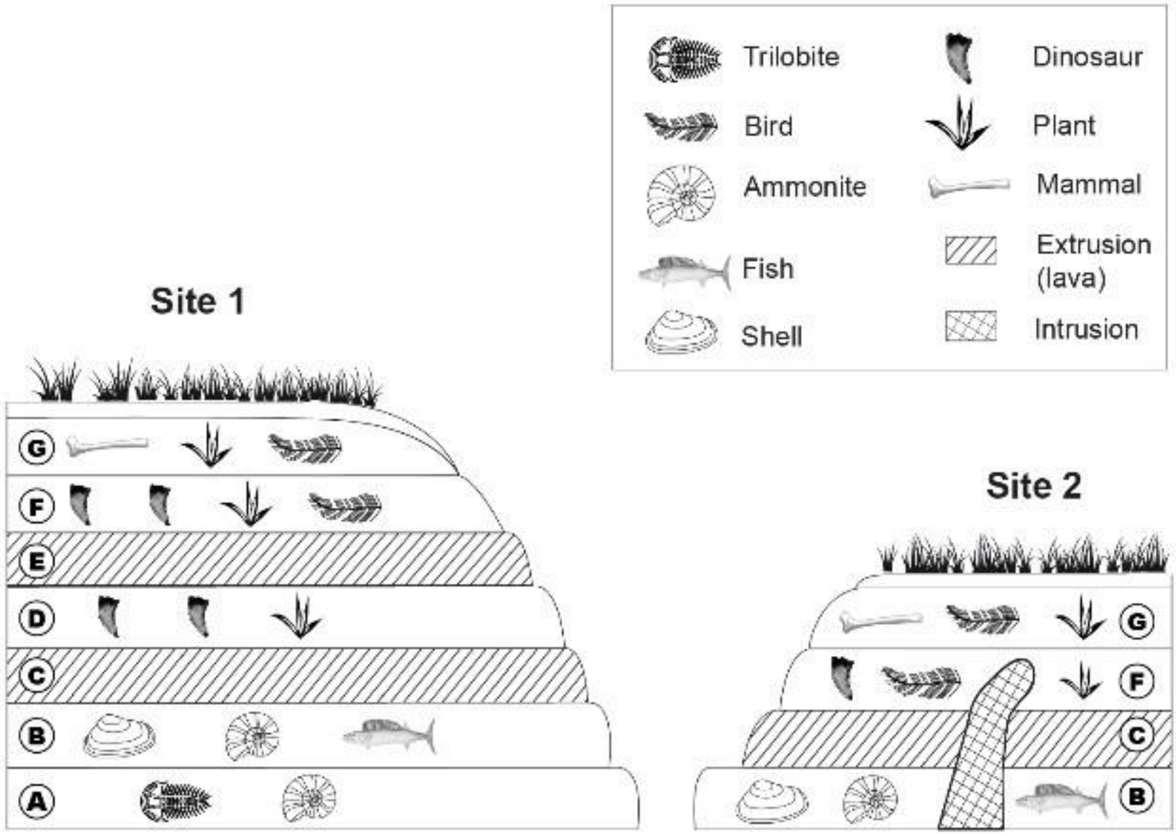


Figure 32: Example of a rock strata diagram

Image long description: Rock strata diagrams for 2 sites. Site 1 is 7 layers deep, with layers labelled A to G from deepest to highest. Site B is 4 layers deep, labelled B, C, F and G. A key includes drawings of trilobite, bird, ammonite, fish, shell, dinosaur, plant, mammal, extrusion (lava) and intrusion, corresponding with drawings in the rock layers at the sites. For Site 1, drawings in level A show markers for trilobite and ammonite; level B shows shell, ammonite and fish; level C shows extrusion (lava); level D shows 2 dinosaurs and plant; level E shows extrusion (lava); level F shows 2 dinosaurs, plant and bird; and level G shows mammal, plant and bird. For Site 2, level B shows shell, ammonite and fish; level C shows extrusion; level F shows dinosaur, bird and plant; and level G shows mammal, bird and plant. Continuous intrusion is shown in levels B, C and F.

Conventions

- The diagram represents a cross-section of rock layers.
- The key describes the symbols in the diagram.
- Letters represent rock layers deposited over time, with the oldest at the bottom and the youngest at the top (for example, in Figure 32, the oldest layer is labelled 'A' and the youngest layer is labelled 'G').

Botanical sketch

A botanical sketch is a drawing that accurately represent plants and their physical features.

River red gum (Eucalyptus camaldulensis)

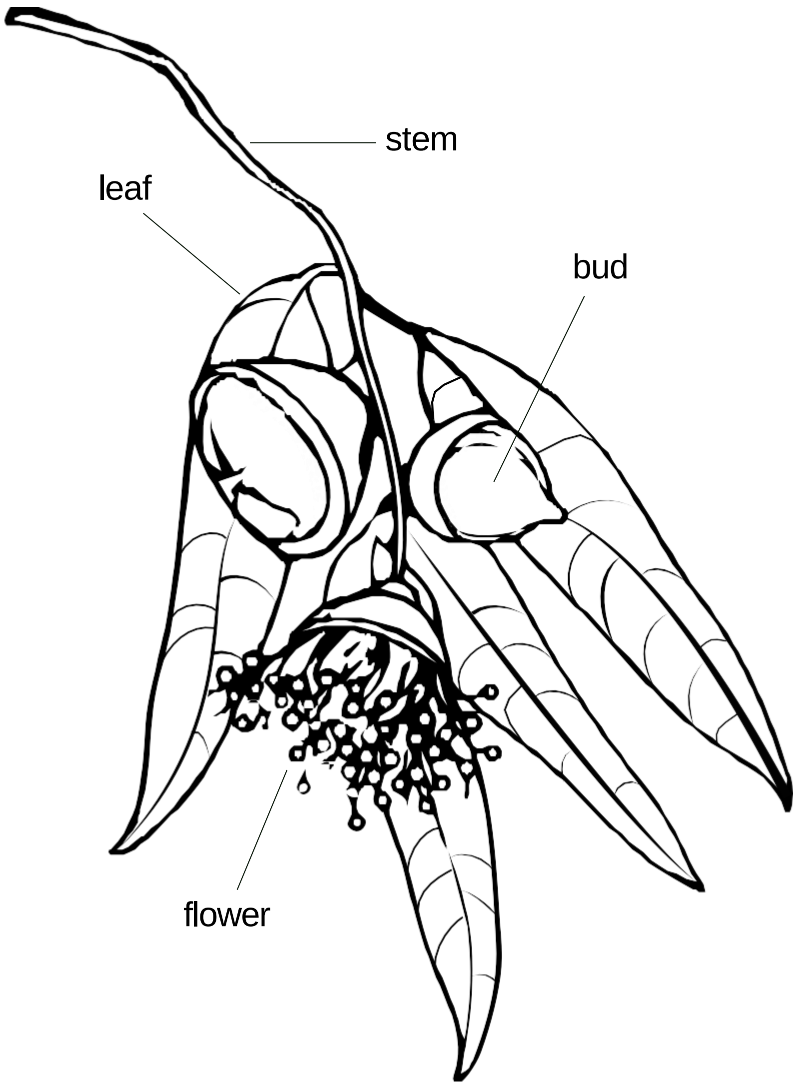


Figure 33: Example of a botanical sketch

Conventions

- Single lines are drawn in pencil to show the outline of features.
- The sketch is the same scale as the original parts of the plant.
- The sketched parts of the plant are proportional to each other.
- Labels are included as appropriate.

Appendix 2: Written practical reports

This appendix includes an outline for a written practical report that can be used to communicate a scientific investigation to a scientifically literate audience. A written report is one way of communicating and is not necessary for every investigation. Scientific reports use scientific language and terminology and conform to conventions in representations.

Terminology

- **Title**: Concise and specific description of the investigation.
- **Aim**: Brief statement to identify what is being tested.
- **Introduction**: Background information or theory related to the topic.
- **Prediction** (for Stage 4): Statement of the expected outcome of the investigation based on prior knowledge.
- **Hypothesis** (for Stage 5): Testable statement about the relationship between the independent and dependent variables.
- **Apparatus**: Lists the equipment used and quantities needed.
- **Method**:
  - Provides a numbered list of steps that describe the procedure in a way that others can replicate.
  - Identifies independent, dependent and controlled variables.
  - Includes what type of data will be recorded, and where it will be recorded.
  - May include a scientific diagram.
- **Risk assessment**:
  - Identifies all hazards and suggests steps to mitigate the risks associated with each hazard.
  - Often included as a table.
- **Results**:
  - Presents data collected during the investigation.
  - Usually includes a table and graph.
- **Discussion**:
  - Re-states the aim and hypothesis to frame the discussion.
  - Includes calculations of results and errors.
  - Interprets results and compares them with expected results.
  - Discusses errors and limitations.
  - Includes scientific implications, and suggestions for future research.
- **Conclusion:**
  - Summarises the findings of the investigation and the significance of the results.
  - Includes a statement referring to the prediction or hypothesis.
- **References**:
  - Uses an accepted citation method.

Appendix 3: Method to investigate the solubility of substances

Variables table

Independent variable	Dependent variable	Controlled variables
Type of solid (sugar, table salt, wax, sand, bread)	Whether the solid dissolves or remains undissolved (solubility)	▪ Same size beakers (150 mL) ▪ Same volume of solvent (100 mL) ▪ Same temperature of solvent (room temperature) ▪ Same mass of solids (5 g) ▪ Same time for solids to dissolve (10 minutes) ▪ Same type of oil used in second set of trials

Safety risks and mitigation

Risk	Mitigation
Slipping from spilled water or oil	Clean any spills immediately and ensure the workspace remains clear of hazards.
Cuts from sharp edges on solids like wax or sand	Handle all materials carefully and wear gloves when necessary.

Method

1. **Ensure safety**
   a. Wear safety goggles to protect eyes and ensure the workspace is free from hazards such as spills.
   b. Use gloves to avoid direct contact with the substances, particularly when handling unfamiliar materials.

2. **Prepare the beakers**
   a. Place 5 clean 150 mL beakers next to each other on a flat bench.
   b. Make sure the bench is dry and level to prevent spillage.

3. **Measure the water**
   a. Use a 100 mL measuring cylinder to measure exactly 100 mL of water at room temperature.
   b. Pour 100 mL of water into each of the 5 beakers.

4. **Measure the solids**
    a. Weigh 5 different solids, each with an equal mass of 5 g (for example, sugar, table salt, wax, sand and bread).

5. **Add the solids**
    a. Place one solid into each beaker at the same time, to maintain uniform conditions.

6. **Observe the reactions**
    a. Allow the solids to remain in the beakers for 10 minutes.
    b. Identify which solids have dissolved, indicating solubility in water. Solids that remain visible are insoluble.

7. **Record the data**
    a. Document the results in a data table, noting which solids dissolved and which remained undissolved.
    b. Include any additional observations, such as changes in water clarity or temperature.

8. **Repeat with oil**
    a. Replace the water with oil and repeat steps **2** to **7** to investigate which substances are soluble in oil.
    b. Record the results in a new data table, clearly indicating which solvent was used (water or oil).

9. **Improve reliability**
    a. Repeat the entire experiment at least twice more to increase the consistency and reliability of the data.
    b. Compare the results from all trials to check for any inconsistencies or anomalies.