Learner's Book answers

Unit 1 Cells

Topic 1.1 Plant cells

Getting Started

Learners discuss and share ideas on the size of cells, how they can be seen and what they may look like.

Questions

1 They are chloroplasts. They are green because they contain chlorophyll. This is where photosynthesis happens, where food is made.

2 A cell wall is on the outside of the cell, but a cell membrane is further in.

A cell wall is made of cellulose, but a cell membrane is not.

A cell wall is strong and stiff, but a cell membrane is flexible.

A cell wall is much thicker than a cell membrane.

A cell wall helps to hold the plant cell in shape, but a cell membrane does not.

A cell membrane helps to control what goes in and out of the cell, but a cell wall does not.

Think like a scientist: Making a model of a plant cell

1 Answers will depend on the model that the learner has made and those that other learners have made.

2 Answers will depend on the model that the learner has made. Look for answers that make statements about how the model does represent a plant cell, and also statements about how it is not a perfect representation.

Think like a scientist: Looking at plant cells through a microscope

1 The onion cells are not green because they do not contain chloroplasts or chlorophyll. Onion cells are inside the onion and do not get any light, so there is no point in having chloroplasts.

2 Answers will depend on any difficulties that the learner had.

Topic 1.2 Animal cells

Getting Started

Cell wall, cellulose, cell membrane, cytoplasm and chloroplasts.

Questions

1 A: plant cells; B: plant cells; C: animal cells. A and B have cell walls and regular shapes, whereas C does not have cell walls and is irregular in shape.

2 Answers will depend on how the learners made their plant cell model. They should suggest:

Removing the part of the model that represents the cell wall, while keeping the cell membrane in place.

Removing the parts representing chloroplasts.

Removing the part representing the sap vacuole.

Topic 1.3 Specialised cells

Questions

1 Cell membrane, cytoplasm

2 They do not have cell walls or large sap vacuoles.

Activity: Structure and function in animal cells

Name of cell	Function of cell	Specialised structure	How this helps the cell to carry out its function
Red blood cell	Transports oxygen	has haemoglobin in its cytoplasm	haemoglobin carries oxygen
		is very small	it can squeeze through tiny capillaries
		has no nucleus	more room for haemoglobin, so it can carry more oxygen
Neurone	Carries electrical signals from one part of the body to another	has a long axon	allows electrical signals to travel long distances very quickly
		has dendrites	these pick up electrical signals from other nerve cells
Ciliated cell	Stops bacteria and dust getting into the lungs	has tiny, thread-like cilia along one edge	cilia wave in unison, sweeping mucus, in which bacteria and dust are trapped, away from the lungs

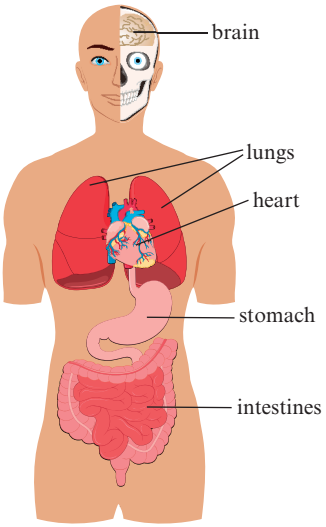
3 They are underground where they get no sunlight, so they cannot photosynthesise. There is therefore no need for them to have chloroplasts.

4 Cell wall, cell membrane, cytoplasm.

Activity: Structure and function in plant cells

Name of cell	Function of cell	Specialised structure	How this helps the cell to carry out its function
Root hair cell	Absorbs water and mineral ions from the soil	has a long extension from one side	allows water to move easily from the soil into the cell
Palisade cell	Make food by photo-synthesis	has many chloroplasts containing chlorophyll	chlorophyll absorbs energy from sunlight which the plant uses to make food

Topic 1.4 Cells, tissues and organs



Questions

1 The ciliated epithelium tissue sweeps mucus, containing dust particles and bacteria, away from the lungs.

2 Any sentences using the words appropriately are acceptable.

3 A group of similar cells is called a **tissue**.

An **organ** is a structure made of many different tissues.

An **organ system** is a group of organs that carry out a particular function.

An **organism** is a living thing. It may contain many different organ systems, organs and tissues.

Check your progress

1.1 a Ciliated cell

b Root hair cell

c Palisade cell

1.2 a A = cell membrane

B = cytoplasm

C = nucleus

D = mitochondrion

b It does not have a cell wall or a sap vacuole.

1.3 A: chloroplast, where photosynthesis takes place.

B: cell wall: holds the cell in shape.

C: nucleus: controls the activities of the cell.

D: cell membrane: controls what goes in and out of the cell.

E: mitochondrion: where energy is released from nutrients.

1.4 a Neurone

b It transmits electrical impulses.

c It has a long axon that allows the impulses to travel long distances very quickly.

d Nervous system

1.5 a Tissue

b Organ

c Organ system

Unit 2 Materials and their structure

Topic 2.1 Solids, liquids and gases

Getting started

1 Accept any two correct answers for each of: solid, e.g. wood and bread; liquid, e.g. water and cooking oil; gas, e.g. air and oxygen.

2 Complete the table using the items in question 1. This will depend on what the learners choose. An example is given in the Learners book. Concentrate on the reasons for the choice.

Questions

1 Solid, liquid and gas.

2 Gas

3 Solid

4 Solids: keep the same shape; take up the same amount of space; keep the same volume; cannot be compressed (squashed) or poured.

5 They can be poured; they take the shape of the container.

6 They can be poured; they take the shape of the container.

7 They can be compressed.

Think like a scientist: Modelling the particles in solids, liquids and gases

1 **For a solid:** we had to form rows with each of us touching the people next to us and the people in front and behind. We had to stay in our place. We could only vibrate.

For a liquid: we were close together but not in rows. We had to touch all the people next to us at all times. We could move past one another but had to stay in touch.

For a gas: we were spread out around the room and not touching anyone else. We could move freely.

This answer will depend on what they did. They should mention touching or not touching as appropriate and being in an appropriate position.

2 *In solids, the particles are arranged* in regular rows touching each other. The particles are tightly packed together and can only vibrate.

In liquids the particles are arranged so that they are touching one another but are not in a regular pattern. The particles can move past one another and change their positions.

In gases, the particles are arranged so that they are far apart. There is no pattern and the particles are free to move and to spread out.

Think like a scientist: Particle theory

1 The parts of the sponge that are solid have the particles arranged like a solid: in regular rows and packed so that they are touching each other. However, the solid part of the sponge is arranged so that it has gaps in it and these gaps are filled with air. Since air is a gas, the particles have a lot of space between them and when you press down on a sponge it is the air which is being compressed, not the solid.

2 Particle theory explains the properties of solids, liquids and gases well. It accounts for the fact that solids and liquids cannot be compressed because there is no space for the particles to squeeze closer together and the fact that gases can be compressed because the particles are spread far apart.

3 The strengths of particle theory are that it accounts for the properties of solids, liquids and gases and means you can explain what is happening.

4 Credit any weakness suggested that is justified. This question is a challenge and some learners will not be able to find any weaknesses. In discussion the main points might be that: there is no account of the size and/or shape of the particles, no account of the spaces between the particles in solids and liquids.

Topic 2.2 Changes of state

Activity 2.2.1: Which change of state?

Melt: from solid to liquid.

Condense: from gas to liquid.

Boil: from liquid to gas.

Questions

1 28 cm^3; 54 cm^3; 82 cm^3

2 **A** 24 °C **B** 15 °C **C** 29 °C

Think like a scientist: Measuring the temperature when you heat water

1 The graph should be plotted accurately with axes labelled correctly with correct units. Credit the use of pencil and ruler and appropriate use of graph paper.

2 When we heated the water, the temperature increased. The longer we heated the water, the more the temperature rose. The increase in temperature was not at a constant/steady rate. The temperature did not increase by the same amount each minute. It increased quickly at the start, but then slowed down. The description should include the relationship between the time and the temperature with comment about the rate of increase in temperature.

3 When the water was boiling, its temperature remained at 100 °C, which is its boiling point.

4 This happens because the liquid water is changing into a gas, which is lost into the air, so the heat energy is being used for this, and not for increasing the temperature of the water.

5 So that it is measuring the temperature of the water and not the temperature of the beaker, which is in closer contact with the Bunsen burner.

Reflection

This will depend on what they found. It may be to do with reading the thermometer or measuring the volume of water. They should mention safety glasses and the danger from steam. They could mention moving around while carrying out the practical task.

Topic 2.3 Explaining changes of state

Getting started

1 Melting: solid to liquid

Condensing: gas to liquid.

Freezing: liquid to solid.

Questions

1 When the solid is heated, energy is transferred to the particles and they vibrate more. This takes up more space, so the solid expands.

2 The particles in both solids and liquids are touching each other with no spaces between them, so they cannot be squeezed into a smaller space.

3 The particles in liquids and gases are free to move past each other so that when they are poured, they can flow.

4 The particles in a liquid can move past each other and are held by weak attractive forces. When a liquid is heated, heat energy is transferred to the particles, so that they can move more. Some particles have enough energy to escape into the air as a gas.

5 The particles in a liquid have enough energy to move past one another. If the liquid is frozen, some of the heat energy the particles have is transferred to the surroundings. This means that the particles have less energy and cannot move. The liquid has been changed to a solid.

6 When the particles of steam move around the bathroom, some hit the cold surface of the mirror. Some of the heat energy of the particles is transferred to the mirror so the particles of steam have less energy and condense to form a liquid.

7 A Melting

B Boiling (accept evaporating)

C Freezing

D Condensing

Think like a scientist: Modelling changes of state

1 Description should cover learners standing in regular rows touching each other and vibrating. When heated the learners should vibrate more until they can move past one another, but should still remain touching one another. The discussion about if they were a good or a bad model will depend on what they did. Look for sentences such as: *we did …, which was a good model because …*

2 Description should cover learners standing together touching one another, but being able to move past one another. The more strongly they are heated, the more they should move, until they can break away from the weak forces holding them together and form a gas. The energy transferred is so much that they should be able to demonstrate boiling with learners changing places very rapidly at the surface. Discussion of model as above.

3 Description should cover particles of a gas moving around the room and coming into contact with cold surfaces. It should include energy being transferred from the gas particles to the surface, the particles losing energy and the particles slowing down. Particles are now unable to move apart and can only side past one another, forming a liquid. Discussion of model as above.

4 Description should cover particles in a container touching one another, but being able to slide past one another. When placed in a freezer, heat energy from the particles is transferred to the freezer and the particles now do not have enough energy to slide past one another. A solid has been formed. Discussion of model as above.

Topic 2.4 The water cycle

Questions

1 Rain, hail and snow.

2 When water vapour in the clouds cools, it condenses and forms liquid water. This becomes too heavy to be held in the clouds and falls as rain.

3 Liquid water in a pool on the road is made up of particles that are touching one another, but are not in a fixed pattern. The particles are able to move past each other. As the particles have energy transferred to them from the surroundings, as the sun comes out and/or the temperature increases, they have more energy and can move more. Some have enough energy to overcome the weak forces holding them together and escape by evaporating into the atmosphere as water vapour.

4 This answer will depend on local conditions. It could be from a well, a reservoir, rivers or desalination plant. Encourage learners to include detail in their answers, and think about where and how this water reaches them.

5 Suggestions may include the building of underground boreholes and wells; storing water in reservoirs; desalination plants; water treatment plants to return water to a useable state; moving from one area to another when there is no more water.

6 Accept any sensible suggestions, such as for our blood, digestive system, respiratory system, etc.

7 Washing (ourselves and our clothes, houses, cars); flushing the toilet; watering plants and gardens or in agriculture; manufacturing things such as clothes, chemicals, processed food. Credit any sensible suggestions.

8 Credit efforts to list the ways in which water is used and estimates of how much is used.

Topic 2.5 Atoms, elements and the periodic table

Getting started

1 The diagram should have particles of similar size and be drawn so that they are in regular rows. Particles should be touching one another.

When the solid melts, energy is transferred from the surroundings to the particles and they can vibrate more. When they have enough energy they can overcome the forces holding them in place and slide past other particles.

2 Heat it.

Questions

1 Atoms are tiny pieces or particles of matter.

2 There are 94 different kinds of naturally occurring atoms, so there are 94 different naturally occurring elements.

3 Mg is magnesium; Be is beryllium; Li is lithium and N is nitrogen.

4 Aluminium is Al; boron is B; fluorine is Fl and potassium is K.

5 Hydrogen

6 Calcium

7 Choose any two from sodium, aluminium, silicon, phosphorous, sulfur, chorine and argon.

8 Ne and Ar

Topic 2.6 Compounds and formulae

Questions

1 Any two of: sodium chloride does not have a shiny surface like sodium metal. Sodium chloride is white, not silver like sodium metal. Sodium chloride is formed of crystals not solid like sodium metal. Sodium chloride is edible, but sodium metal is not.

2 Sodium chloride is a solid, but chlorine is a gas. Sodium chloride is white, but chlorine gas is greenish yellow. Sodium chloride is edible, but chlorine is not.

3 Sodium and chlorine

4 Hydrogen and sulfur

5 Magnesium and oxygen

6 The learner has written the non-metal first in the name; the metal comes first and the name of the non-metal changes. The correct name is calcium sulfide.

7 Calcium, nitrogen and oxygen

8 Magnesium, carbon and oxygen

9 Lithium, sulfur and oxygen

10 K, O_2, Al, Ca and H_2 are elements because each contains only one type of atom.

NaCl and CaCl2 are compounds because each contains more than one type of atom.

11 a 2

b 2

12 a Hydrogen and oxygen

b Two atoms of hydrogen combine with one atom of oxygen.

13 CO is called carbon monoxide to prevent confusion because there is another gas, carbon dioxide or CO_2, that is made from carbon and oxygen.

14 a Magnesium oxide

b Sodium chloride

c Calcium chloride

15 Oxygen and hydrogen

16 Lithium hydroxide

17 Three

Topic 2.7 Compounds and mixtures

Getting started

Elements: nitrogen, sodium, O_2 and K.

Compounds: carbon dioxide, calcium chloride, CaO, CH_4 and H_2O.

Think like a scientist: Using iron and sulfur

1 a A mixture of iron and sulfur appears light grey/yellow. It is a powder.

b It is a solid mass and cannot be poured.

2 The iron cannot be removed from the iron sulfide using a magnet because the iron atoms have bonded with the sulfur atoms and are no longer magnetic.

Questions

1 Nitrogen

2 Four

3 Carbon dioxide

4 Bicarbonate; calcium and chloride. Ignore the dry residue at 180 °C.

Think like a scientist: Is water really a mixture?

1 Answer should include discussion of the particles in the liquid water having weak forces holding them together; the particles being able to slide past one another, but once they have more energy when the water is heated, they gain enough energy to overcome these forces and so some particles can escape from the surface of the water as a gas and move into the air around the evaporating dish.

2 Solid crystals

3 It was dissolved in the water.

4 A mixture of water and other substances. We know this because, once all the water had evaporated, these solids were left so we know they were there, but we couldn't see them because they were dissolved.

5 To protect our eyes because as the water evaporates there is often some 'spitting' from the dish.

Check your progress

2.1 Solids

2.2 a Gas

b Solid

c Liquid

2.3 Any two from: The water particles gain energy from the warm air and they are able to escape the forces holding them together. They become water vapour, a gas, and are able to move into the air. They evaporate.

2.4 a i and iii

b The particles lose energy to the surroundings. This means that they cannot move so much. They cannot slide past one another, but stay in a fixed place. They only have the energy to vibrate.

2.5 a Precipitation

b Condensation

c Evaporation

2.6 a Give credit for use of a sharp pencil and ruler; appropriate scales for the size of graph paper; appropriately labelled axes; accurate plots.

b Do not credit if the 2-minute plot is taken into account. The line of best fit should be a fairly smooth curve.

c The reading of 19 °C at 2 minutes.

d Zara misread the thermometer.

e The temperature remains fairly constant.

f This is because the liquid is boiling. All the energy from the heat source is being used to change the liquid to a gas.

2.7 a D

b A or C

c B

d A

2.8 a i Mg

ii O

iii H

iv Ca

v B

b i Carbon

ii Sodium

iii Potassium

iv Chlorine

v Silicon

c They use symbols because it saves time and space, it is a useful shorthand way of referring to the elements.

d There are many elements that begin with the same letter, such as carbon, chlorine, calcium and copper, so we need to use a second letter to distinguish them from one another.

Unit 3 Forces and energy

Topic 3.1 Gravity, weight and mass

Getting started

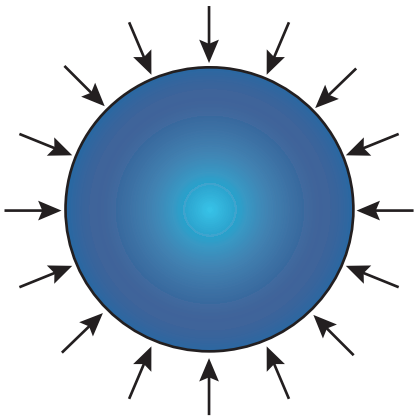
1 Makes it fall/pulls it down/keeps it on the desk/'requires force (or energy)' to lift it.

2 The newton, N, is a unit of **weight.**

3 The kilogram, kg, is a unit of **mass**.

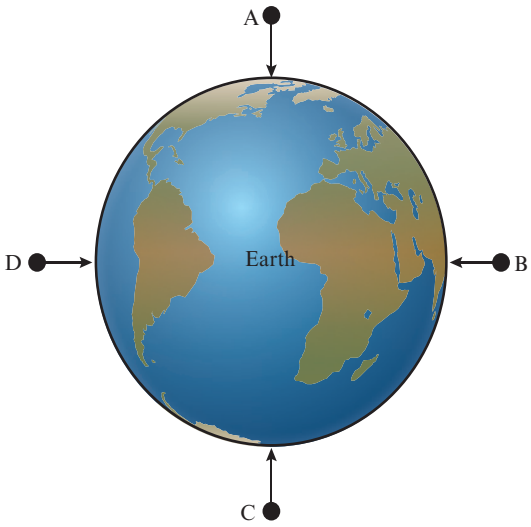
Questions

1 Circle drawn with at least four arrows; all arrows would pass approximately through the centre of the circle if continued; arrows are acceptable inside or outside the circle.



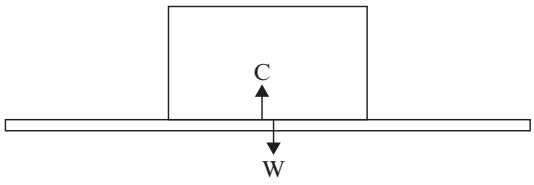
2 People at the South Pole are pulled towards the centre of the Earth. They are pulled 'down' onto the ground by gravity; accept this idea if drawn on the diagram for question 1.

3



4 They are wrong; any object with mass has gravity; the Moon has a (relatively) large mass so will exert a force of gravity.

5



6 8000 N

7 $\frac{40\,000}{4} = 10\,000\,\text{N}$

8 a The weight is greater than the contact force; the force downward is greater than the force upward, so there will be downward movement.

b When the contact force becomes equal to the weight, forces (down and up) will balance/cancel out, so no movement up or down.

9 a $75 \times 10 = 750\,\text{N}$

b $\frac{8500}{10} = 850\,\text{kg}$

10 a Jupiter

b Saturn

c $25 \times 3.7 = 92.5$ N

d It would be the same – mass is the quantity of matter in an object, so mass does not depend on the strength of gravity.

11 Weight makes the scales work as it is the force of gravity on your body pushing down on the scales. Mass causes weight, so both are required to make the scales work.

12 Gravity on Earth is greater than gravity on the Moon, so to go away from Earth needs more force to overcome the greater weight. To come back to Earth needs less force to overcome the smaller weight from the Moon and the Earth's gravity helps to pull the spacecraft back. (Common misconception here is that going to the Moon is 'up' and coming back to Earth is 'down'.)

Activity: Mass or weight?

Mass...	Weight...
is measured in kiograms, kg.	of an object is affected by the strength of gravity on a planet.
is not affected by gravity.	is measured in newtons, N.
is the quantity of matter in an object.	of an object decreases as the object goes further away from Earth.
can be measured in grams, g.	is the force needed to lift an object.
is the property of a planet that makes the planet have gravity.	is equal to the contact force on a level surface that is not moving.

Think like a scientist: Linking weight and mass

1 As the mass gets bigger, the weight gets bigger. When the mass doubles, the weight doubles.

2 It is not exactly 10 N; answer in range 9.5–9.9 N.

3 The differences are very small; both values rounded to the nearest whole number are 10; 10 is easier to multiply by.

Topic 3.2 Formation of the Solar System

Getting started

1 Large mass

2 Sun

3 Sun

Questions

1 All the planets in the Solar System orbit the Sun in **the same direction**.

2 Idea that the orbits are all on the same level or plane/not tilted relative to each other.

3 Nebula

4 Gravity

Think like a scientist: Using models

1 Possible answers include: it is not possible to do an experiment (to replicate the formation of the Solar System) in a lab; an experiment would take up too much space; an experiment would be too difficult to set up.

2 A limitation

3 a Both Venus and Uranus spin on their axes in the opposite direction to all the other planets.

b If the cloud of dust and gas came together in a flat circle, everything would have been going around in the same direction. Venus/Uranus spinning in the opposite direction seems to contradict this.

4 Most, but not all, of the evidence supports the model; the model that is used has limitations.

Topic 3.3 Movement in space

Getting started

1 Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, (Pluto).

2 The Moon

Questions

1 Towards the (centre of the) Sun

2 Gravity from the Sun

3 Jupiter (as it has the second largest mass)

4 Vacuum

5 There is no air resistance acting on it in space; air resistance acts on Earth and would be too great to allow the spacecraft to reach this speed.

6 Gravity only

7 Speed of the planet increases as it gets closer to the Sun, as the force of gravity (from the Sun) on the planet increases.

Activity: Planet speeds

1 As the distance from the Sun increases, the speed of orbit of the planets **decreases**.

2 Easier to see any trend or pattern in the results; easier to see any result that doesn't fit the pattern.

3 As distance from the Sun increases, the force of gravity (from the Sun on the planet) decreases; as the force on the planet decreases, its speed decreases.

4 These are not continuous data or these are discrete data; there are no data in between the values and no need to read off other values.

Think like a scientist: Discovering planets

1 Predictions

2 Observations

3 Conclusion

4 Uranus moving further away from the Sun **contradicted** the original prediction about its orbit.

Scientists found Neptune using careful **observations.**

Topic 3.4 Tides

Getting started

1 The Sun

2 The Moon

3 Gravity

Questions

1 The Sun and Moon

2 Tidal force

3 a 12 hours

b 12 hours

c 6 hours

4 The water will be at its lowest level at low tide; this may not be deep enough for some boats.

5 When there is a full Moon or new Moon then the Sun, Moon and Earth are in line; the pull of gravity or tidal force will come from both the Sun and Moon; the tidal force will be stronger or more force pulling on water.

6 Tidal range of 2.0 m will be 1.0 m higher and 1.0 m lower than the average maximum depth so 5.0 + 1.0 = 6.0 m.

Activity: Investigating tides

1 The tidal force from the Moon pulls the water towards the Moon on the side of Earth facing the Moon.

2 Two

3 Two

4 a As it takes the Earth 24 hours to rotate once on its axis, two high tides in 24 hours are 12 hours apart.

b Low tide is mid-way between two high tides, so six hours after high tide. Six hours after the next high tide means 12 hours apart.

5 a They will occur slightly later each day; the Moon orbits Earth in the same direction as Earth rotates on its axis.

b The Moon takes 29 days between being over the same position on Earth, which takes 24 hours (one day) to rotate once on its axis. The Moon will make 1/29 of its orbit in 24 hours, which is 1/29 of a circle: 1/29 of Earth's rotation is about 50 minutes, so tides will get 50 minutes later each day.

6 The ocean facing the Moon is deeper in set 2.

The tidal force from the Sun and Moon together is stronger than from the Moon alone, so the pull on the water will be greater.

7 New Moon

8 Full Moon

a Highest tides will be at new Moon and full Moon.

b Two

Think like a scientist: Discovering the causes of tides

1 The sailor noticed that the depth of water changed. This was **an observation.**

The sailor thought that the change was caused by the Moon. This was **a prediction**.

The sailor did not know about gravity, so could not give **an explanation** for the tides.

2 Either:

A simple description of an experiment to demonstrate that water is not magnetic, e.g. pour (sea) water on the desk and try to attract it with a magnet (not just a statement that water is not magnetic).

or

A simple description of an experiment to demonstrate that there is no magnetic effect from the Moon detectable on Earth, e.g. demonstrating that a magnetic compass points in the same direction regardless of the position of the Moon.

3 Newton provided evidence to support an hypothesis; Newton made predictions that were shown to be accurate.

Topic 3.5 Energy

Getting started

1 Answers may include activities such as walking, running, lifting, writing.

2 Answers may include fuels such as wood, coal, (natural) gas, oil, or oil-derived fuels, e.g. petrol/gasoline, diesel.

Questions

1 a Chemical

b Electrical

2 a Chemical

b Chemical

c Gravitational potential and kinetic

d Gravitational potential

3 a Chemical, elastic or gravitational potential (or others not given in the table, such as nuclear).

b Kinetic, light, sound

4 Any example of something that is hot getting cooler over time.

5 Increase in demand for energy: more people means more food needed, so more chemical energy; people want electrical goods, so more electrical energy needs to be generated; people want cars and transport, so more fuel is needed which means more chemical energy. Other answers include reference to waste disposal/recycling/building if linked to named energy stores.

Topic 3.6 Changes in energy

Getting started

1 Stores may include: elastic, gravitational potential, chemical, thermal, kinetic. Transfers may include: light, sound, electrical, thermal.

2 Cells/batteries, food and chemical fuels are chemical energy stores.

Hot objects are thermal energy stores.

Moving objects are kinetic energy stores.

Objects that have been lifted are gravitational potential energy stores.

Objects that have been stretched/compressed are elastic energy stores. Light coming from the Sun to Earth. Sound from talking going to someone's ears. Electrical in wires. Thermal from a heater to the air in a room.

Questions

1 When something happens, energy is **changed** or **transferred.**

2 a Electrical to light

b Chemical to kinetic/electrical to kinetic (if referring to an electrically powered bus)

c Electrical to sound/chemical to electrical to sound (if referring to a battery powered radio)

3 a Chemical → kinetic

b Chemical → thermal

c Kinetic → gravitational potential

d Gravitational potential → kinetic

Activity: Freezing water

1 It decreases.

2 It turns from liquid to solid or freezes which requires a temperature decrease.

3 As thermal energy

4 The thermal energy comes from the water.

5 The thermal energy goes out of the water and into the freezer and out the back of the freezer.

Think like a scientist: Candle energy

1 Risk of breaking thermometer; thermometer is measuring equipment not stirring equipment.

2 The wax is a store of chemical energy in candle; chemical energy converted to thermal energy in flame.

3 The wax got used up or decreased in mass.

4 Two from: the container; the tripod/support/gauze; the air around the equipment; the heat-proof mat/desk.

5 Move the candle (flame) closer to the beaker; protect against draughts; put a lid on the beaker; use a thinner gauze.

Other answers could refer to using knowledge about conduction, convection or radiation, such as insulating the beaker/a container made of material that is a better conductor than glass.

6 Data are continuous; there are values between the recorded temperatures; idea of being able to read off other values.

Topic 3.7 Where does energy go?

Getting started

Burning wood for cooking changes chemical energy to thermal and light energy. Thermal energy is transferred to the food.

Walking up stairs changes chemical energy in food into kinetic energy for movement. The kinetic energy for movement is changed to gravitational potential energy to go upwards.

Cycling on a level road changes chemical energy in food into kinetic energy for movement. Some of this energy is used to overcome friction and air resistance.

Questions

1 Energy that spreads out and becomes less useful.

2 Thermal, light and sound

3 a Electrical to light (useful), thermal (wasted)

b Chemical to kinetic (useful), thermal and sound (both wasted)

c Electrical to kinetic (useful), thermal and sound (both wasted)

4 Graph 3: learners should be able to do this by working out that an object's temperature will eventually become the same as its surroundings.

Activity: Ripple tanks

The wave should be visible for between six and eight passes across the tray. The depth of water in this experiment affects the wave speed and not the number of passes, but as the water gets deeper they may be able to see at least one more pass.

It should not make a significant difference whether the wave goes along or across the tray.

1 Depth of the water or height the tray is dropped from.

2 Along the tray; this is because it makes the same number of passes in each direction, but one pass is longer this way.

3 Kinetic

4 **dissipates** (learners should not be asked where the energy dissipates to, as the answer to this in water waves is complex; if they ask, it is sufficient to state that it is used in the movement of the particles in the water)

Think like a scientist: Energy dissipation

1 Graph should have axes in the correct orientation; axes should be labelled with units and have sensible linear scales; all points should be plotted correctly and a smooth curve drawn.

2 As time increases, temperature decreases; temperature decreases quickly at first, then more slowly as time goes on.

3 To ensure all the water is at the same temperature and the thermometer is not in a hot or cold spot.

4 Thermal energy decreases with time. (It is important that learners do not think temperature is the same as thermal energy, but this point should not be explained at this stage – it is sufficient to state that they are different.)

5 The container; evaporation or steam; into the surrounding air; into the surface the container was sitting on.

6 a Blow on it or direct cold air from a fan onto it; put it in a colder place; increase the surface area of the tea; answers that use knowledge of conduction, convection or radiation, e.g. use a better conductor for the container.

b Put it in a warmer place; put a lid on the container; put it in an insulated container.

7 The tea will stop cooling; it will only cool down to the temperature of the room or surroundings; it cannot cool to any lower temperature by itself.

Check your progress

3.1 a Weight

b Mass

3.2 a The Sun has a larger mass than the other planets.

b i $1 \times 10 = 10\,N$

ii $150 \div 1000 = 0.15\,kg$

$0.15 \times 10 = 1.5\,N$

c i Its weight would be less on the Moon/greater on Earth

ii Its mass would be the same.

3.3 a Gravity; from the Sun

b (Force of) Sun's gravity is stronger on Mercury than Earth (must have idea that it is gravity from the Sun which is stronger, not just gravity.)

3.4 a B and D

b 12 (hours)

c Using M = Moon, E = Earth, S = Sun, the possibilities are M-E-S or S-E-M and E-M-S or S-M-E shown in line.

d The Moon causes a tidal **force** on the Earth.

3.5 D: weight and force

3.6 a Dissipate

b Useful: kinetic

Wasted: thermal, sound

3.7 B: air resistance no; gravity yes.

3.8 a Thermal

b Any two from:

into the container; into the air; into steam; into other named object in surroundings.

Unit 4 Grouping and identifying organisms

Topic 4.1 Characteristics of living organisms

Questions

1 Feeding

2 Smell

3 Carbon dioxide

4 Reproduce

5 Growth

6 Respiration

7 Movement

Activity: Is a car alive?

1 Learners may suggest some of these similarities:

- Both the car and living things can move.
- The car uses fuel, which is like the food taken in by a living thing (nutrition).
- The car uses oxygen and food to release energy, which is like respiration.

- The car produces exhaust gases, which is like excretion.
- Some cars have sensors, which is like sensitivity in living things.

2 Differences can include: the car can move, but not by itself (although learners may think of driverless cars, which of course do move without a human driver). The car cannot reproduce or grow.

Topic 4.2 Viruses

Getting started

The characteristics are listed in Topic 4.1, where descriptions are also given.

Activity: Are viruses alive?

Learners should point out that viruses are able to replicate themselves, which is a characteristic of living organisms. However, they can only replicate inside a living cell, and they have none of the other characteristics of living organisms. On balance, most learners are likely to decide that viruses are not living organisms.

Topic 4.3 What is a species?

Activity: Comparing two species of elephant

There is a wide range of similarities that could be noted: they both have four legs, tusks, trunk and large ears that lie back against their necks.

Learners may see some of these differences in the pictures in the Learner's Book. Note that they cannot be expected to know which are simply differences between these two individuals, and which are differences between the two species.

African elephants have larger ears, longer tusks and a more domed head. They are grey, whereas Indian elephants are brown.

Questions

1 Organisms that belong to the same species usually look **similar** to one another.

They look **different** from organisms belonging to other species.

2 To be the same species, they need to reproduce together to produce fertile offspring. Ligers are not fertile.

Think like a scientist: Comparing organisms belonging to different species

1 and **2** Learners' answers will depend on the species that you have supplied.

3 Scientists would try to find out if the two organisms can reproduce with each other. If they have offspring, they would need to find out if those offspring can reproduce. If they can reproduce, then the organisms belong to the same species. If not, they belong to different species.

Topic 4.4 Using keys

Questions

1 1b, 3a

2 There are *two* statements to choose from each time.

Think like a scientist: Using a key to identify species of fish

1 A is a horn shark

B is a dragon fish

C is a zebra fish

D is a clown fish

2 **1 a** Fish has stripes……..go to 2

b Fish does not have stripes…… horn shark

2 a Stripes are vertical ..... go to 3

b Stripes are not vertical ..... zebra fish

3 a Fins have spines ..... dragon fish

b Fins do not have spines ..... clown fish

Topic 4.5 Constructing keys

Getting started

The first and third questions are not suitable because you cannot be sure of the answer. Different people might disagree about whether a plant is 'tall' or not, or whether its leaves are 'dark green'. The statements in a key must always give a clear yes/no answer.

Think like a scientist: Making keys to identify four learners

1 The keys should be assessed according to how well they work. Look for:
- Choices that offer easy-to-make decisions.
- No more than four choices to make in all.
- A key that works.

2 Learners should try to make at least one suggestion for improvement. The best suggestions will be tightly focussed and give their partner a clear instruction for how they could improve the key.

Think like a scientist: Writing a key to identify species of cats

1 The keys should be assessed according to how well they work. Look for:
- Choices that offer easy-to-make decisions.
- No more than four choices to make in all.
- A key that works.

2 Assess feedback as in Think Like a Scientist Q2 above. You can also check how well each learner has responded to their feedback by looking at any changes they made to their key.

Check your progress

4.1 a It can move. It feeds. It respires. It can sense changes in its environment.

b Any two of: it excretes, it reproduces, it grows.

4.2 A class arachnids

B class insects

C class insects

D class myriapods

E class crustacea

4.3 a She did not find red-crowned and yellow-crowned parakeets making nests together which suggest that they do not reproduce with each other.

b She should check more pairs of parakeets in the wild.

4.4 Look for the following points:

There is a series of pairs of statements.

Each pair of statements is a contrasting pair.

Each pair of statements can be used unambiguously.

There are no more than four pairs of statements.

Unit 5 Properties of materials

Topic 5.1 Metals and non-metals

Getting started

Accept any correct answers – the metals may include those used for door handles (may be aluminium, steel or brass), window frames, jewellery, electrical fittings, light fittings.

Accept suggestions as to how these can be recognised as metals such as feels cold to the touch, shiny.

Questions

1 Accept any ten metals.

2 Gold and silver are used for jewellery because they are shiny and quite rare, which increases their value.

3 Copper is useful because it can be made into wires, it is ductile and is a good conductor of electricity so it is used for electrical wires.

4 Malleable: able to be shaped.

Ductile: able to be drawn out into a wire.

5 Olympic medals are made from gold, silver and bronze.

6 All metals (except aluminium) are found on the left side of the Periodic Table.

7 Accept any five non-metals other than sulfur and helium.

8 Sulfur is used to harden rubber.

9 The useful property of helium is that it is very light.

10 The non-metals are on the right side of the Periodic Table.

Topic 5.2 Comparing metals and non-metals

Questions

1 Credit any five named objects made from metals.

Credit any five named objects made from non-metals.

2 Non-metal

3 It is a liquid at room temperature.

4 Conduct electrical energy; conduct heat energy

Topic 5.3 Metal mixtures

Getting started

A is an element because there is only one type of atom present.
B is a compound because there are two types of atoms bonded together.
C is a mixture as there are two types of atom but they are not bonded together.
D is an element as there is only one type of atom present.

Think like a scientist: Modelling a metal and an alloy

1 Answers will depend on how successful they are with the practical task. The bubbles should line up in rows, but do not encourage learners to simply give the expected answer at the expense of observations; in other words, learners should be credited for writing what they observed.

2 Other bubbles will move to fill the space. Again, credit what the learners observe.

3 Dependant on what they observe. The expectation is that the rows of bubbles move freely and slide across one another.

4 Dependant on what learners observe. The expectation is that the larger bubble disrupts the rows, so that the bubbles cannot move as freely.

Questions

1 An alloy is a mixture of metals.

2 Aluminium is light and easily malleable, which makes it suitable for building planes.

3 An aluminium alloy is used because aluminium is not strong enough to withstand the stresses involved in flight.

4 24 carat gold has 24 parts out of 24 gold; there is no other metal present, so it is pure gold.

5 18 carat gold is an alloy made of 18 parts gold to 6 parts of another metal, such as silver or copper; 24 carat gold is pure gold.

6 Pure silver is not used for coins because it is too expensive and it is not hard enough to stand up to the damage that is caused when coins rub against one another in pockets, purses or vending or counting machines.

7 We don't use pure copper for our coins because it is too expensive and too soft. Copper also reacts with the air and turns green.

8 Any alloy used inside the body, for example for hip replacements, must be strong and light, and not react with the body tissues.

9 Some glasses frames are made from shape memory alloy metal because they can easily be returned to their original shape by heating, if they get bent.

10 A range of temperatures is given because there is more than one type of bronze. These are made using different proportions of copper and tin, sometimes other metals are added. Each different mixture has a different melting point.

11 Credit any correct shared properties, such as: they are both alloys, have a range of forms and melting points, both contain copper, resistant to corrosion.

12 Credit any correct shared properties, such as: both elements; metals; conduct heat and electricity.

13 Credit any correct different property, such as: copper is reddish in colour whereas tin is white; tin is softer than copper; tin is not as good a conductor as copper; the melting point of copper is much higher (1085 °C) than that of tin (232 °C).

Topic 5.4 Using the properties of materials to separate mixtures

Getting started

Expected answers might be: in a mixture the things are just mixed up but are still separate. However, in a compound the substances have joined together. The point of this exercise is to discuss and share ideas, and to establish what learners know.

Questions

1 The liquid water in the flask is heated and, as the particles of water have more energy transferred to them, they begin to move more. Eventually some are able to overcome the weak forces that are holding them in place. The liquid water changes state to become a gas, which escapes into the condenser.

2 The steam in the condenser moves along the central tube. The condenser has an outer tube, through which water from the tap flows and this cools the condenser. The steam inside the condenser has heat energy transferred from it to the water in the outer tube. As the particles of water in the steam lose energy they cannot move freely and condense into water.

3 The different properties of water and food dye used to separate them are their different boiling temperatures.

Think like a scientist: Separating sandy, salty water

1 The sand remains because the grains are too large to pass through the small holes in the filter paper.

2 This is not a good idea because the wet filter paper is easily torn. If you stir up the mixture with a pencil, you are likely to damage the filter paper and let the contents flow through it.

3 You should wear safety glasses and if the solution starts to spit you should turn off the Bunsen burner.

4 You could heat the salty water in a condenser.

5 You could wash the salt using clean water, filter using finer filter paper and then evaporate again. You could repeat this several times.

Think like a scientist: Separating two solids

1 The salt will dissolve in water, but the carbon will not.

2 Safety glasses, beaker, conical flask, filter funnel, filter paper, evaporating basin, pipe clay triangle, tripod, Bunsen burner, heat-proof mat, stirring rod, tongs. Accept other suitable apparatus.

3 Accept logical steps that will work, such as:

Mix the salt and carbon with water and stir. Filter the mixture. Place the filtered liquid into an evaporating basin. Heat with a Bunsen burner until the solution starts to spit. Turn off the heat. Leave to cool and for the remaining water to evaporate.

4 Wear safety glasses. Take care while the solution is heating as it may spit. Move the evaporating basin with tongs.

Topic 5.5 Acids and alkalis

Questions

1 Citrus fruits, tomatoes. Accept drinks such as cola and coffee.

2 They taste sour.

3 Corrosive means that it will dissolve your clothing and skin and cause chemical burns.

4 If you spill acid you should wash the area with lots of water.

Topic 5.6 Indicators and the pH scale

Questions

1 The indicator turns one colour in an acid and a different colour in an alkali.

2 Red cabbage indicator turns red in lemon juice.

3 It turns blue.

4 Red

5 Water is neutral. I know this because litmus in water is neither red nor blue, it is purple.

6 How acidic or alkaline a substance is.

7 pH 7

8 It is a strong acid.

9 pH 12 to 14

10 Blue

11 Red, orange or yellow

Check your progress

5.1 Metals are shiny when freshly **cut** or polished. They are strong and if you tap them they **ring** like a bell. Metals **conduct** heat energy and **electricity**. Metals are **malleable**, which means they can be beaten into shape.They are **ductile**, which means they can be drawn out into wires.

5.2 a Silver coins are not made of pure silver because they would be too expensive, and would wear quickly due to their softness.

b In a pure metal the atoms line up in regular rows, side-by-side and one on top of another. This means that when the metal is hit the rows can move across one another. In an alloy particles of a different size are mixed with the pure metal so the particles in the rows are not all the same and the pattern is disrupted. When the alloy is hit the rows cannot slide across one another in the same way. Credit a diagram to help the explanation.

5.3 a **i** Is ductile or conducts electricity.

ii It is shiny or expensive.

iii It is strong.

iv It conducts heat well, it is strong, it does not rust.

b Any **three**, such as those below. (The important issue is that the feature of both the metal and the non-metal must be mentioned.)

- Metals are solid at room temperature, but many non-metals are gases.
- Metals are shiny, but non-metals are dull.
- Metals are malleable and do not shatter, but non-metals are brittle.
- Metals are ductile, but non-metals are not.
- Metals conduct heat energy well, but non-metals do not.
- Metals conduct electricity well, but non-metals do not.

5.4 Equipment he will need: dustpan and brush, thick rubber gloves, safety glasses, filter paper, filter funnel, beaker, conical flask, evaporating basin, tripod, pipe clay triangle, Bunsen burner, tongs.

Marcus should put on the gloves and safety glasses, and use the dustpan and brush to pick up the glass and copper sulfate crystals from the floor. He should carefully pick out the larger pieces of glass. Then he should put the glass and copper sulfate crystals into a beaker of water. The copper sulfate will dissolve but the glass will not. He may be able to pour off some of the liquid into another beaker leaving some of the pieces of glass behind. The mixture of glass and blue liquid should be filtered. The glass fragments will be left in the filter paper. Marcus should be careful handling this. The blue liquid that comes through the filter paper should be placed in an evaporating basin and heated. The Bunsen burner should be turned down once the liquid starts to boil and turned off once it starts to spit to prevent him getting burnt. The evaporating basin should be left for a few days so that all the water can evaporate. The evaporating basin should only be moved using the tongs.

5.5 a An indicator

b Red

c Purple

5.6 a The driver places warning notices nearby so that everyone knows what is being delivered and that means they will know at once how to treat it if there is an accident.

b The area of the spill could be covered with lots of water to dilute the acid so that it causes less harm.

5.7 a

Melting point in °C	Tally
up to 0	|||
0 to 499	|||
500 to 999	|
1000 to 1499	|||

Boiling point in °C	Tally
up to 0	||
0 to 999	|||
1000 to 1999	|
2000 to 2999	||||

b For each graph:

- Use of sharp pencil, ruler and general presentation
- Accuracy of the plots

c Oxygen and helium

d Mercury

e Gold, lead, copper, aluminium, nickel, sulfur and sodium

f Helium

g Gold

Unit 6 Earth physics

Topic 6.1 Sound waves

Getting started

1 Things such as: aircraft, explosions, power tools, public-address systems, large crowds cheering, thunder, dogs barking.

2 Things such as: whispering, walking on carpet, insects flying, cats purring, people or animals breathing.

3 Sounds such as babies crying, car alarms, whistles, birds cheeping, wheels or hinges squeaking.

4 Sounds such as thunder, bass musical instruments, animals growling, large road vehicles, aircraft.

Questions

1 B

2 A

3 Vibration of the wings

4 Sound travels through air as a sound **wave**.

5 C

6 Vibration of particles in air (caused by the thunder).

7 Vibrations are very small, so sounds are very quiet or too quiet to hear.

8 A, B, C

9 Vacuum on the Moon. No particles; sound waves cannot travel without particles.

10 You would not hear an explosion in space. Space is a vacuum and sound waves cannot travel in a vacuum.

Activity: Modelling sound waves

1 Away from the moving hand

2 No. Only the wave / vibrations

3 Backwards and forwards along the line of the wave direction or along the line of the spring.

4 Movement

Think like a scientist: Sound and vibration

1 The string

2 Sound heard louder/more clearly when string was tight than when string was slack.

3 The sound was stopped or reduced in loudness.

4 No difference

5 The string must vibrate to carry the sound (wave); the sound wave makes the string vibrate.

6 Make a recording of the voice and play back at the same loudness each time, or suggested use of any other sound source that can be controlled.

Topic 6.2 Reflections of sound

Getting started

Learners could draw a diagram of the slinky spring showing compression and stretching. Alternatively, learners could draw a series of double headed arrows aligned end-to-end.

For the challenge part, learners could use phrases, such as pushing and pulling, compressing and stretching, particles getting closer and further apart.

Questions

1 C

2 B

3 Fewer echoes in B; curved surfaces in B

4 C

5 Distance = $1500 \times 0.2 = 300$m

$\frac{300}{2} = 150$ metres

Activity: Modelling echo location

1 The food/prey/named animal

2 a The mirror reflects the light just as the food reflects the sound; the reflections can be seen; the reflections can be used to locate the mirror.

b Light is not the same as sound; the mirror does not move as the food would move; the bat or dolphin hears the reflected sound with less loudness and we cannot do this with light; we need to move the light source around to judge the distance to the mirror.

Think like a scientist: How is sound reflected?

1 The angle between the tubes and the reflected surface is equal. As the angle between the sound source tube and the surface increases, so does the angle of the other tube.

2 Reference to hard, smooth surfaces giving better reflections or soft, rough surfaces giving poorer reflections.

3 Glass, tile, metal, wood (good)

Fabric, sponge (bad)

Topic 6.3 Structure of the Earth

Getting started

The aim is to find out what learners think rather than obtaining a factually correct answer. Diagrams could vary from a solid object with no layers, to a hollow object, to a solid object with any number of layers.

Questions

1 Core

2 Iron, nickel

3 Oxygen

4 Aluminium

5 The shapes of the continents fit together; the types of rocks on the different continents match up where they fit together; the fossils on the different continents match up where they fit together.

6 Because he could not explain how continental drift occurred.

7 Answer can be determined from the map in the Learner's Book.

8 The tectonic plates move on liquid magma.

Activity: Drifting plates

1 a The tectonic plates

b Heat from the Earth's core

c Magma or the mantle

2 Strengths: movement of the polystyrene is caused by heat; movement can be seen in a short time.

Limitations: tectonic plates are not small and light; tectonic plates do not move on water; movement of tectonic plates is much slower.

Topic 6.4 Changes in the Earth

Getting started

1 Similarities: a volcano is sometimes a type of mountain, both are made from rock, both are higher than surrounding ground level, both have a base and a highest point.

2 Differences: mountains are not active or do not erupt, volcanoes have lava/magma, volcanoes have a crater or openings.

Questions

1 B

2 Plates push against each other; rocks are pushed upward at the boundary.

3 C

4 Forces on tectonic plates; build-up of force or pressure; sudden movement.

Activity: Model for moving tectonic plates

1 Model A – the cloth wrinkled and was pushed up into folds.

Model B – one piece of paper slid over/under the other; when the pieces of paper made contact edge-to-edge, the pieces bent and formed a curve; the paper was raised up from the surface.

Model C – the modelling clay was distorted/compressed and folded upward.

Model D – the outer part of the chocolate cracked and the soft inner part came out; the cracked parts were pushed upward.

2 Model A – formation of fold mountains.

Model B – first part: subduction/one tectonic plate moving under another; second part: formation of fold mountains.

Model C – formation of fold mountains.

Model D – earthquake (when the chocolate breaks); formation of volcanoes (when the soft centre comes out); formation of fold mountains.

3 Model A – strength of this model is the flexibility of the cloth allowing folding to occur easily. One limitation is that one piece of cloth represents two different tectonic plates.

Model B – strength of this model is the two pieces of paper represent two tectonic plates.

One limitation is that paper is too stiff to fold like the cloth in model A.

Model C – flexibility of the modelling clay is the strength of this model.

Model D – strength of this model is the ability to represent both the solid crust (the chocolate) and the liquid magma (the soft centre).

4 Model A – use two pieces of cloth.

Model B – any way of increasing friction between the two pieces of paper, or increasing contact at the edges, such as crumpling and then straightening out again to introduce wrinkles.

Model C – place a lower friction surface under the modelling clay to represent the mantle.

Model D – possible reference to warming or cooling the chocolate depending on how well the activity worked, given the temperature of the classroom.

5 Model D is best because it models all three phenomena: fold mountains, earthquakes and volcanoes.

Topic 6.5 Solar and lunar eclipses

Getting started

1 In straight lines

2 When an opaque object blocks light, light shines past the sides of the object and a darker area, which is the shadow, forms on another object (such as the ground or a wall) where the light has been blocked.

3 The Moon gives out its own light – false

The Sun gives out its own light – true

Questions

1 C

2 B

3 A solar eclipse occurs when the Moon passes in front of the Sun; the Sun can only ever be seen in the daytime.

4 False; for the shadow of the Earth to be seen passing across the Moon, the observer must be at a point on Earth furthest away from the Sun; it will be night time in this position.

Activity: Classroom eclipses

1 The side of the Earth facing towards the lamp/Sun is in the day and the side of the Earth facing away from the lamp/Sun is in the night.

2 A solar eclipse

3 There is a total eclipse where the shadow on the Earth is darkest and a partial eclipse on the Earth where the shadow is lightest.

4 A lunar eclipse

Think like a scientist: Making predictions about eclipses

1 The date, the time and the place from which it can be seen.

2 $223 \times 29.5 = 6578.5$

3 They must be in line with each other.

4 Working out the time between events in the past can be used to predict the times in the future.

5 Observe whether the eclipse actually happens when predicted.

6 The times will not be exact, so any differences become increasingly greater further into the future.

7 Knowing the time interval between eclipses can allow them to work backwards. The date in that year when the eclipse occurred must be the date of the battle.

8 Solar eclipse. The Sun can just be seen behind the Moon.

Check your progress

6.1 Vibration

6.2 A **sound wave** travels from **the pen** to **Sofia's ears**.

The **sound wave** travels through the **air**.

6.3 Arrow drawn as a straight line pointing in any direction.

Two more opposing arrows or double headed arrow; parallel to the direction.

6.4 Modelling

6.5 a W–B; X–D; Y–C; Z–A

b Separate parts of the Earth's crust; that move on the mantle.

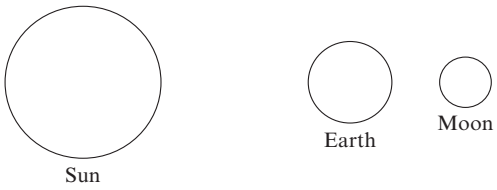
6.6 Earthquakes

6.7 Tectonic plates move together in opposite directions.

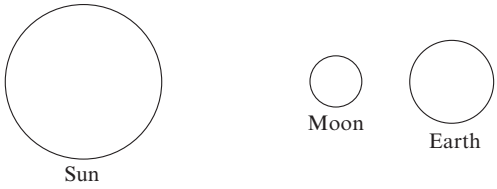
Rocks get pushed upward at the boundary (of the plates).

6.8 A solar eclipse happens when the **shadow** of **the Moon** forms on the Earth.

6.9 a



b



Unit 7 Microorganisms in the environment

Topic 7.1 Microorganisms

Questions

1 Viruses are not generally considered to be living organisms as they show none of the characteristics of living organisms apart from reproduction, which they can do only when inside a cell.

2 What we see on the surface of the fruit is a very large number of individual cells, i.e. – a colony. Each individual cell is a complete organism. We can only see these cells using a microscope.

3 The cells are arranged end-to-end in long threads. Learners may also mention the circular cells arranged in a sphere.

4 **a** Look for a drawing of one or two of the bluish-white cells.

b Look for a drawing of one of the cells or threads with green colouring.

c Labels should show that the plant-like cells have cell walls, and green colouring inside them (which is chlorophyll; the chloroplasts are not visible). Animal cells do not have these features.

Think like a scientist: Growing microorganisms from the air

1 Nutrients are materials that organisms need for growth and to provide energy.

2 The purpose of this investigation is to grow microorganisms that have come from the air. You do not want to grow any microorganisms that were there before you took the lid off the dish.

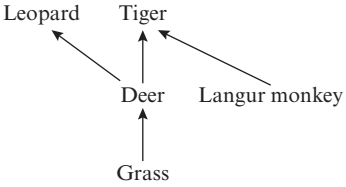
3 Drawings will depend on what has grown on the agar jelly.

Topic 7.2 Food chains and webs

Getting started

1 Grass → deer → tiger

2



Questions

1 The food chain should show sunlight, then an arrow going to wheat, then an arrow to a chicken and finally an arrow to Arun.

2 This will depend on the learner's choice of food.

3 Accept any food chain taken from the food web.

4 Acacia tree and grass

5 7

6 3

7 Any two from cheetah, leopard, hyena and aardvark.

8 Any two from:

Cheetah (predator) and springbok, zebra or aardvark.

Leopard (predator) and hyena, springbok, zebra or aardvark (prey).

Aardvark(predator) and termites (prey).

Hyena (predator) and springbok (prey).

Think like a scientist: Using a food web as a model

1 Learners should recognise that a food web is useful for showing, in a simple and visual way, the feeding relationships between organisms. We can see how energy passes from one organism to another.

They should also recognise that the food web is far from a complete representation of what actually occurs. In reality, many more organisms will be part of the web. The model also does not tell us how important each relationship is. For example, do leopards eat mostly hyenas, or are zebras their most important prey? Are sprinbok mostly killed by cheetahs, or are hyenas a more likely predator for them?

Topic 7.3 Microorganisms and decay

Activity: What can microorganisms decay?

1 Bread, leather, wood, fruit

2 Any two things made of organic matter.

Any two things not made of organic matter.

3 Bread, leather, wood, fruit and the two named items made of organic matter in the answer to question 1.

Questions

1 Decomposers break down organic material, making it decay.

2 For example, they make food go bad.

3 Learners will need to come up with their own ideas. They may think of micoorganisms that convert food from one form to another, for example milk to yoghurt. They may also think of how they get rid of dead bodies and waste material. (This is covered in the next topic.)

Think like a scientist: Investigating how temperature affects decay by microorganisms

1 Learners are likely to find that the bread went mouldy more quickly in the warm place than in the fridge. If they have collected quantitative results, they can make a quantitative comparison.

2 Answers will depend on any differences between the results for different groups. Differences could be in the way the experiment was conducted, e.g. different bread was used, the way it was covered was different, some groups made their bread wetter than others. Or it could depend on how many microorganisms fell onto the bread during the time that it was exposed to the air.

3 The conclusions should relate to the purpose of the investigation. For example, higher temperatures speed up decay by microorganisms.

Think like a scientist: Investigating how moisture (water) affects decay

The plan should state:

That the amount of water will be varied and how this will be done.

How decay will be observed or measured, for example by estimating or measuring how much of the bread is covered by mould.

Which variables will be kept the same, including the temperature, type of bread, time of exposure to the air and type of covering.

A prediction of the results that would be expected – which will probably be that decay will happen faster on moist bread than on dry bread.

Topic 7.4 Microorganisms in food webs

Getting started

1 Correct

2 Correct

3 Correct

Activity: Decomposing fruit

1 Answers will depend on what learners saw as the fruit decayed. They may see fungi growing, or the food may just gradually liquefy, indicating that bacteria are the main agents of decomposition.

2 Decomposers are breaking down the fruit and making it rot.

Questions

1 The food chain should begin with a producer, and have arrows pointing from the producer to a consumer and then another consumer. There should be an arrow from each of these organisms to the decomposers.

2 Decomposers are consumers. They do not make their own food.

Activity: Are all decomposers microorganisms?

1 The fungus is a decomposer. It is breaking down the wood in the log as it feeds on it.

2 It is not a microorganism when it is producing toadstools. At other times, when there are no toadstools, the fungus is a microorganism, existing as microscopic threads that grow through the wood.

3 From sunlight: the tree used energy in sunlight to make food. Some of this energy was then passed on to the fungus as it fed on the wood of the tree, and then to the slug as it fed on the fungus.

4 Tree → fungus → slug

5 Bacteria

Check your progress

7.1 B and C

7.2 Decomposers should be shown feeding on all other organisms in the chain. Arrows should point in the right direction.

7.3 a There are various possibilities for entirely correct tables. For example:

	Next to cow dung	No cow dung
Length of grass leaf in cm	11	9
	13	10
	9	6
	12	7
	8	9

Length of grass leaf in cm	
Next to cow dung	No cow dung
11	9
13	10
9	6
12	7
8	9

b Next to cow dung: mean length

No cow dung: mean length

Column headed 'mean' with answers inserted.

c The conclusion does match the data. However, only five grass leaves were measured from each area. The sample size is not big enough to be representative. The farmer should measure many more grass leaves from many more areas with and without cow dung.

d The fungi break down or decompose the cow dung. This releases nutrients into the soil, which the grass uses to help it to grow faster and taller.

7.4 a To kill any microorganisms already present, as these might make the milk go bad rather than turn it into yoghurt.

b The kind of microorganisms (bacteria) that change milk into yoghurt.

c Sofia could put the milk into a warm place.

Microorganisms grow faster at warmer temperatures, so they would have changed the milk into yoghurt faster.

d The pH would become lower.

The microorganisms change sugars in the milk to lactic acid. Acids have a pH below 7.

Unit 8 Changes to materials

Topic 8.1 Simple chemical reactions

Getting started

A substance that can poison you: toxic

A substance that catches fire easily: flammable

A substance that can dissolve your skin: corrosive

Think like a scientist: Burning magnesium

1 The description should include the fact that it burns very brightly and that the ribbon disappears or changes.

2 A white powder is formed.

3 The reactants are magnesium and oxygen.

4 These should include wearing safety glasses, not looking directly at the burning magnesium, holding the magnesium at arm's length and taking care with the hot tongs.

Think like a scientist: Reactions with water and acid

5 Each reaction should show the relevant reactants and products.

Reactants: zinc and hydrochloric acid.

Products: zinc chloride and hydrogen.

For examples where there was no reaction, they should write only the names of the reactants as there are no new products.

6 Wear safety glasses; handle acid with care; do not overfill the test tubes to avoid fizzing and spilling. Credit anything relevant.

7 A lighted splint placed in the mouth of a test tube containing hydrogen will produce a pop sound.

Questions

1 The melting point of magnesium is 651 °C and that of oxygen is – 214 °C, whereas the melting point of the product, magnesium oxide, is much higher at 2800 °C.

2 Both magnesium and magnesium oxide are solids.

3 a Chemical reaction

b Physical change

c Chemical reaction

d Physical change

e Chemical reaction

f Chemical reaction

4 Magnesium reacts with oxygen to produce magnesium oxide and it reacts with hydrochloric acid to produce magnesium chloride and hydrogen.

5 Magnesium is a light grey/silver coloured solid, which is readily malleable. Credit other properties such as it is very light or soft.

6 Zinc chloride and hydrogen.

Topic 8.2 Neutralisation

Getting started

Neutral means neither acid nor alkali. Learners may cite properties such as pH 7 or turning universal indicator solution green.

Questions

1 Green

2 A neutralisation reaction happens when an acid and an alkali are mixed.

3 Toothpaste is alkaline so that it can neutralise the acid in your mouth, and help to stop your teeth decaying.

4 The acid in your mouth comes from the millions of bacteria there. When bacteria feed they produce acid.

5 In some countries the lakes have become very acidic as a result of acid rain: this changes the pH and plants and animals can no longer live there. These countries may drop alkalis into the lakes to overcome the effects of this.

6 Some farmers may spread lime onto acidic soils to neutralise them. They do this so that crops that prefer less acidic soil will grow well.

Activity: Rainbow neutralisation

1 The answer will depend on how successfully the practical task was carried out; it should be about pH 2.

2 This should be about pH 13.

3 The bottom of the test tube.

4 So that the liquids did not mix too much.

5 This will depend on the acid and alkali used. It is likely to be the symbol for corrosive – can destroy living tissue and cause burns, or the symbol for health hazard – can cause harm and irritate skin and eyes.

Think like a scientist: Testing the pH of the soil

The answer will depend on the learner's results, and what their research uncovers.

Topic 8.3 Investigating acids and alkalis

Getting started

Learners should be able to link pH 1-3 with various shades of red; pH 4-6 orange and yellow; pH 7 green; pH 8-10 shades of blue; pH 10-14 darker shades of blue/purple.

Questions

1 They should wear safety glasses and take care when handling strong acids. If they spill the acid they should dilute it with water and if they get it on their skin, they should wash it off at once and seek medical help.

2 The variables that are the same are: volume of acid; type and strength of acid; volume of universal indicator, and volume of powder added with each spatula.

3 They are changing the powder they are testing.

4 They are measuring the number of spatulas of powder they use to neutralise the acid.

5 The most effective powder is powder B.

6 The least effective powder is powder C.

7 There should be some discussion of the fact that there could be mistakes as there is only one set of results.

8 Powder A

9 The first result for powder B looks 'wrong'.

10 They may have miscounted the number of spatulas, or heaped them up so that they were adding more each time. They may have measured the volume of acid incorrectly. Credit any sensible ideas.

11 They should have ignored the 'wrong' result and repeated the experiment.

12 No, they should not have included it; they should have ignored it when they calculated the mean.

Topic 8.4 Detecting chemical reactions

Getting started

Answers will depend on what the learners have remembered and understood. The idea is to use the answers to enable you to see what point the learners are at.

Reactants are the chemicals you start with in a chemical reaction, whereas products are the chemicals you end up with at the end of a chemical reaction.

A chemical change is one in which new chemicals are made, such as in a reaction between magnesium and hydrochloric acid. When there is a physical change no new chemicals are formed, but there is a change from a solid to a liquid, for example.

An acid has a pH of under 7, whereas an alkali has a pH of over 7.

Activity: Testing gases

1 The limewater was colourless to start with and as the carbon dioxide gas bubbled into the tube of limewater, it started to go cloudy. The more gas bubbled, the whiter and cloudier the limewater became.

2 When the glowing splint was placed in the test tube of oxygen the splint relit and appeared to bev properly alight.

Think like a scientist: Chemical reactions or not?

The answers to the questions *What do you observe?, Has a chemical reaction taken place?* and *What evidence do you have?* will depend on the experiment done and what the learners observe.

Check your progress

8.1

Physical change	Chemical change
melting chocolate	burning a piece of wood
heating glass and bending it	cooking an egg
	baking a cake

8.2 a Hydrogen

b Place a lighted splint in the gas. If it is hydrogen it will burn with a loud 'pop'.

c Zinc sulfate and hydrogen

d When there are no more bubbles of gas produced you will know that all the acid has reacted.

8.3 a Mg

b Oxygen

c Magnesium oxide

d Magnesium chloride

8.4 a D

b B

c A

8.5 a Purple or blue

b Green

c The acid and the alkali were equal in strength.

$50\,cm^3$ of alkali was neutralised by $50\,cm^3$ of acid, so they must be the same strength. If the acid was stronger, a smaller volume of acid would have been needed to neutralise the alkali.

d Credit the use of ruler and pencil.

Appropriate scales and labelled axes.

Points accurately plotted.

Points connected appropriately.

Unit 9 Electricity

Topic 9.1 Flow of electricity

Getting started

1 Cell, wire

2 Current

Questions

1 Electrons

2 Current in a circuit is the movement of **electrons**.

These particles have a **negative** charge.

These particles are **attracted** by the positive terminal and **repelled** by the negative terminal of a battery.

Activity: Modelling electron flow

1 The cell

2 The same

3 No, it was not possible.

4 Electrons

5 a Electrons move in one direction; or electrons cannot be moving in one part of the circuit and stationary in another part; only the cell can move the electrons

b Electrons would move at a steady speed, whereas the string has a jerky movement; a switch cannot be modelled in this circuit; the movement of the string does not do anything such as produce light or make a sound, whereas current in a circuit would do something.

Think like a scientist: Making predictions about current

1 The lamps will light; the correct prediction is that they will all light at the same time; some may predict that a lamp closer to the power supply will light first, or that the lamps will come on in some other sequence.

2 a Any of these predictions, correct or not, is testable.

b Hypothesis

3 All the lamps light at the same time when the switch is closed.

4 Electrons all start to move at the same time when the switch is closed, so current starts to flow all around the circuit at once.

Topic 9.2 Electrical circuits

Getting started

a Provide energy/make current flow.

b Make the circuit complete or break the circuit/make the current start or stop flowing.

c Give out light (when current flows through).

d Make a sound (when current flows through).

e Measure current in the circuit.

Questions

1 a

b

c

d

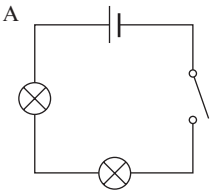
2 The wire is drawn through the lamp; wire extends into cell; there is a gap at the corner between the wires.

3 C

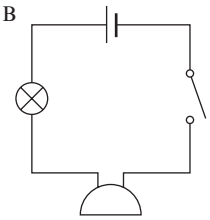
Think like a scientist: Drawing circuit diagrams

The circuit diagrams should be:

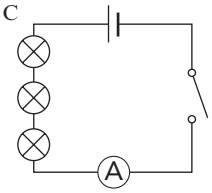
A



B



C



Components in the circuits can be in any order.

Activity: Circuit uses

Any possible uses for something that produces light and sound at the same time, such as an alarm or toy. They can be different because the components can be connected in a different order.

Topic 9.3 Measuring the flow of current

Getting started

1 Electrons

2 a Ammeter

b

Questions

1 Amps/amperes (not the letter A alone)

2 a 2.5 A

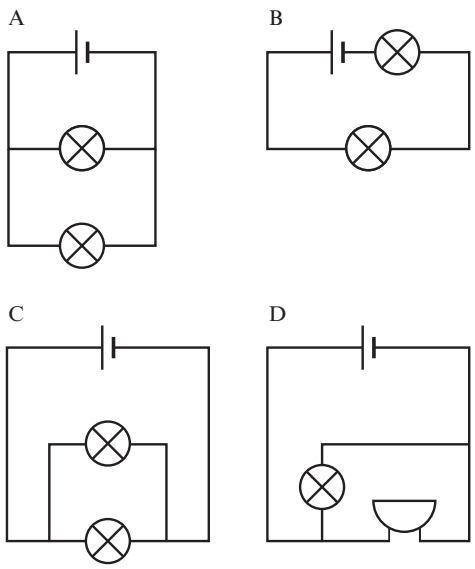
b 5 A or 5.0 A

c 8 A or 8.0 A

d 1200 A

3 The greater the current in a circuit, the **faster** the flow of **electrons**.

4



Think like a scientist: Making predictions about current

Circuit copied with arrows pointing around the circuit away from the negative (shorter, thicker end of the cell) towards the positive (longer, thinner terminal).

1 a Learners can make any prediction here, but only prediction A is correct.

b The explanation should match with the choice in **a** but does not have to be correct.

2 Should state that the current is the same at each point.

3 If prediction B or C was made in question 1, then these should be identified as incorrect; if prediction A was made, it should be identified as correct.

4 Idea that electrons move to make current flow; electrons cannot go faster in one part of this circuit than in another.

Topic 9.4 Conductors and insulators

Getting started

When current flows, particles called **electrons** move.

In metals, these particles **are free to move**.

Questions

1 Examples of electrical conductors include **steel** and **aluminium**.

Examples of electrical insulators include **plastic** and **wood**.

2 To keep the cost low or silver would be too expensive.

3 a Plastic is an insulator; protect people from electric shock.

b Metal is a conductor; to allow current to flow to the wire.

4 In a conductor, the electrons are free to move; in an insulator, the electrons are not free to move.

Activity: Conduct or insulate?

Object	Conductor or insulator	Reason
copper pipe	conductor	Copper is a metal and metals are conductors
plastic comb	insulator	Plastic is a non-metal, which is an insulator
gold ring	conductor	Gold is a metal and metals are conductors
wooden ruler	insulator	Wood is a non-metal, which is an insulator
glass	insulator	Glass is a non-metal, which is an insulator
steel spoon	conductor	Steel is a metal and metals are conductors
door key	conductor	A key is made from metal and metals are conductors
pencil	insulator	Wood is an insulator
T-shirt	insulator	Cotton/fabric/cloth is an insulator
test tube	insulator	Glass is an insulator

Think like a scientist: Conductor or insulator?

1 To make sure the lamp lights or that the cell is working.

2 The lamp will light if a conductor is placed between the clips; current can flow through the conductor and complete the circuit.

The lamp will not light if an insulator is placed between the clips; current will not flow through the insulator so the circuit will not be complete.

3 Table with item to be tested in the first column; column to show whether the lamp lights.

Conclusion as to whether item is a conductor or insulator could be given as another column in the table or separately.

4 Metals conduct and non-metals do not conduct.

5 a Some metals are painted; paint is an insulator.

b Scrape off some of the paint.

Topic 9.5 Adding or removing components

Getting started

1 a Amps/amperes

b A

2 a Current in a circuit is the flow of particles called **electrons**.

b As current increases, the flow of these particles gets **faster**.

Questions

1 C

2 a B

b Increasing the number of cells in a circuit will increase the current.

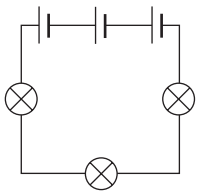
3 a C

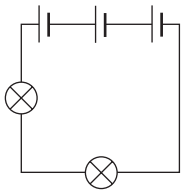
b Decreasing the number of lamps in a circuit will increase the current.

4 a Add another cell; remove one of the lamps.

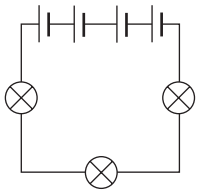
b Remove one of the cells; add another lamp.

Activity: Model circuits

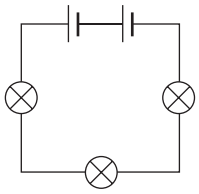
1 

2 a 

or



b Adding a cell or removing a lamp will increase the current.

3 a 

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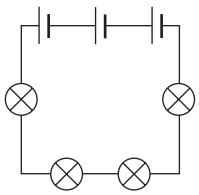


b Adding a lamp or removing a cell will decrease the current.

4 If the new circuit has:

- An equal number of cells and lamps then the current will be the same.
- A larger number of cells and the same number of lamps then the current will be larger.
- A larger number of lamps and the same number of cells then the current will be smaller.

Think like a scientist: Measuring current

1 In a table with columns headed number of cells, number of lamps, current in amps.

2 Table completed with values of current only in the table body, units (A) in column header.

3 a Increasing the number of lamps decreased the current (or vice versa); increasing the number of cells increased the current (or vice versa).

b Only done with one circuit; only done with lamps; the total length of the wires also changed.

Check your progress

9.1 a Electrons

b Negative

c Away from the negative and towards the positive.

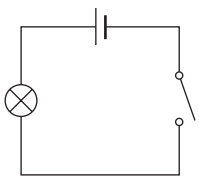
9.2 a i Cell 

ii Switch (open)

iii Lamp 

iv Ammeter 

v Buzzer 

b 

Switch can be closed if obvious.

9.3 B

9.4 C and D

9.5 a A conductor allows electrons to flow and completes the circuit

b The object is an insulator.

The cell has stopped working/the lamp has stopped working/a wire is broken.

c A conductor **allows** electron flow.

In a conductor, electrons are **free to move**.

An insulator **inhibits** electron flow.

In an insulator, electrons are **not free to move**.

9.6 a Series circuit correctly drawn.

Circuit can have more than two cells or fewer than three lamps or both.

b Series circuit correctly drawn.

Circuit can have fewer than two cells or more than three lamps or both.