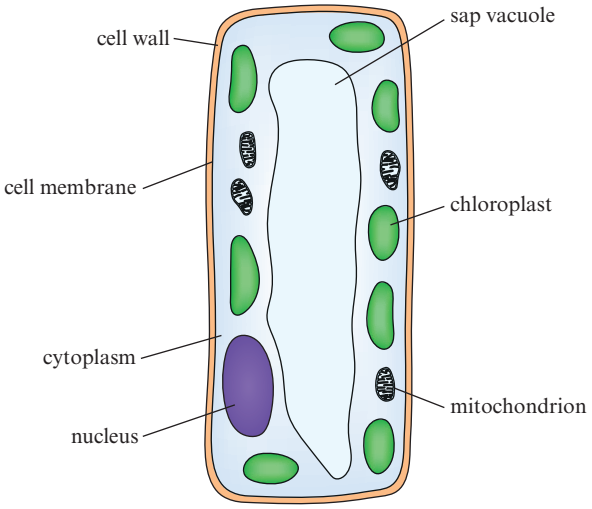
Workbook answers

Unit 1 Cells

Topic 1.1 Plant cells

Exercise 1.1A Structure of a plant cell



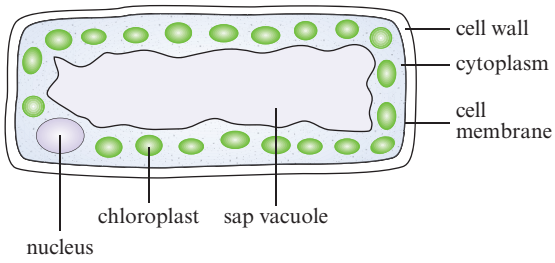
Exercise 1.1B Drawing and labelling a plant cell

1 For example:

Use a ruler to draw the label lines.

Make sure that each line connects the label to the part accurately.

2



Exercise 1.1C Different plant cells

1 Plant cell **A** has chloroplasts, but plant cell **B** does not.

Plant cell **A** is rectangular, but plant cell **B** is hexagonal.

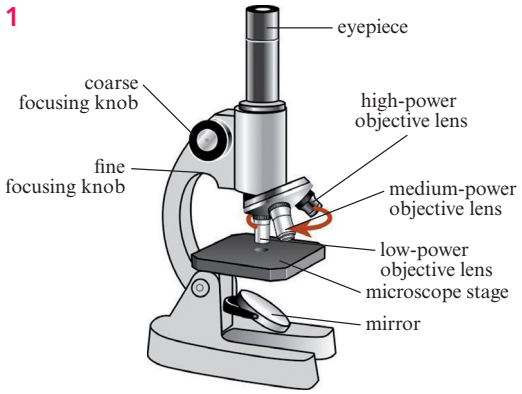
Plant cell **A** has a larger sap vacuole than plant cell **B**.

2 Plant cell **A** comes from a leaf. This is because it has chloroplasts, which contain chlorophyll that absorbs energy from light for photosynthesis. Photosynthesis takes place in leaves. Plant cells that are not in the light do not contain chloroplasts.

Topic 1.2 Animal cells

Exercise 1.2 How to use a microscope

1



2 The most likely answers are:

- She has not placed the part of the slide containing cells over the hole in the stage.
- She has not focused the microscope correctly.
- She has not adjusted the mirror so that light passes through the slide.

Be prepared to accept other sensible answers.

3 There is no 'correct' answer to this open-ended question. Look for:

- Useful advice that a learner could follow to be successful in seeing cells, e.g. referring to the three suggestions in the answer to question 2.
- Advice written in a clear manner.
- Advice provided in a sensible sequence, in the order of the steps that Zara would take.

Topic 1.3 Specialised cells

Exercise 1.3 How cells are specialised for their functions

1 a Red blood cells contain a substance called **haemoglobin**. This helps them to carry **oxygen** around the body.

b Red blood cells are smaller than most cells. This helps them to squeeze through the small blood vessels called **capillaries**.

2 a Root hair (cell)

b It has a cell wall and a large sap vacuole.

c Absorb water and mineral ions from the soil.

d It has a long extension that makes it easy for water to move into from the soil.

3 a The table should be designed so that contrasting points are aligned with each other. Note that the question does **not** ask for comparisons of function, only structure.

Ciliated cell	Palisade cell
does not have a cell wall	has a cell wall
does not have chloroplasts	has chloroplasts
has cilia	does not have cilia
has a nucleus	has a nucleus
has cytoplasm	has cytoplasm
has a cell membrane	has a cell membrane
does not have a sap vacuole	has a sap vacuole

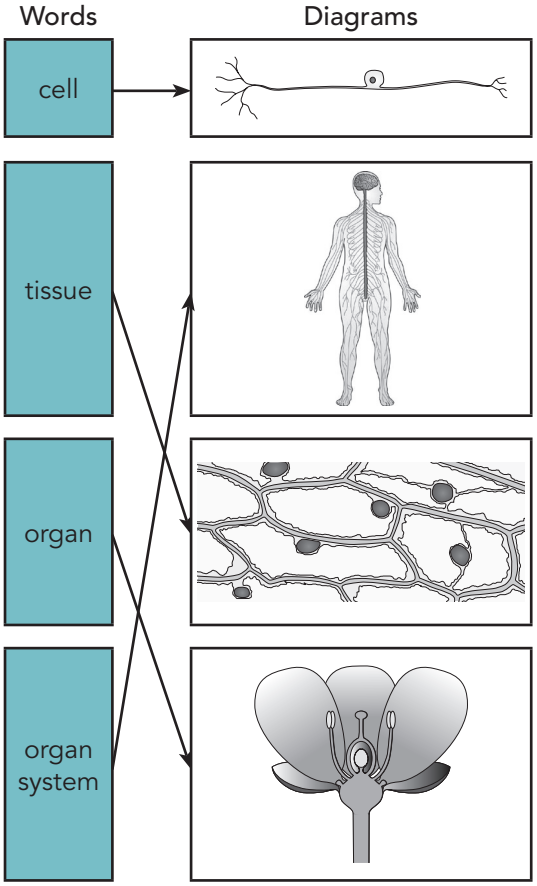
b Look for descriptions that use different forms of words from those in the Learner's Book, such as:

Ciliated cells have many tiny cilia on one surface. These can wave in a ripple-like movement, which moves mucus over their surfaces. The mucus traps bacteria and dust, and the cilia sweep this away from the lungs.

Palisade cells have many chloroplasts. This is where photosynthesis happens, so palisade cells are adapted to carry out photosynthesis and make food for the plant.

Topic 1.4 Cells, tissues and organs

Exercise 1.4A Identifying cells, tissues, organs and organ systems



Exercise 1.4B Human organ systems

Function	Organ system	Some organs in the system
transporting substances around the body	circulatory system	e.g. heart, arteries, veins, capillaries
breaking down food and absorbing it into the blood	digestive system	e.g. stomach, intestines, liver
taking oxygen into the body and getting rid of carbon dioxide	respiratory system	e.g. lungs, trachea

Function	Organ system	Some organs in the system
helping different parts of the body to communicate with one another	nervous system	e.g. brain, nerves, spinal cord, any sense organs (eye)

Exercise 1.4C Sting cells in *Hydra*

1 a Tissue

b Tissue

c Cell

d Organ

2 No, *Hydra* do not have a digestive system. A system is made up of many different organs, and *Hydra* just have a cavity inside which food is digested.

3 Nucleus, cytoplasm, cell membrane

4 It does not have a cell wall. This is the only genuinely distinguishing feature. The lack of a large vacuole or lack of chloroplasts does not mean it is definitely not a plant cell, as there are many examples of plant cells that lack these features.

5 Look for an explanation that relates the structures inside the sting cell and its behaviour to its function of trapping (and possibly killing) prey. The answer must not replicate the sentences in the text preceding the diagrams. Students should use the information from here, but present it in their own words.

Unit 2 Materials and their structure

Topic 2.1 Solids, liquids and gases

Exercise 2.1A Sorting solids, liquids and gases

1 and **2**

Solids	Liquids	Gases
Flour	Milk	Butane Gas
Butter	Beaten Eggs	Air
Sugar	Water	Flame
Cooking Pan		
Butane Gas Burner		
Football		
Candle		

Exercise 2.1B Solid, liquid or gas?

1 A is a gas. The test shows that it can be compressed. Only gasses can be compressed.

2 B can flow, so it could be a gas or a liquid. It keeps the same volume, so it must be a liquid.

3 Learners should suggest testing to see if material C can be compressed. If it can, then C is a gas; if not, it is a liquid.

4 Yes, he is correct. Material D can flow, so it could be a gas or a liquid. Material D keeps the same volume, so it must be a liquid.

5 Material E keeps the same volume, so it cannot be a gas.

6 He should test to see if material E can flow. If it can flow (be poured), it is a liquid. If it cannot flow, it is a solid.

Exercise 2.1C Properties of solids, liquids and gases.

1 A A liquid and a gas.

B A liquid and a gas. However, since the containers have no lid, the gas would escape.

2 A Flour is a powder. Although each individual speck of flour is solid, it is so small that it can flow and be poured.

B The flour is formed of small specks which are solid. These maintain their shape, but there are spaces between them as the flour is in the form of a powder, so the specks can move past one another to form a different shape.

C The specks of flour have air in the spaces between them and when the specks are pushed together the air is forced out. This allows the specks to be squeezed into a smaller space.

Topic 2.2 Changes of state

Exercise 2.2 Marcus's water heating investigation

1 Marcus wears safety glasses.

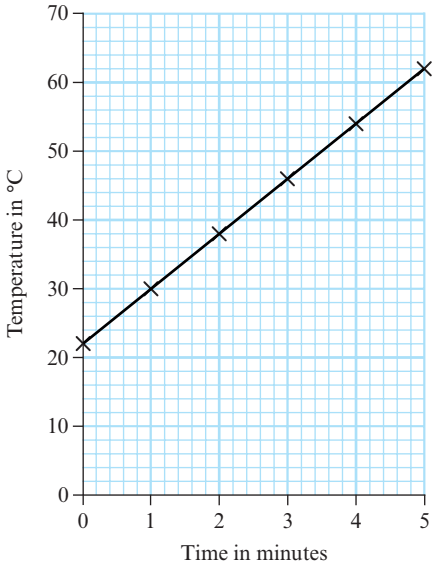
2 Table drawn; two columns with headings **Time in minutes** and **Temperature in °C**.

3 After four minutes the temperature is 54 °C.
At the start, the temperature is 22 °C.
After three minutes the temperature is 46 °C.
After one minute the temperature is 30 °C.
After five minutes the temperature is 62 °C.
After two minutes the temperature is 38 °C.

4

Time in minutes	Temperature in °C
0	22
1	30
2	38
3	46
4	54
5	62

5



6 The graph shows that the longer the water is heated, the higher the temperature. The line is straight, which shows that the temperature increases regularly (by 8 °C per minute). As long as the learner gives the idea of a relationship between time for heating and an increase in temperature, give them credit.

7 a The point at five minutes does not fit the pattern. This point should be circled.

b Zara should ignore it on her graph.

8 Give credit for a smooth line that does not join point-to-point and is not affected by the point at five minutes.

9 The line goes up steeply as the temperature increases. The slope of the curve decreases at the eight-minutes mark and becomes almost flat from that point on.

10 The temperatures remain about the same at the end of the investigation because, although there is more heat energy reaching the water, the water is boiling and the energy is being used for the particles of water to change to a gas and escape as steam.

11 a No. There is a smaller volume.

b There is a smaller volume of liquid at the end of the investigation because some of the liquid water has been converted to a gas and has escaped from the container into the room.

Topic 2.3 Explaining changes of state

Exercise 2.3A Change of state

1 Solid

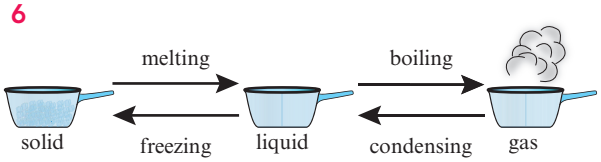
2 *Heading B: Particles in a solid:* Particles shown in the box should all be the same size, similar to those shown in diagram A. They should all be arranged in regular rows touching one another.

3 Gas

4 *Heading C: Particles in a gas:* Particles shown in the box should all be the same size, similar to those shown in diagram A. They should all be arranged so they are spaced far apart and not touching one another.

5 Gain; more; strong; past; liquid

6



Exercise 2.3B Particle theory and change of state

1 In ice, water particles are in a fixed position as it is a solid. During heating, energy transfers to the water particles, allowing them to escape the forces holding them in place. The particles begin to move past each other, forming liquid water.

2 The particles in the iron bar are in a fixed position and can vibrate. As the bar is heated the particles gain energy and can vibrate more. As the particles vibrate they take up slightly more space and the metal bar expands.

3 a Gas
b Condensation
c Vibrate
d Melting
e Evaporation
f Move
g Gas

Exercise 2.3C Explaining changes of state

1 The particles in a liquid are touching each other and have enough energy to be able to slide past one another to change their positions. They are held together by weak forces. When the liquid is frozen, heat energy is transferred to the freezer. The energy is lost from the particles and they are not able to move as much. The particles become unable to slide past one another and become fixed in regular rows with all the particles touching one another.

2 The particles in a gas are spread out, have no forces holding them together and have so much energy that they can move about. When the particles touch a cold surface, some of their heat energy is transferred to it so the particles lose heat energy. This means that the particles cannot move about, but can move past one another forming a liquid with the particles touching one another.

3 The particles in a liquid are touching each other and have enough energy to be able to slide past one another to change their positions. They are held together by weak forces. When a liquid is heated the particles gain energy and are able to move more and escape the weak forces holding them together and change into a gas.

4 Learners may list words they have not used, but are appropriate here. Answers depend on the learners.

Topic 2.4 The water cycle

Exercise 2.4 The water cycle

1 a Ocean
b Clouds
c Precipitation
d Evaporation

2 e Transpiration
f Surface run-off
g Ground water

3 The Sun

4 Particles of water evaporate from the ocean. Particles have energy transferred to them and can move more, so they can overcome the forces holding them together. The liquid water changes to water vapour, a gas. This gas rises up into the atmosphere where it forms clouds.

5 It rains because the particles of water vapour in the clouds get colder, so they lose energy, and because the particles cannot move so much they form drops of water that are too heavy to stay in the clouds and fall as rain.

6 Precipitation is rain or anything else that falls from clouds. It can take the form of liquid water which is rain, solid lumps of ice which is hail, or snow which is also made of ice, but not so solid. Credit sleet, which is between rain and snow. For hail or snow to fall it must be colder than when rain falls.

Topic 2.5 Atoms, elements and the Periodic Table

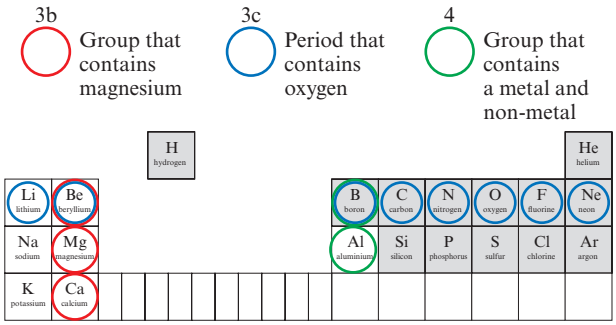
Exercise 2.5 Atoms, elements and the Periodic Table

1 a Na
b Mg
c B
d Ca
e K

2 a Argon
b Phosphorous
c Carbon
d Chlorine
e Lithium

3 a Non-metals
b The vertical column containing magnesium should be circled red.
c The horizontal row that contains oxygen should be circled blue and should include lithium and beryllium.

4 The vertical column containing aluminium and boron should be circled green.



5 One of nitrogen, oxygen, fluorine or neon

6 Magnesium or beryllium

7 One of silicon, phosphorous, sulfur, chlorine, argon, potassium or calcium

8 Carbon or boron

Topic 2.6 Compounds and formulae

Exercise 2.6 Compounds and formulae

1 a True
b False
c True
d False
e False
f False
g True

2 a Potassium and chlorine
b Potassium
c Magnesium and oxygen
d Copper oxide
e Iron chloride

3 a Sodium oxide
b Calcium carbonate
c Potassium nitrate
d Potassium nitride
e Hydrogen fluoride

4 a Carbon and oxygen
b Copper, oxygen and sulfur
c Aluminium and chlorine
d Sodium and sulfur
e Calcium, oxygen and chlorine

5 Potassium, oxygen and hydrogen

6 Answers shown in table

Chemical name	Formula	What the compound contains
magnesium oxide	MgO	one magnesium atom bonded to one oxygen atom
sulfur dioxide	SO_2	one sulfur atom bonded to two oxygen atoms
aluminium chloride	$AlCl_3$	one aluminium atom bonded to three chlorine atoms
calcium sulfide	CaS	one calcium atom bonded to one sulfur atom
magnesium carbonate	$MgCO_3$	one magnesium atom bonded to one carbon atom and three oxygen atoms

7 a $NaCO_3$
b $CaCl_2$
c $CaCO_3$
d O_2
e K_2CO_3

8 a This particle is made of 12 atoms of carbon, 22 atoms of hydrogen and 11 atoms of oxygen.

b It means two particles of the sugar maltose.

9 a Magnesium hydroxide

b 2

c 2

10 Calcium hydroxide; $Ca(OH)_2$

Topic 2.7 Compounds and mixtures

Exercise 2.7 Compounds and mixtures

1 The correct statements are **a**, **c**, **d**, **f**, **h**, **i**.

2 A, C and D.

3 C and E

4 F

5 E

6 C

7 a Iron sulfide is a compound. A mixture would be iron filings mixed with sulfur powder. Accept any other correct example.

b In the compound the elements are bonded together and the new product has different properties from the elements that made it. In the mixture the elements are not bonded together and no new product is formed. The elements retain their properties in a mixture.

c The compound iron sulfide is not magnetic, but iron is. Sulfur is a bright yellow colour, but iron sulfide is not. Accept any other correct answers.

d In the mixture the iron is still magnetic but in the compound it is not. The elements retain their properties in the mixture: the iron is still a grey colour and the sulfur is still yellow. They are just mixed together and can be separated. In the compound the elements are not easily separated.

Unit 3 Forces and energy

Topic 3.1 Gravity, weight and mass

Exercise 3.1A Differences between weight and mass

1 Mass can be measured in **g** or **kg**.

Weight is measured in **N**.

2 **weight**

The force of gravity on an object.

Changes, depending on the strength of gravity.

mass

The quantity of matter in an object.

Constant, even when the strength of gravity changes.

3 a $75 \times 10 = 750$ N or newtons

b $900 \times 10 = 900$ N or newtons

c $0.1 \times 10 = 1$ N or newtons

Exercise 3.1B Values of weight and mass

1 Top row - tick top pan balance

Bottom row - tick force meter

2 120 kg, 6.04 kg, 0.001 g

3 a $\frac{250}{10} = 25$ kg or kilograms

b $\frac{0.9}{10} = 0.09$ kg or 90 g

c It will be less than 10.

d It would be the same; mass is the quantity of matter in an object; mass is not affected by (the strength of) gravity.

Exercise 3.1C Effect of gravity on objects

1 Arrows should point towards the centre of the Earth.

2 a Similar: attract/pull things together; they are both non-contact forces/both act at a distance.

b Different: magnets can repel/gravity cannot repel.

3 a Newton meter/force meter

b Axes labelled with the quantity and unit: mass in kg on the *x*-axis and weight in N on the *y*-axis. Linear scales starting at zero on both axes and sensible use of the grid, e.g. 1 large square to 0.1 kg and to 1.0 N. All points plotted to within $\frac{1}{2}$ small square.

c Straight line ruled through points.

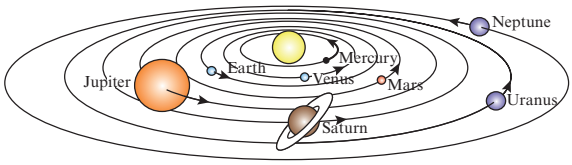
d Mass is independent; weight is dependent

e Weight of 1.0 kg is 9.8 N, so weight of 2.0 kg is 2 × 9.8 = 19.6 N

Topic 3.2 Formation of the Solar System

Exercise 3.2A Ideas about formation of the Solar System

1



2 a Hypothesis

b Gravity

c Scientists use computers to **model** the formation of the Solar System.

Exercise 3.2B Watching stars being born

1 Nebula

2 Telescope

3 An observation

4 Fair tests

Exercise 3.2C Observing and predicting

1 Because it takes millions of years/cannot be completed in a person's lifetime.

2 Scientists think the Solar System formed from a cloud of dust and gas – hypothesis

Scientists use computers to demonstrate the formation of the Solar System – modelling

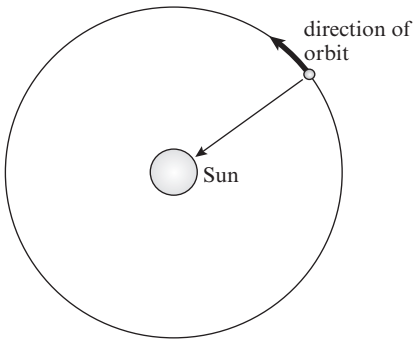
Scientists can see that stars are forming in clouds of dust and gas in space – observing

Scientists know that all the planets orbit the Sun in the same direction – evidence

Topic 3.3 Movement in space

Exercise 3.3A Travelling through space

1 Arrow should point towards the Sun



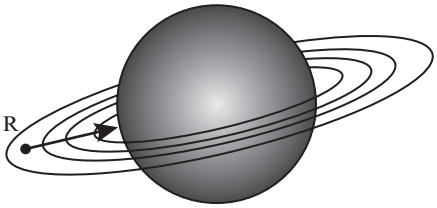
2 a Vacuum

b Air resistance

Exercise 3.3B Are there forces in space?

1 There is no air resistance.

2 Arrow from R toward centre of planet.



Exercise 3.3C Speeding up, slowing down and changing direction

1 a To overcome gravity and air resistance.

b Air resistance is a force that slows things down/acts opposite to movement.

2 Path curves towards, but does not touch, Jupiter; extent of curve can be very little or very great; path must not show start of orbit around Jupiter.

Topic 3.4 Tides

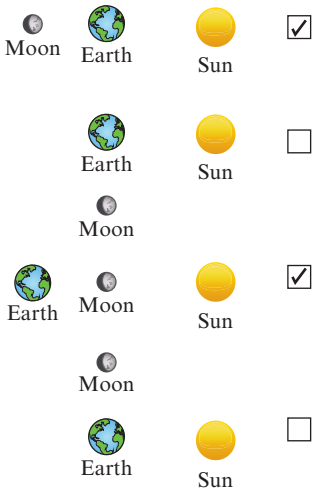
Exercise 3.4A High and low tides

1 Tidal forces from the Sun and Moon.

2 a 12 (hours)

b 6 (hours)

3



Exercise 3.4B Times of the tides

1 11:00 same day

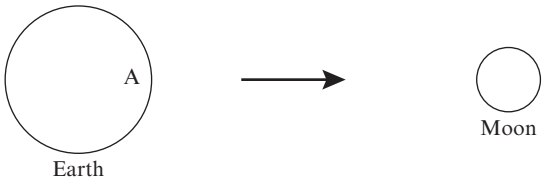
2 a 3.2 (m)

b Any interval between 15 minutes and 60 minutes/1 hour.

Exercise 3.4C Forces and tides

1 This force is called a **tidal** force.

2 Arrow pointing from A towards the (centre of) the Moon.



3 High tide, because the gravity from the Moon is pulling the water at A; water will be deeper at A (than at other tide times).

4 20:00 or 8.00 p.m

Topic 3.5 Energy

Exercise 3.5A Describing energy

Elastic – energy stored in an object that has changed shape.

Gravitational potential – energy in objects that are lifted higher.

Electrical – energy carried by current in wires.

Chemical – energy stored in fuel.

Sound – energy transferred from vibrations.

Thermal – energy in hot objects.

Light – energy that we can see.

Kinetic – energy of moving objects.

Exercise 3.5B Examples of energy

1 a Food is a store of **chemical** energy.

b A book lifted up onto a shelf has a store of **gravitational potential** energy.

c The Sun transfers **thermal** energy and **light** energy to Earth (words can be in either order).

d A musical instrument transfers **sound** energy to our ears.

2 Gravitational potential and chemical are stored.

Thermal and light are transferred.

Exercise 3.5C Energy investigations

1 Kinetic

2 A prediction

3 Two reasons from: too dangerous/unsafe; temperature difference was too small for them to detect; too difficult to measure the temperature at the top and bottom at the same time.

Topic 3.6 Changes in energy

Exercise 3.6A Energy diagrams

1 Electrical → **light**

2 Electrical → **sound**

3 **Chemical** → kinetic

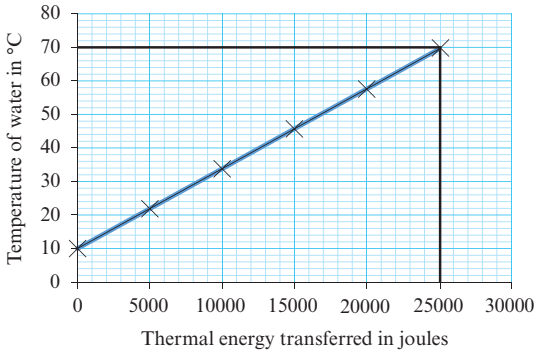
4 **Gravitational potential** → **kinetic**

Exercise 3.6B Reading from a graph

1 As the thermal energy transferred **increases** the temperature of the water **increases**. Cannot be decreases in both because energy is being transferred to the water.

2 10 °C

3 Vertical line drawn down from a line at 70 °C to the 25 000 J on the *x*-axis.



4 Mass of water used.

Exercise 3.6C Series of energy changes

1 Elastic energy is stored in the (compressed) spring (when the toy is pushed down); elastic energy is changed to kinetic energy; kinetic energy is changed to gravitational potential as the toy jumps up; gravitational potential is changed back to kinetic energy as the toy falls down.

Topic 3.7 Where does energy go?

Exercise 3.7A Energy word search

T	D	E	S	T	R	O	Y	E	D	D	T	D	T
U	E	D	E	T	S	A	W	W	I	W	D	E	L
D	G	U	E	A	E	Y	U	L	I	T	S	T	I
S	S	E	T	S	F	A	S	U	L	H	L	A	G
T	R	E	G	R	E	E	P	F	S	E	W	P	H
O	E	D	L	A	T	I	D	E	R	R	N	I	T
R	A	R	S	A	N	E	Y	S	A	M	D	S	U
E	I	S	H	S	S	I	E	U	T	A	O	S	E
D	R	E	C	O	V	E	R	E	D	L	T	I	U
N	C	L	S	F	D	N	U	O	S	E	D	D	E
I	E	E	L	I	R	U	G	O	R	R	W	S	E
D	O	E	N	E	R	G	Y	D	E	W	D	E	D
S	E	S	E	U	E	E	D	R	H	T	I	T	H
E	U	D	O	T	D	A	R	F	G	D	G	U	S

1 Energy (example)

2 Stored

3 Useful

4 Wasted

5 Recovered

6 Dissipated

7 Light, thermal, sound

8 Destroyed

Exercise 3.7B Energy loss

1 Two from: same volume/mass of water (do not accept amount), same shape of beaker/same surface area, same material of beaker, set up in same place, take temperatures at the same times.

2 Thermal

3 Two from: (surrounding) air, container, surface that the container is on, e.g. bench/table.

4 Measure the temperature of the surroundings before, during and after placing the hot water. The temperature will have increased (if thermal energy has gone there).

5 One from: do not touch hot beakers/hot water, stay away from steam, use glassware/container material that will not shatter/melt when hot water is added.

Exercise 3.7C Wasted energy

1 100 − 80 = 20%

2 a 100 − 25 = 75%

b Two from: thermal; sound/vibration, chemical if clearly referring to unburned fuel/chemicals in exhaust.

c Diesel engine is more efficient; idea that it will be more cost-effective/cheaper in the long-term; make more profit as less money spent on fuel.

Unit 4 Grouping and identifying organisms

Topic 4.1 Characteristics of living organisms

Exercise 4.1A Matching terms and descriptions

Nutrition – feeding – taking in materials from the environment for energy and growth.

Respiration – breaking down nutrients to release energy.

Excretion – getting rid of waste materials.

Reproduction – making new individuals of the same kind of organism.

Growth – getting bigger.

Sensitivity – detecting changes in the environment.

Movement – changing the position of part or all of the body.

Exercise 4.1B Characteristics of living organisms

1 Sensitivity

2 Respiration

3 Movement

4 Excretion

5 Nutrition

6 Reproduction

7 Growth

Z	Q	X	U	E	E	B	C	Y	S	T	N	P	R
R	A	C	H	P	X	E	L	H	T	W	O	R	G
E	M	Q	U	A	L	W	H	T	R	E	I	N	E
S	J	U	Z	C	K	E	M	N	I	X	T	F	S
P	G	N	W	Y	A	O	O	M	T	C	C	X	E
I	M	P	C	B	L	I	V	K	D	R	U	S	T
R	H	C	T	I	T	O	E	C	E	E	D	R	L
A	U	P	B	I	E	I	M	O	U	T	O	W	T
T	E	R	R	V	S	C	E	P	S	I	R	R	E
I	N	T	R	E	S	K	N	F	F	O	P	E	R
O	U	Y	T	I	V	I	T	I	S	N	E	S	G
N	H	I	J	T	U	F	V	J	E	A	R	D	E

Exercise 4.1C Living or not?

This is a challenging activity. Learners may be able to appreciate that deciding whether something is alive or not is not completely straightforward. Look for the following ideas in the learner's answers:

- The characteristics of living things are sensitivity, respiration, movement, excretion, nutrition, reproduction and growth.
- Anything that shows all of these characteristics is a living thing.

Not all living things show these characteristics all of the time: an elephant, for example, is alive but does not reproduce all the time; apples do not show sensitivity (but they are respiring, and they contain seeds that will grow into a complete living thing); seeds do not move (but will eventually grow into a plant that can move parts of its body).

Topic 4.2 Viruses

Exercise 4.2: All about viruses

1 Viruses are very **small**. Viruses are not made of **cells**. Viruses can only **replicate** when they are inside a living cell.

2 a They can replicate.

b They can only replicate inside a living cell and they are unable to carry out any of the other characteristics of living organisms.

3 a Learners should ensure that they use trustworthy websites, such as those from universities. They may also use Wikipedia, although care always has to be taken with this site, as entries are not always correct or unbiased. If Wikipedia is used, it is good to check that the information it provides matches information on academic sites.

b The first virus to be discovered was tobacco mosaic virus. A Russian scientist, Ivanovsky, found that if he passed extracts from infected leaves through a filter, bacteria could not get through: the extract could still infect other leaves. He concluded that there was something in the extract that

was even smaller than bacteria and could cause infection. But he did not use the word 'virus' and he thought that the 'something' was probably a chemical. In 1898, a Dutch scientist called Beijerinck did further work on this subject and decided that 'viruses' were a liquid. It was some years later that an American scientist, Stanley, proved that they were very small particles.

Note that progress was slow because microscopes were not yet able to 'see' very small things such as viruses.

Topic 4.3 What is a species?

Exercise 4.3A Different species

White rhinoceroses and Indian rhinoceroses belong to different **species**. This means that they cannot **reproduce** with each other to produce **fertile** offspring.

White rhinoceroses and Indian rhinoceroses do not look **exactly the same as** one another. Indian rhinoceroses have one **horn** but white rhinoceroses have two **horns**.

Exercise 4.3B Horses, donkeys and mules

1 There is a wide range of similarities that students could find, such as having four legs, two ears, hair on the body and so on. Allow any correct answers.

2 There are various answers that students might give. For example, the donkey is smaller; it has longer hair along its neck.

3 They have different Latin names. They cannot breed together to produce fertile offspring.

Exercise 4.3C A new frog species

This is a very open-ended task and many students will benefit from discussion about the issues involved before attempting to construct their answer. This could be done as a class discussion, or you could ask students to discuss in pairs or small groups. They could then either write their answers individually or work together to construct an answer.

Some students may simply state that the researchers should find out whether this frog can breed with frogs of other species. You could explain the great difficulties in determining this, and that usually decisions about species are made by making comparisons between the characteristics of the organisms.

Look for these features in the students' answers.

- An appreciation of the importance of using several specimens to study, because of variation within a species, but that studying too many of the frogs might endanger the species, especially if these are not returned to their natural habitat.
- A clear, simple description or list of what evidence the scientists should collect. This could include information about observable features, such as coloration, measurements of body parts, behaviour and perhaps a study of its genes, and that these should be compared with the same features in other similar frog species. Some students might also suggest studying the tadpole, to see if they differ in any way from the tadpoles of the other species.
- Reference to the ability of this frog to breed with known species of frog to produce fertile offspring.
- Suggestions about how the scientists could use their information to test their hypothesis that the frog belongs to a new species, such as investigating whether the newly-found frogs can breed with other similar species, as well as making a detailed comparison of their appearance with these other species.
- Reference to how other scientists might evaluate this evidence, such as checking the data that is relies on, looking at the number of frogs that have been found and investigated, and checking if it is possible to repeat the findings of the first group of scientists.
- Some students may also be able to add information that they find on the internet. For this, it is very important to make sure that they have written in their own words, and not copied sentences directly from their sources.

Topic 4.4 Using keys

Exercise 4.4A Using a key to identify a fruit

Fruit B is sycamore.

Exercise 4.4B Using a key to identify four fish

1 a 1a

b Basking shark (its eye is above the front end of its mouth)

2 a 1b

b Sea bream (it has short spines on its top fin)

3 Greenland shark

4 John Dory

Exercise 4.4C Using a key to identify tree species, using their leaves

1 Leaf A is hazel.

2 1b, 2a, 3b

3 Leaf B: 1a, rowan

Leaf C: 1b, 2a, 3a, 4b, cherry

Leaf D: 1b, 2a, 3a, 4a, willow

Leaf E: 1b, 2b, maple

Topic 4.5 Writing keys

Exercise 4.5 Making a key to identify plant species from their leaves

1 Answers to include:

- Shape – one whole shape, or divided into three parts, or with several 'fingers'.
- Edge (the proper biological term is the margin) – smooth or jagged.
- Veins – form a network, or run parallel to the midrib.
- Texture – smooth or rough.
- Stalk – some have a leaf stalk and some do not.
- Size – some are larger than others.

2 The key should have questions that relate to the differences identified in the answer to question 1. Check that the key works.

3 The key should have these features:

- There should be a series of choices to make, each time deciding between two contrasting statements.
- Each choice should be possible to make while looking at only one leaf, so a choice between 'large' and 'small' is not suitable.
- The key should have no more than four pairs of choices to make.

Unit 5 Properties of materials

Topic 5.1 Metals and non-metals

Exercise 5.1 Metal properties and uses

1 a Iron is used for building bridges.

b Gold is used for jewellery.

c Copper is used for electrical wiring.

2 The following terms should be circled: malleable; feels cold to the touch; makes a ringing sound when tapped; conducts heat; ductile; has a shiny surface.

3 a Sonorous

b Ductile

c Malleable

d Shiny

e Magnetic

f Conductor

g Properties

4 Credit a correct named metal and any descriptive words. Credit any appropriate property linked to a function.

Topic 5.2 Comparing metals and non-metals

Exercise 5.2A Metal or non-metal?

1

List of materials	Sofia's answer	Correct?
Silver	Metal	✓
Oxygen	Non-metal	✓
Helium	Non-metal	✓
Carbon	Metal	✗
Copper	Metal	✓
Nitrogen	Non-metal	✓
Sulfur	Metal	✗
Iron	Metal	✓

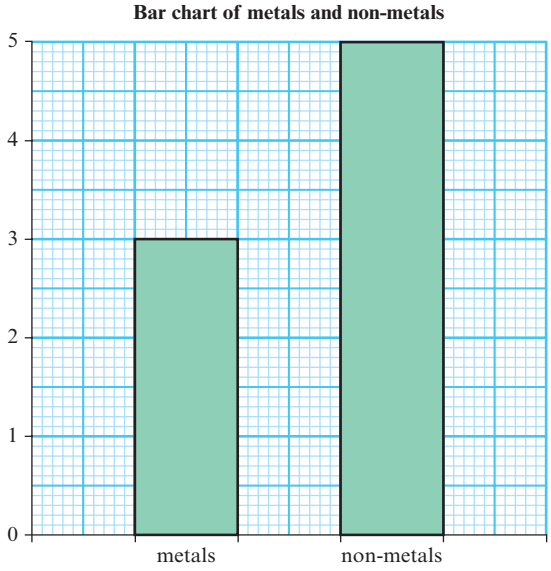
2 5

3 3

4 3

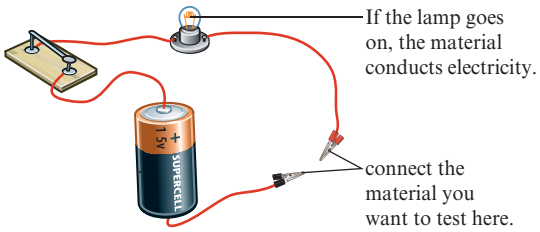
5 5

6



Exercise 5.2B Comparing metals and non-metals

1



2 a False

b True

c False

d True

e False

Exercise 5.2C Identifying metals and non-metals

1 Give credit for identifying any properties that indicate metal or non-metal and for any use. If learners are able to link the use to the properties, this shows a good use of their knowledge.

Substance A is a metal.

Reasons: because it conducts electricity.

It is mercury.

Use: It has been used in thermometers because it is a liquid at room temperature and it expands a lot with a small increase in temperature. Learners may also mention its use in barometers, dental amalgam and as liquid contact switches in some electrical circuits. Due to its toxicity, mercury is no longer used in thermometers and barometers.

Substance B is a non-metal.

Reasons: because it is dull and brittle and only one form (dull brittle) conducts electricity. The shiny form does not conduct electricity.

It is carbon.

Use: In the dull, soft form it is used in pencils for drawing, because it is so soft the carbon wears away as it leaves marks on the paper. It is also used in electrical motors as brushes. The hard shiny form is diamond, which is used in jewellery because it is shiny, rare and expensive. Diamond is also used in drills to cut through other substances because it is so hard.

Substance C is a non-metal.

Reasons: because it is a gas at room temperature and it does not conduct electricity.

It is oxygen.

Use: Oxygen is used in respiration of most living things. It is also very reactive and is used in burning.

Substance D is a non-metal.

Reasons: because it is a gas at room temperature and it does not conduct electricity.

It is helium.

Use: as it is very unreactive, but very light, it is used in airships and to inflate balloons.

Substance E is a metal.

Reasons: because it conducts heat and electricity well.

It is copper.

Use: for electrical wiring because it is ductile and conducts electricity well. It is used for cooking pans because it conducts heat very well.

Substance F is a non-metal.

Reasons: because it does not conduct electricity and it is brittle.

It is sulfur.

Use: to harden rubber.

Topic 5.3 Metal mixtures

Exercise 5.3 Alloys

1 An alloy is a mixture of metals.

2 Accept any correct answers, such as bronze, nitinol (accept shape memory alloy), duralumin, 18 carat gold, cupronickel.

3 The atoms of iron in a solid piece of iron are lined up in regular rows with the atoms touching each other. The rows of atoms can slide over one another when they are hit. When atoms of another element, such as carbon, are added to the iron, they disrupt the regular pattern of the rows, so they do not slide over one another when they alloy is hit. This makes the alloy much stronger.

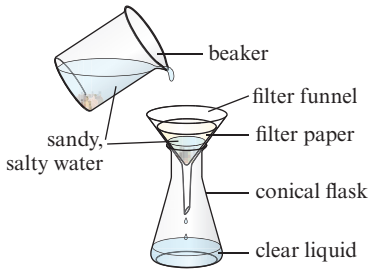
4 Answers to this question will depend which alloy is chosen. Credit answers that address the questions in the Workbook and not just a copied list of information from the internet.

Topic 5.4 Using the properties of materials to separate mixtures

Exercise 5.4 Separating mixtures

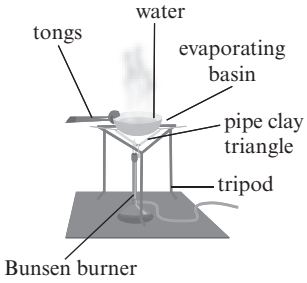
1 Safety glasses, filter funnel, filter paper, conical flask, evaporating basin, pipe clay triangle, tripod, Bunsen burner.

2 Diagram should be drawn using a pencil and ruler and be labelled with filter paper, filter funnel, conical flask, beaker, clear liquid, sandy, salty water.



3 Zara should take care with the wet filter paper as it can tear easily. If it tears, the contents of the beaker will flow into the conical flask.

4 Diagram should be drawn with a pencil and ruler. All items should be labelled.



5 Zara must wear safety glasses and take care when heating the evaporating basin as the contents may spit. Zara should use tongs to move the hot evaporating basin if it is not possible to leave the apparatus in place to cool. If a Bunsen burner isn't available, an alternative suitable heating arrangement such as a hot plate or spirit burner could be used.

6 Marcus could carefully pick up any large pieces of glass and sweep the rest of the mixture up with a dustpan and brush. To keep safe, he could wear thick gloves when he picks up the glass.

7 Marcus will use the different properties of the glass and copper sulfate to separate them: the glass will not dissolve in water, but the copper sulfate will. Marcus adds water to the mixture of glass and copper sulfate crystals and stirs it. The copper sulfate will dissolve, the glass will not. He should then filter the mixture. The pieces of glass will not pass through the filter paper. The solution of copper sulfate and water will pass through the filter paper. Marcus should be careful handling the small pieces of glass in the filter paper. He should wear gloves and dispose of it carefully.

8 Marcus should then put the solution of copper sulfate into an evaporating basin and heat it. The water will evaporate leaving the copper sulfate behind in the evaporating basin. He needs to be careful as the solution may spit as it starts to boil. If this happens he should turn the Bunsen burner off and leave the solution to evaporate fully. The property he uses to separate them is that water boils at 100 °C and changes state to form a gas, but the copper sulfate does not.

He may need to dissolve the crystals in distilled water to wash them if they are not clean and then reheat to remove the water (as above) and leave the crystals so that all the water evaporates off completely. This may take some time, but he could speed up the process by placing the evaporating basin in a warm oven.

Marcus should use tongs to move the hot evaporating basin if it is not possible to leave the apparatus in place to cool. If a Bunsen burner isn't available, an alternative suitable heating arrangement such as a hot plate or spirit burner could be used.

9 The condenser works to separate the water and food dye by using the different boiling points of the water and food dye.

Water boils at 100 °C and food dye does not. The mixture of water and food dye is placed in the flask and heated once the water is boiling. The water begins to evaporate leaving the food dye in the flask. The water vapour/steam passes out of the flask into the condenser where it is cooled by the flow of water in the outer tube. The steam/water vapour condenses back to liquid water, which is collected in the beaker. The food dye remains in the flask because it has a different boiling point from the water.

5.5 Acids and alkalis

Exercise 5.5 Acids and alkalis

1

Acid	Alkali
citric acid, corrosive, nitric acid, sour, lemon juice, cola, vinegar, sharp, harmful	sodium hydroxide, washing powder, harmful, corrosive, soap, washing soda

2

	
Corrosive	Flammable

3

Safety point	Reason
wearing safety glasses	To protect eyes from sparks and splashes.
standing up to work	If you spill anything it will not be in your lap.
placing bottle stoppers upside down on the bench	So that you do not get the chemical on the work surface or dirt into the bottle.
replacing the bottle stopper as soon as you have finished using the bottle	So that you are less likely to have a spill if you knock the bottle over and so that you do not mix up which stopper belongs on which bottle and you do not contaminate the chemicals.
working in an orderly way	So that you are less likely to have an accident, or mix up what you are doing and use the wrong chemical.

5.6 Indicators and the pH scale

Exercise 5.6A Finding mistakes in a table

Liquid	Colour with universal indicator solution	pH	
lemon juice	yellow	4	weakly ~~*alkaline*~~ *acid*
soap solution	blue/green	8	weakly alkaline
water	green	~~*5*~~ 7	neutral
hydrochloric acid	~~*blue*~~ *red*	2	strongly acid
sodium hydroxide	blue/purple	11	strongly alkaline

Exercise 5.6B Indicators

1 An indicator tells you if a substance is an acid or an alkali. Also credit any reference to pH and information about how acidic or alkaline a substance is, or if a substance is neutral.

2 Cut up some coloured plant material such as red cabbage or beetroot and place it in the mortar; crush it using the pestle; add some ethanol and crush it some more; remove some of the liquid using the pipette and place it in a test tube.

3 You could test your indicator solution by placing a little acid in a test tube and adding a few drops of the indicator. Record the colour. Then you could place a little alkali in another test tube and add a few drops of the indicator solution. Record the colour change. If your indicator works there will be different colours in the acid and the alkali.

4 If you try to use this type of indicator, you will not be able to see the colour change because the coffee or cola will stain it a darker colour, so you will not be able to decide if it is an acid or an alkali.

Exercise 5.6C Indicators

1 pH1

2 Universal indicator is more useful than litmus because litmus only changes to red, blue or purple giving the indication acid, alkali or neutral. However, universal indicator has a range of colour changes, which enables us to determine the pH between 1 and 14.

Unit 6 Earth physics

Topic 6.1 Sound waves

Exercise 6.1 The movement of sound

1 Particles in the air vibrate.

2 True, true, false

3 Sound does not travel though **a vacuum** because there are no **particles**.

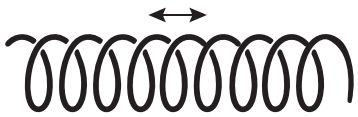
4 Particles in the water vibrate up and down.

5 Sound waves need particles to vibrate; there are no particles in a vacuum.

6 Vibration of the air; idea that vibrations are related to the music.

7 a Arrows drawn as → and ← or ↔ anywhere on diagram.

or



or

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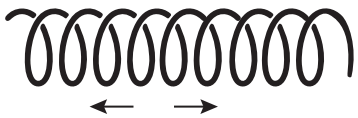


b Spring drawn with compressed and stretched coils; does not have to be a regular pattern; spring must be reasonably straight.

8 Particles in a solid are closer together/ touching *or* particles in a gas are far apart/ not touching idea that vibrations can be passed between particles more easily when the particles are closer together.

9 Vibrations that are too large can damage parts of the ear.

Topic 6.2 Reflections of sound

Exercise 6.2 Reflections of sound

1 Echo

2 A flat wall

3 Sound wave is reflected off the walls, floor and ceiling of the tunnel; he hears the echo.

4 Tunnel; because the walls, floor and ceiling reflect the sound.

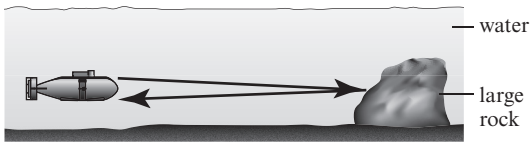
5 a Bar graph with letters A to D on horizontal axis; loudness of echo from 0 to 65 dB on vertical axis; bars of correct height, equal width and not touching.

b B

c C

6 Time = $\frac{(85 \times 2)}{340}$ = 0.5 (seconds)

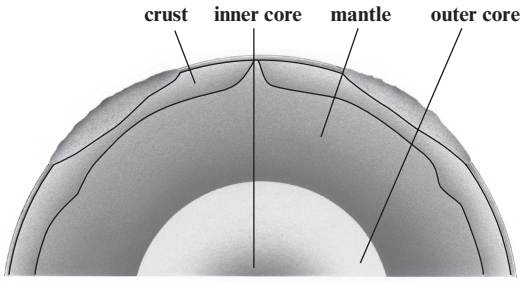
7 The submarine emits a sound. The sound wave travels through the water and reflects off the rock. The sound wave arrives back at the submarine. The time between the sound wave being emitted and received can be used to work out the distance to the rock.



Topic 6.3 Structure of the Earth

Exercise 6.3 Continental drift

1



2 a Core

b Crust

c Mantle

d Inner core

3 Slow movement of the continents

4 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.

5 The theory of tectonic plates

6 The Earth's crust is made of parts called tectonic plates; these plates are made from solid rock and move on liquid magma which is beneath the plates.

7 Website 1 is relevant and uses accepted science of today that is supported by evidence. Website 2 makes a claim that the Earth is getting bigger, which is not supported by evidence. Claim that the Earth is getting cooler is not supported by evidence. We know that the plates/continents are not all moving apart as there are fold mountains and earthquakes that occur from plates moving towards each other or sideways. This source may be biased. It may use facts that are not relevant.

Topic 6.4 Changes in the Earth

Exercise 6.4 How the Earth changes

1 Plate boundary

2 Earthquake

3 a Letter E anywhere beside a black line and the letter is on land.

b Letter V anywhere beside a black line and the letter is in water.

c Letter M anywhere beside a black line and the letter is on land.

4 a 10

b 1000

5 a At plate boundaries

b Either tsunami or idea that large magnitude earthquake in the ocean can cause shocks on land that is closest to the location of the earthquake.

Topic 6.5 Solar and lunar eclipses

Exercise 6.5A How eclipses happen

1 The Moon – does not give out its own light.

The Sun – gives out its own light.

The Earth – does not give out its own light.

2 Shadow

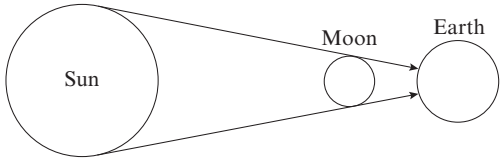
3 a A solar eclipse happens when **the Moon** comes between **the Sun** and **the Earth**.

b A lunar eclipse happens when **the Earth** comes between **the Sun** and **the Moon**.

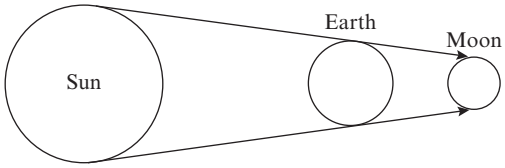
Exercise 6.5B Diagrams of eclipses

In 1a and 1b positions are more important than relative sizes.

1 a

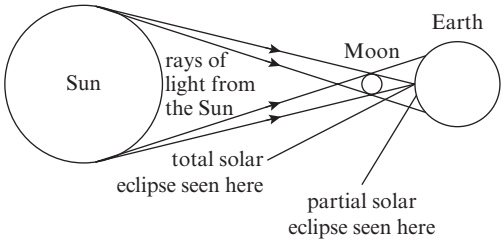


b

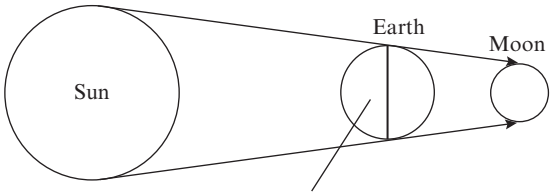


Exercise 6.5C More detail on eclipses

1



2



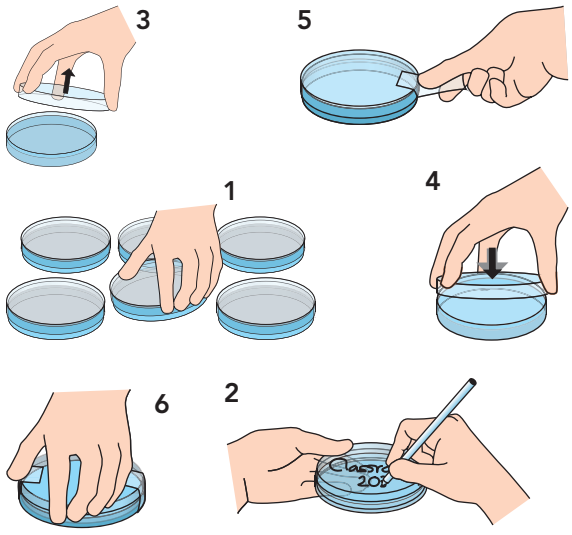
It is daytime on this side of the Earth, so the Moon in its current position cannot be seen from here.

Unit 7 Microorganisms in the environment

Topic 7.1 Microorganisms

Exercise 7.1 Microorganisms experiment

1



2 The length of time he leaves the lid off; the type of jelly in the dish.

3 There are more microorganisms in the air in Classroom 203 than in Classroom 204.

4 Bacteria grow faster at a temperature of 30°C than at 10°C.

5 Look for a description that explains how to change the independent variable (temperature) and measure the dependent variable (rate of growth of bacteria) while keeping other variables, such as the length of time the agar is exposed for, the same.

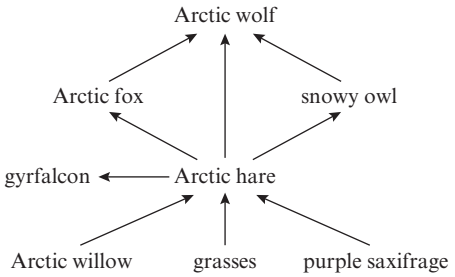
Set up (at least) three Petri dishes with agar jelly exactly as described for the previous experiment. Put all three dishes in the same place, and take off their lids. Leave the lids off for exactly the same time. Put one dish in a cold place, for example a fridge, another in the laboratory (at room temperature) and another in a warmer place, such as an incubator. The temperatures could be measured with a thermometer.

To collect results, the dishes could be left for a set amount of time, and then the sizes of the bacterial colonies measured in each dish. Alternatively, the sizes of the colonies could be measured and recorded each day, for several days.

If the hypothesis is correct, the colonies in the dishes kept in warm places will be larger than those in the dishes kept in cold places.

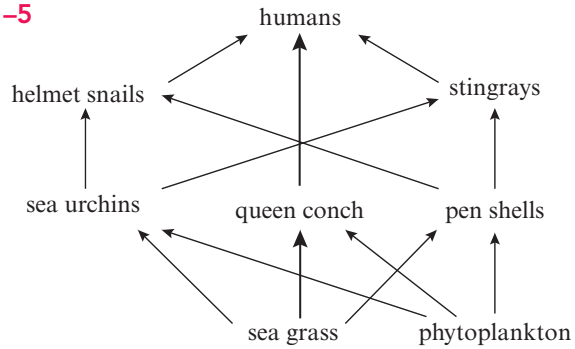
Topic 7.2 Food chains and webs

Exercise 7.2A Arctic hares



Exercise 7.2B Building up a food web

1–5



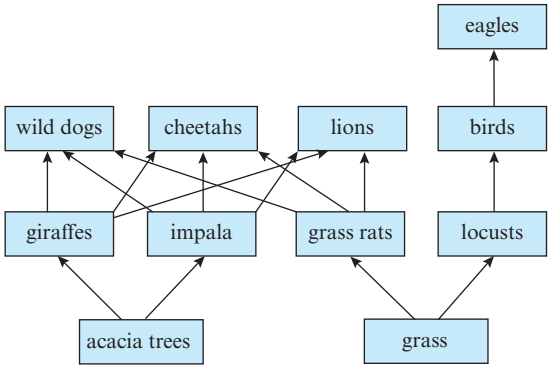
6 Sea grass and phytoplankton

7 Any two of: sea urchins, pen shells, queen conch

8 Any two of: helmet snails, stingrays, humans

Exercise 7.2C, Constructing a food web

1



2 There should be green circles around the acacia trees and grass.

3 There should be blue circles around giraffes, impala, grass rats and locusts.

4 There should be red circles around wild dogs, cheetahs, lions, birds and eagles.

Topic 7.3 Microorganisms and decay

Exercise 7.3A Decomposers in a compost heap

1 Circles drawn around glass, metal and plastic.

2 These things are not organic and they will not rot/cannot be broken down by microorganisms.

3 Students may suggest putting the material onto a microscope slide and looking at it through a microscope. This should be credited, but in practice it would be impossible to pick out microorganisms from among the non-living parts of the material. It would be better to mix the material with some water and then spread a little of the mixture onto sterile agar jelly in a Petri dish. After some days, microorganisms in the material will have formed little colonies on the agar. It would also be good to have another dish where just water was added to the jelly as a control experiment, so that the number of colonies could be compared.

Exercise 7.3B Investigating leaf decay

1 The October result for the leaves in the 1 cm mesh bag.

2 The bag with the 1 cm mesh

3 Microorganisms, earthworms and other small animals.

4 Parts of the leaves disappeared because they decayed. The results show that decay was greatest when earthworms and other small animals, as well as microorganisms, could reach the leaves.

Exercise 7.3C Analysing data about mould on bread

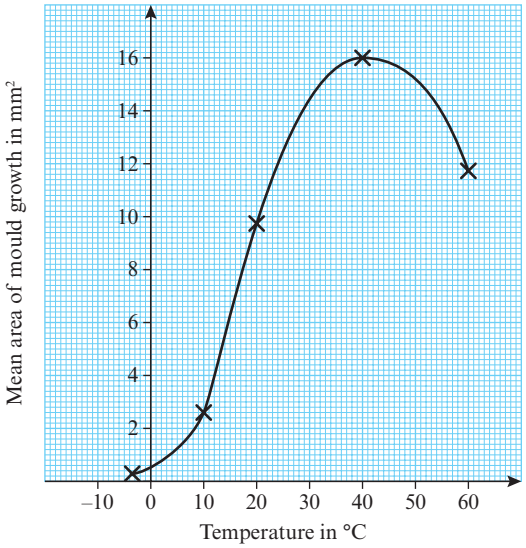
1 The best way would be to use a piece of mesh, or some transparent paper marked off in squares of known size, e.g. with 2 mm sides. They could place the mesh or paper over the mould, and count how many squares the mould covers.

2 A circle should be drawn around the number 5, bread sample 2 in dish 4.

3 16 mm² but, strictly, this should be written as 16.0 mm², to match the number of decimal places given for the other means.

4 11.7 mm²

5



6 There could be variables that the girls were not able to control, for example:

- Despite their best efforts, there may have been more moisture on some pieces of bread than others.
- More mould spores might have landed on one piece of bread than on another.
- There might have been small variations in the nutrient levels in different pieces of bread, even if they came from the same slice.
- It is really difficult to estimate the area that the mould covers, because the patches are irregular, so the girls' measurements may not have been very accurate.

7 The conclusion should relate to the aim of the experiment, which was to investigate how temperature affects the growth of mould on moist bread. Suitable conclusions could be:

- Mould grows best on bread at 40 °C.
- As temperature increases, the growth of mould increases, until the temperature is higher than 40 °C.
- Mould generally grows better at higher temperatures than at lower temperatures, but it does not grow well at temperatures above 40 °C.

8 Look for:

- An answer that relates to these particular results, i.e. to mould growing on moist bread at different temperatures, rather than a general answer.
- An explanation – that is, the answer gives reasons why the results are as shown in the table or graph, rather than simply describing the results.
- A logical explanation, which is easy to follow sequentially, step by step.
- An explanation that uses all of the information provided, and that relates to the full pattern of results across the whole range of temperatures.
- An answer written in the student's own words, with almost nothing copied word-for-word from the information provided.

Topic 7.4 Microorganisms in food webs

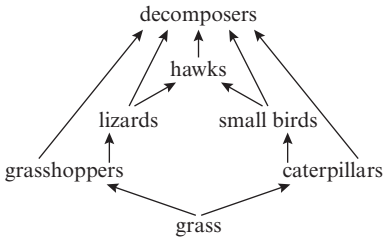
Exercise 7.4 Microorganisms in food webs

1 **a** Microorganism

b Food web

c Decomposer

2



3 They break down waste material from living organisms, and also their dead bodies. This returns nutrients to the soil, which plants can use to grow. This then supplies food for all the other organisms in the food web.

Unit 8 Changes to materials

Topic 8.1 Simple chemical reactions

Exercise 8.1A Physical and chemical reactions

1 The correct statements are:

In a physical change, no new substances are formed.

When iron atoms bond with sulfur atoms, it is a chemical change.

When you cook an egg, it is a chemical change.

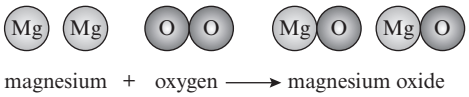
2 a Water

b Oxygen and hydrogen

c Oxygen and hydrogen

Exercise 8.1B Atoms in chemical reactions

1 a and b



magnesium + oxygen ⟶ magnesium oxide

2 Hydrogen

3 If a lighted splint is placed in the gas there will be a 'pop' sound.

4 a zinc + **hydrochloric acid** → zinc chloride + **hydrogen**

b **magnesium** + sulfuric acid → magnesium sulfate + **hydrogen**

5 Magnesium, hydrogen and chlorine

Exercise 8.1C Metal and acid

1 Graph should be plotted using a sharp pencil and ruler. Mass of metal used on the *x*-axis and volume of hydrogen on the *y*-axis. A suitable scale should be used. Points should be plotted accurately and a line of best fit drawn.

2 Conclusions should include the more metal used, the larger the volume of hydrogen produced. However, the increase in the volume of hydrogen produced is not consistent and varies between increases of 30 cm^3 and 70 cm^3 for each additional 0.5 g of metal used.

3 If you had to use measuring cylinders of 100 cm^3, your results would not be very accurate, as you would have to change cylinders during the reaction. This would result in the loss of some of the gas, so the results would not be very accurate.

4 Zinc sulfate and hydrogen

5 Magnesium chloride and hydrogen

Topic 8.2 Neutralisation

Exercise 8.2A Measuring

1 B 25 cm^3

C 36 cm^3

D 12 cm^3

E 47 cm^3

2 Check that learners have drawn the level of the liquid at these volumes:

B 20 cm^3

C 35 cm^3

D 15 cm^3

E 5 cm^3

The lines should be slightly curved, with the bottom of the curve at the level of the scales for these volumes.

3 A 16 cm^3

B 23 cm^3

C 40 cm^3

D 49 cm^3

E 62 cm^3

Exercise 8.2B Neutralising acid

For example:

I put on my safety glasses to protect my eyes in case of spills or splashes.

I collected the chemicals from the teacher. I used a beaker to take a small amount of acid back to my workspace. I used 0.5 mol/dm^3 hydrochloric acid and carefully filled a burette. I made sure that the burette was secure in the clamp stand and that the tap was closed, so that no acid was spilt.

I collected some sodium hydroxide from the teacher in a beaker. I measured 25 cm^3 (accept any suitable volume) of the sodium hydroxide using a measuring cylinder and put it into a conical flask.

I added a few drops of universal indicator solution to the sodium hydroxide in the flask. The solution turned blue because sodium hydroxide is an alkali. I placed the conical flask under the burette.

I slowly added acid from the burette to the conical flask. I gently shook the flask each time I added acid. I was careful to look at the colour of the solution. When the solution was green, I knew I had added enough acid to neutralise the sodium hydroxide.

Learners should be able to write this using the method you used in class. The important points are:

The acid should be in the burette.

The sodium hydroxide should be measured using a measuring cylinder or a pipette.

The safety measures and the reasons for them.

Topic 8.3 Investigating acids and alkalis

Exercise 8.3A Indigestion investigation

1 Number of spatulas used to neutralise the acid.

2 Arun's test:

Not fair because when he tested powder B he used less hydrochloric acid (25 cm^3) than when he tested powders A and C (50 cm^3).

Sofia's test:

Not fair because a different acid (sulfuric acid) was used with powder A than with powders B and C (hydrochloric acid).

Zara's test:

Not fair because no universal indicator was used with powder C.

Exercise 8.3B Planning investigations

1 A variable is something that can change, such as the type of acid or the type of indigestion powder used.

2 a She must use the same volume of lake water in each of her tests.

b The tests are repeated to ensure the results are consistent.

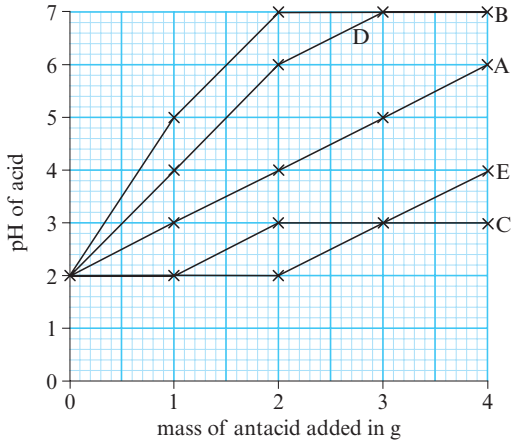
c Lake C is the least acidic. Lake B is the most acidic. There is a very large range in the acidity of the lakes.

Exercise 8.3C Investigating antacids

1

Antacid powder	pH				
	after 0 g	after 1 g	after 2 g	after 3 g	after 4 g
A	2	3	4	5	6
B	2	5	7	7	7
C	2	2	2	3	3
D	2	4	6	7	7
E	2	2	3	3	4

2



3 They kept the **volume of acid** and the **type of acid** the same to make this a fair test.

4 B and D

5 B

6 C

7 pH 7

8 3.5 g

9 D because it reaches pH7 but it does not neutralise the acid too fast so may not produce a lot of uncomfortable gas quickly. (Accept B if there is a comment about the gas being produced quickly.)

Topic 8.4 Detecting chemical reactions

Exercise 8.4A Key words for material changes

Neutralisation – this is the name of the reaction where an acid is cancelled out by an alkali. A neutral solution has a pH of 7.

Precipitate – this is what is formed when two liquids react and produce a solid.

pH scale – this shows the strength of an acid or an alkali.

Corrosive – able to dissolve or eat away other materials.

Reactants – these are what you start with in a chemical reaction.

Products – these are what is made in a chemical reaction.

Alkali – pH of more than 7

Acid – pH of less than 7

Exercise 8.4B Has a reaction taken place?

Accept any sensible suggestions, such as:

Observation: Colour change; **Example:** copper oxide and sulfuric acid forms copper sulfate and water.

Observation: Heat produced; **Example:** potassium in water forms potassium hydroxide and hydrogen. The heat produced ignites the hydrogen produced.

Observation: Precipitate formed; **Example:** silver nitrate and calcium chloride forms silver chloride (solid) and calcium nitrate.

Observation: Reactant 'disappears'; **Example:** magnesium in hydrochloric acid. Forms magnesium chloride and hydrogen. The magnesium metal disappears as it is used to form magnesium chloride, which is soluble.

Observation: Change in pH; **Example**: sodium hydroxide and hydrochloric acid react to form sodium chloride and water, changing the pH of the sodium hydroxide from a pH above 7 to pH 7.

Exercise 8.4C Testing for gases.

You could place a lighted splint into each test tube. If the gas is hydrogen it will make a 'pop' sound. If the gas is oxygen, the splint will burn brightly. If the gas is carbon dioxide, the splint will go out. The splint will continue to burn as before in the test tube of air. Credit ideas of testing all the gases with a glowing splint with the appropriate results. Any discussion of carrying out the tests for oxygen, hydrogen and carbon dioxide on all test tubes needs to have some comment about the need to have more than one tube of each gas.

Unit 9 Electricity

Topic 9.1 Flow of electricity

Exercise 9.1 The movement of electrons

1 The electrons flow around the circuit.

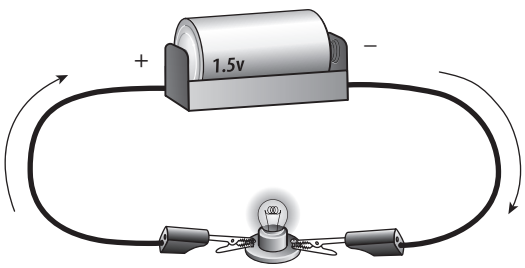
2 a True

b False

3 a A cell has a **positive** and a **negative** terminal.

b In a circuit, electrons flow away from the **negative** terminal and towards the **positive** terminal.

4

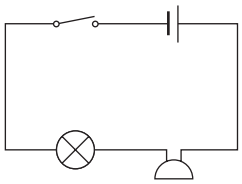


Topic 9.2 Electrical circuits

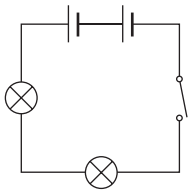
Exercise 9.2 Circuits and symbols

1 Cell, lamp, ammeter, (open) switch.

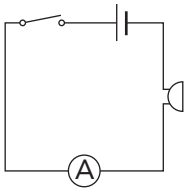
2



3 a



Components can be in any order, switch can be open or closed.

b 

Components can be in any order, switch can be open or closed.

4 Answers should refer to circuit Y.

Any three from:

Y has 2 cells and X has 1 cell / Y has an extra cell.

Y has no buzzer.

Y has an ammeter.

Y has a closed switch and X has an open switch.

Topic 9.3 Measuring the flow of current

Exercise 9.3 Measuring the flow of current

1 A

2 When electrons flow faster in a circuit, the current is **larger**.

3 Anywhere in series with the cell and the lamp.

In series between the lamp and the positive of the cell.

In series between the lamp and the negative of the cell.

4 2.2 A

Topic 9.4 Conductors and insulators

Exercise 9.4 Allowing electrons to flow or inhibiting electrons from flowing

1 Metal

2 Cotton

3 a Iron is a metal; metal is a conductor; the conductor completes the circuit (so the lamp lights).

b The car door is painted; paint is an insulator; the circuit is not completed or the car door has rusted and rust is not a conductor.

4 In gold, the electrons are free to move; in glass, the electrons are not free to move.

Topic 9.5 Adding and removing components

Exercise 9.5 Adding and removing components

1 Cell

2 Another identical lamp

3 Add another cell/remove one lamp (not remove the lamps).

4 a Cells contain chemical energy; chemical energy is changed to electrical energy; so more electrical energy.

b i $\frac{2}{2} = 1\,\text{A}$

ii $\frac{2}{3} = 0.67\,\text{A}$ or $\frac{2}{3}\,\text{A}$