assignments in

Junior Science

book 2

Tectonics

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Editor: Shelley Barons
Design and formatting by DiZign Pty Ltd
Diagrams by DiZign Pty Ltd
Printed in Australia by Ligare Book Printer

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An imprint of Learning Essentials
A.B.N. 56 093 980 726
108 Main Rd
Clayton South VIC 3169

Ph: (03) 9509 5366
www.learningessentials.com.au

ISBN 978 1 92209 077 5

Introduction

Each book in the *Assignments in Junior Science* series provides a selection of worksheets covering one or two major topics. The worksheets are independent, supplying most information necessary to formulate answers. In the answer section at the back of each book, sample answers to most tasks have been given.

Many worksheets have an emphasis on literacy, others concentrate on problem solving, while others utilise science in an experiment or a game format. They are presented in a student-friendly manner and could be used to supplement science lessons for regular class teachers or casual teachers.

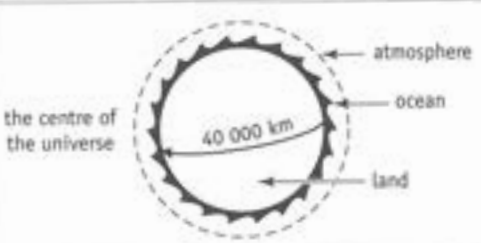
Suada Bilali and Chris Greef are both experienced and practising science teachers who had a lot of fun putting together this collection of worksheets.

Contents

Views of the earth

1

Various peoples of the past have held different views about the earth and sky. Complete the table below by drawing a sketch according to the text or by writing text according to the sketch.

Text	Sketch
1 In Sumer (5000 BC) people thought the earth was a flat disk, and heaven was like a high vault whose ceiling was holding all the stars. The atmosphere was inside this vault.	
2 In Babylon (4500 BC) Eridu described the earth like a mountain on a flat disk. Surrounding the disk there was the ocean. A huge semispherical vault rested on the edges of the ocean and carried the stars. In the east of the vault was a door through which the sun entered in the morning. In the west was another door, the sun exited here in the evening.	
3 In Greece (550 BC) Anaximandros thought that the earth was a cylinder of stone, which was surrounded by a massive river. The stone cylinder was flat or convex at the top. The heavens spanned high over the earth and river, carrying all the stars.	
4 Thales of Miletus in Greece (550 BC) differed from Anaximandros. _____ _____ _____ _____	
5 According to the Bible, the earth was flat with four corners. It was supported by pillars. Heaven separated the waters below from above. The sun, moon and stars moved in the heaven.	
6 Eratosthenes from Greece (200AD) was certain that the earth _____ _____ _____ _____	
7 In Egypt (500 AD) Cosmas saw the earth as a huge rectangle which was girthed by four oceans. At the end of the oceans strong and high walls supported the firmament. The firmament held the stars and planets.	

The rock layers of the earth 2a

1 Read the text below about the layers of the earth.

a In the left margin, write the main topic of each paragraph.

b Underline the scientific nouns (ie things, ideas, places) in each sentence of paragraphs 1, 2 and 3.

c Underline the adjectives (ie describing words) in each sentence of paragraphs 4, 5 and 6.

The earth is huge ball made of mainly different types of rock. Its total diameter is about 12 500 km and it has four layers: crust, mantle, outer core and inner core.

The crust is the outside layer. It is made of solid rock. The thickness of the crust ranges from 5 km under the oceans to 60 km under mountains and is 15 km thick on average. The crust's surface temperature is 20°C on average. The crust makes up 2% of the volume of the earth.

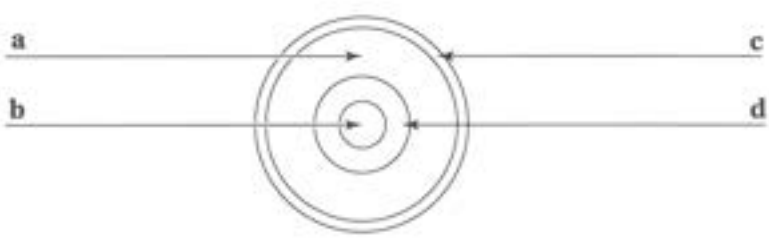
The mantle is the second layer and it is 2800 km thick. Its rocky material is molten and like a thick paste. Its temperature ranges from 800°C near the crust to 2200°C near the outer core. The mantle makes up 81% of the earth by volume.

The outer core is the third layer. It has completely liquid rock material. The outer core is 2000 km thick. Its temperature is 3600°C near the inner core. The outer core is 16% of the earth's volume.

The inner core is the fourth and innermost layer. It contains solid rock material, because the other layers around it compress it with great force. The inner core is 2800 km thick. The temperature at the centre of the earth is 5000°C and is produced by radioactive decay. The inner core makes up 1% of the earth's volume.

The crust and the solid topmost part of the mantle are also called lithosphere and the liquid part of the mantle is then called the asthenosphere.

2 Label the diagram with the layers of the earth.



Graphing information

3 The bar below represents the radius of the earth and is 62 mm long (ie 1 mm of the bar is equal to 100 km of the earth).

Mark off the various thicknesses of the layers, starting with the inner core on the left, and then label the graph.

4 **a** Below draw a 100 mm long bar which represents 100% of the earth's volume.

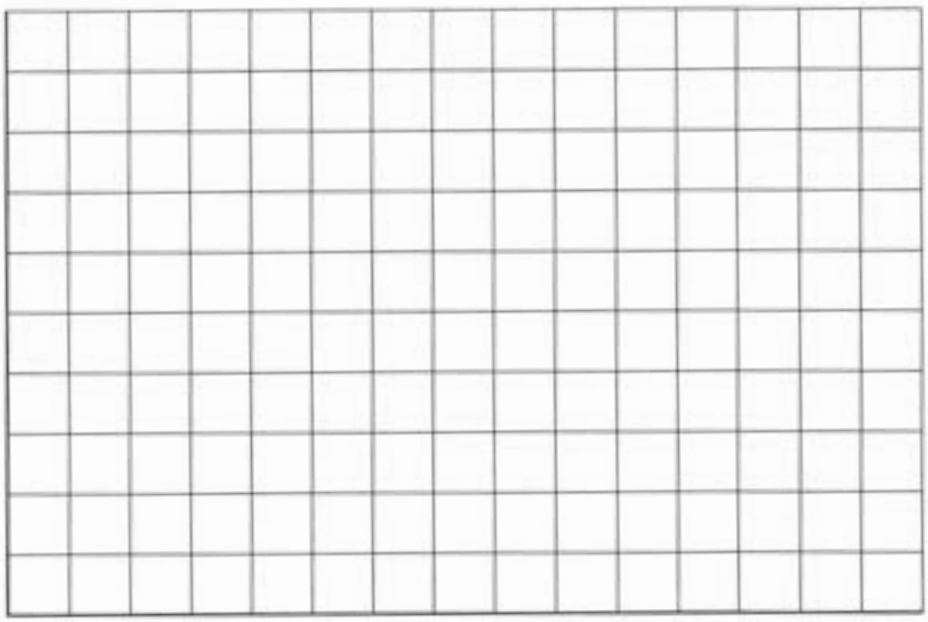
b Mark off the various volumes of the layers, given in the information above, starting with the inner core on the left.

c Label the layers.

5 a On the line graph below, label the horizontal axis (–) 'Distance from the centre' and the vertical axis (|) 'Temperature'.

b Mark off the appropriate numbers and label the axes with the correct unit of measurement.

c Mark appropriate coordinates from the information above as tiny crosses in the graph and join them with a smooth line.



Tabulating information

6 Complete the table by locating relevant information in the text about the rock layers of the earth.

Name	State of matter	Average thickness (km)	Outer temperature (°C)	Volume (%)
centre		—		—

7 Answer the following questions.

a Why is the earth so hot? _____

b Why is the outer core liquid rock material? _____

c Why is the crust made of solid rock material? _____

d Why is the mantle not solid? _____

e Why is the mantle not a runny liquid but a thick paste? _____

f Why is the inner core solid? _____

Spheres of the earth 3

1 The earth can be divided into layers, each with particular features.

a Use the root words and their translations to join the names of the layers with the correct meanings in the table below.

b Then join each meaning to the corresponding thickness of the layer.

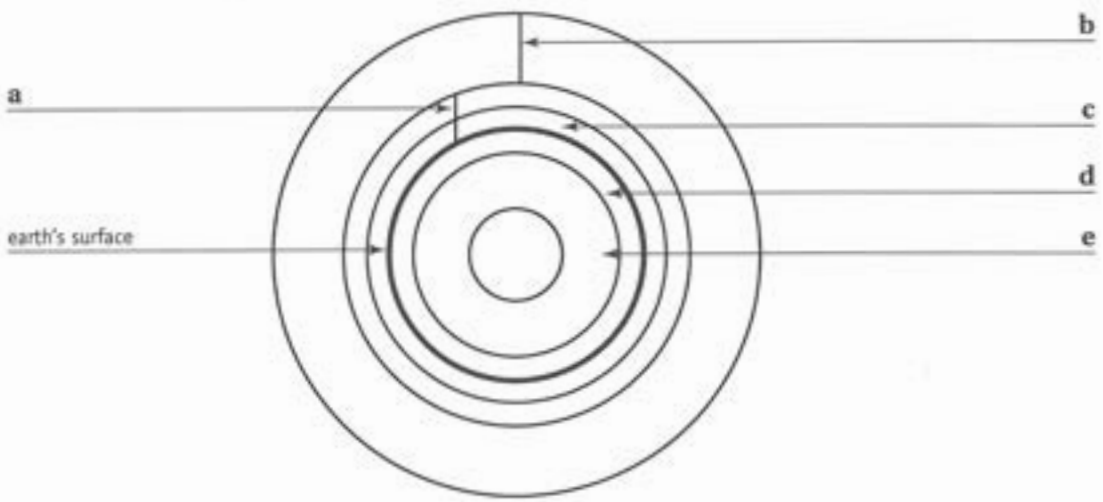
Root words:

Lithos (Gk) = stone Sphera (Ln) = ball, globe Atmos (Gk) = vapour Bios (Gk) = life

Hydor (Gk) = water Sphaira (Gk) = ball asthenes (Gk) = weak, soft

Layer name	Meaning	Thickness
1 Asthenosphere	A Narrow ring of living things	i 0 – 5 km
2 Atmosphere	B Sphere of solid rock, varying thickness	ii 10 km
3 Biosphere	C Thick ring of gases	iii 5 – 60 km
4 Hydrosphere	D Thick layer of liquid rock	iv 100 km
5 Lithosphere	E Thin ring of water, varying thickness	v 100 km

2 Label the diagram of the earth with the layer names from the table.

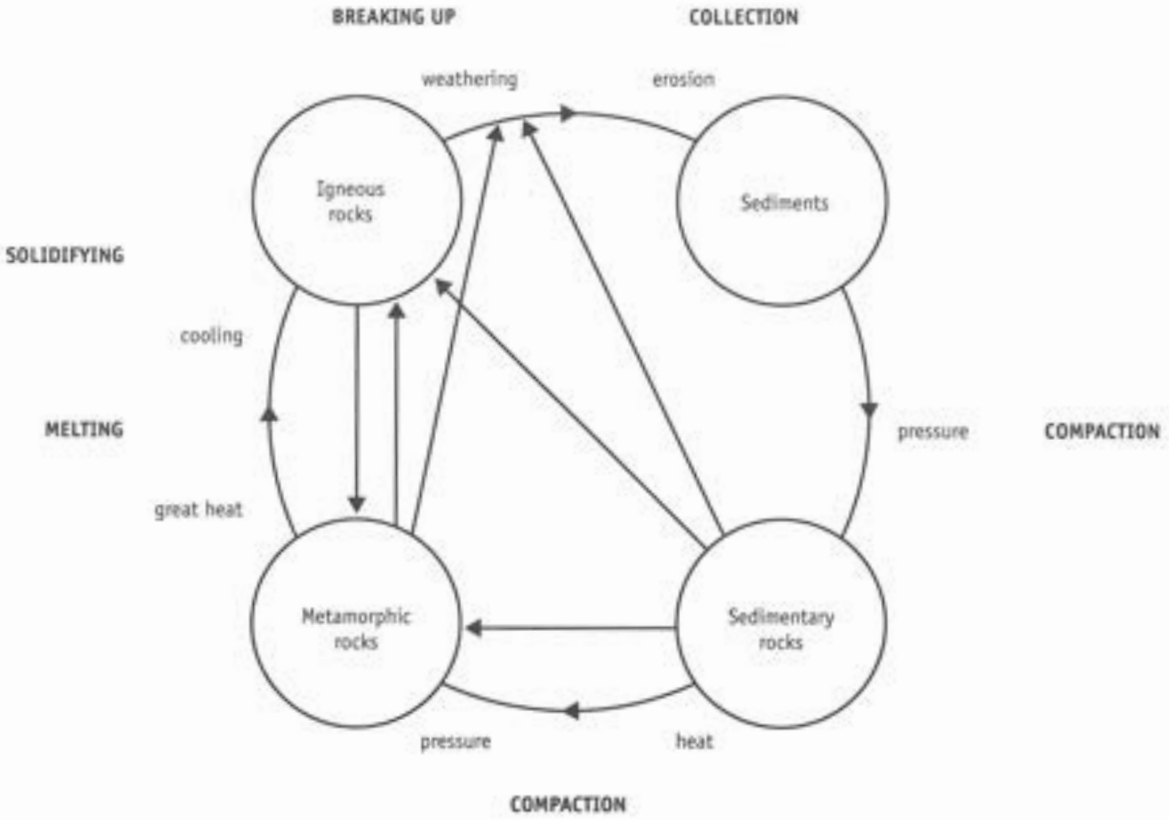


3 Complete the table below. List the names of the spheres in the first column, 'Sphere name'. In the other two columns, think of two things that are commonly found in each sphere and write them into the table.

Sphere name	Example 1	Example 2

The rock cycle

4a



1 Look at the diagram of the rock cycle. Some terms are in circles, some are in capital letters and the others are in lower case. Suggest what each type of term represents.

a Terms in circles: _____

b Terms in capitals: _____

c Terms in lower case: _____

2 Look at the diagram. Define the following processes and explain how they occur.

a Breaking up: _____

b Collection: _____

c Compaction: _____

d Melting: _____

e Solidifying: _____

3 Look at the diagram and state which materials could become the following rock types.

a Igneous rocks: _____

b Metamorphic rocks: _____

c Sedimentary rocks: _____

d Sediments: _____

The rock cycle

4b

Looking at language

Complex sentences are made up of two clauses: an *independent clause*, which could be a sentence by itself, and a *dependent clause*, which usually begins with a conjunction (joining word) and needs an independent clause in order to make sense.

4 Refer to the previous diagram and the tables below and write six sentences about the rock cycle. For each independent clause you need to select a subject, a verb and an adverbial phrase; for each dependent clause you need to choose a conjunction, a subject, a verb and an adverbial phrase. You may choose some terms more than once. The first sentence has been done for you.

Dependent clauses

Conjunction	Subject	Verb	Adverbial phrase
as	liquid rock	*are*	to great heat
because	*sediments*	are eroded	to heat and pressure
since	sediments	are exposed	*under pressure*
when	sedimentary and metamorphic rocks	are weathered	—
	sedimentary, metamorphic and igneous rocks	is cooled	
	sedimentary rocks		

Independent clauses

Subject	Verb	Adverbial phrase
it	are changed	as layers of sediments
the rock material	*are compacted*	into igneous rocks
they	break up	into liquid rock
	collect	into metamorphic rocks
	melts	*into sedimentary rocks*
	solidifies	into sediments

a *When sediments are under pressure, they are compacted into sedimentary rocks.*

b _____

_____

c _____

_____

d _____

_____

e _____

_____

f _____

_____

Mercalli scale

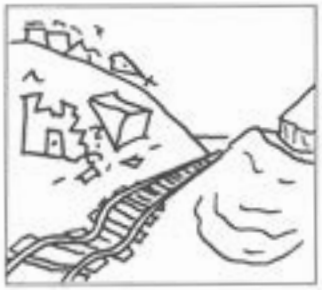
5a

Guiseppe Mercalli (1850–1914) was an Italian seismologist. In 1902 he invented a scale for measuring earthquakes. Unlike the Richter scale, which relies upon readings from seismographs, Mercalli focused on the amount of damage caused by an earthquake as an indicator of the intensity or strength of the earthquake. The original Mercalli scale was updated in 1931 by Harvey Wood and Frank Neumann. Roman numerals are used to record the strength of the earthquake, where I is very low intensity and XII is total destruction.

Below are some earthquake pictures of different events. Cut out the diagrams and classify each one according to the Modified Mercalli scale on the following page. Paste them in the correct order in the space provided.

1

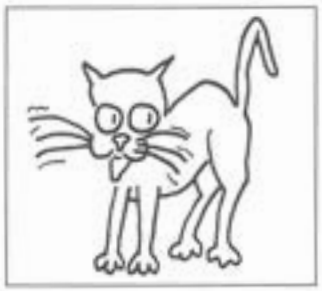
5



9

2

6



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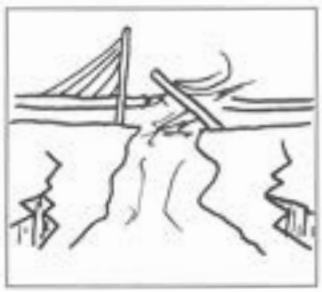
3

7

11

4

8



12

Mercalli scale

5b

Modified Mercalli Scale

I Imperceptible. Not felt by the majority of people, but detected by seismographs. Animals tend to be a little uneasy.	
II Very weak. Some suspended objects may swing. People on upper floors of high buildings may feel it.	
III Weak. Felt by people indoors. Mostly mistaken as vibrations of a passing truck.	
IV Moderate. Felt by many more people indoors. Might wake people up, if at night. Windows, doors and crockery shake; walls tend to creak.	
V Fairly strong. Felt by nearly everyone, even people asleep. Objects may break and weak plaster cracks.	
VI Strong. Felt by everyone. Slight damage, such as chimneys falling. Heavy furniture moves.	

VII Very strong. People tend to run outside and may find it difficult to stand. Poorly built homes may have some damage. Causes waves on water.	
VIII Destructive. Most poorly built homes fall. Heavy furniture overturns.	
IX Very destructive. Most houses will have considerable damage. Roads may have minor cracks. Buried pipes may break.	
X Devastating. Many buildings destroyed. Railway tracks bend and ground cracks. Steep slopes may landslide and water splashes over from rivers and tanks.	
XI Catastrophic. Very few buildings left standing, bridges and underground pipes destroyed. Large ground cracks form.	
XII Major catastrophe. Total damage and destruction. Objects are thrown into the air.	

Using a seismograph 6a

Earthquakes are often measured using the Richter scale. The Richter scale is better known than the Mercalli scale and is used with seismographs. A seismograph is a device that measures the strength of earthquakes.

Building a seismograph

The other day we built and tested a seismograph in our science class. We hung a 2 kilogram weight from a retort stand. The retort stand had a clamp fixed to its top with a boss head. A strong string held the weight way below the clamp. The weight was about 5 centimetres above the base of the retort stand. Then we taped a pen to the weight so that the pen just touched the retort stand base. Finally we slipped a sheet of paper between the pen and retort stand base. And that was our seismograph.

1 Make a labelled sketch of the seismograph described above.

The teacher then told us to simulate an earthquake by gently shaking the table for a few seconds. At the same time one of us had to pull the paper slowly across the retort stand base to make a seismogram.

2 Define the terms 'seismograph' and 'seismogram'.

3 Complete the seismogram by continuing to draw the line during the simulated earthquake until just after it finishes.

4 Describe the line on the seismogram when there is no earthquake and also when there is an earthquake.

5 Describe the line on a seismogram during a strong earthquake.

It was a great activity, trying to imitate an earthquake. We then repeated the simulation but this time we had a really big earthquake. When we stopped shaking the table, we noticed that the weight was swinging like a pendulum. Our seismogram looked a little strange as well.

Using a seismograph

6b

6 Draw a possible seismogram line for the situation described above.

before during after the earthquake

7 Explain why the weight was moving after the big earthquake.

8 Explain how a seismograph works to make a seismogram, using the scaffold below.

Title	
Purpose	
Explanation sequence	
Example	When the Newcastle earthquake occurred in December 1989, it measured 5.6 on the Richter scale. The earthquake lasted only 5 seconds but was felt 5000 km away. Ten people died, 160 people were hospitalised and 50 000 houses were damaged. An aftershock earthquake three days later produced 2.1 on the Richter scale.

9 Suggest how the school seismograph could be improved.

Extra, extra, read all about it! 7a

Below is the front page from the local paper in Shaketown, outlining the earthquake that occurred the night before. Read the article then answer the questions that follow.

Shaketown Morning Sun

Earthquake leaves population shaken

(1) Yet another earthquake in Shaketown has left many people shaken. The earthquake occurred last night at 10:45.

(2) Margaret from Bright St said, "I woke up startled. My bedside lamp had fallen off the table and my hanging pictures on the wall were moving around. I was very scared."

(3) Jimmy, living in Black St, and Mary and husband Lee, from around the corner in Church St, commented that they thought the slight trembling last night was a truck travelling down the street.

(4) Shaketown has a detailed earthquake history. The last earthquake was in January 1992, but did not cause much damage. Seismograph stations in Shaketown detected minor tremors, but not many people felt them.

(5) Another earthquake in 1954 left Shaketown damaged. Every building in town was left with some damage. People today fear that one day the 'big quake' will hit.

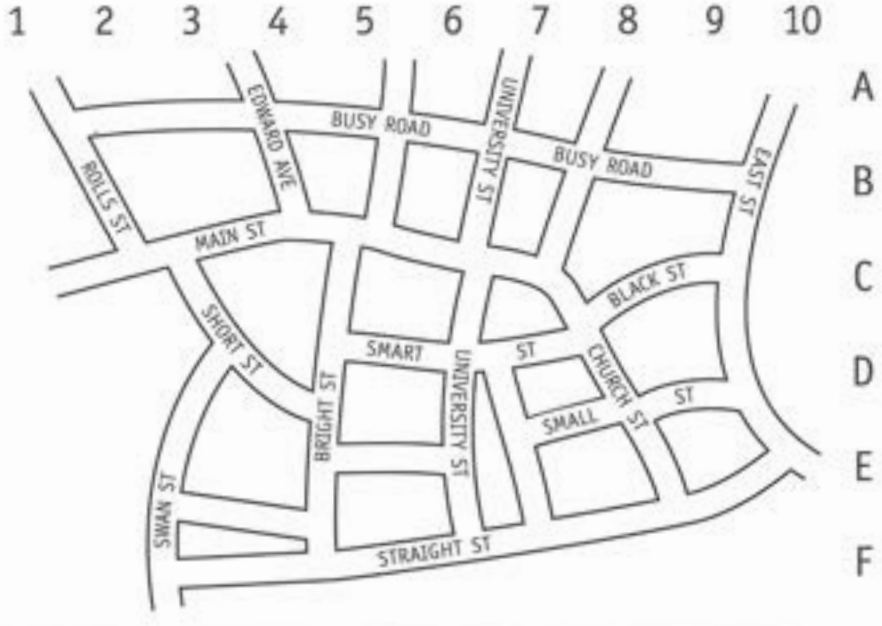
(6) According to Professor Seismo, of Shaketown University, people should be prepared for a major earthquake. "Shaketown sits on top of a fault zone known as a zig-zag fault," he said recently. "It runs right under the town. Our records suggest that there is movement at least once every ten years."

(7) Professor Seismo believes that Shaketown will experience a larger earthquake in the near future but he is not sure when. "We should all take precautions now for a major earthquake."

(8) Last night Professor Seismo was on the balcony of his house in Edward Ave and felt his hanging pot plants swaying. However, his wife inside the house did not notice anything.

(9) Hotel owner Bruce, from Rolls St, told of his frightening ordeal last night. He was about to close the bar, when he heard cracking noises and plaster began to fall off the walls. Many glasses and bottles fell to the ground and shattered. He said, "I ran to the door with difficulty amidst all that noise. I thought the building was going to bury me."

(10) Well-known performer Star, from Swan St, noticed that her pets were behaving strangely last night but did not understand why. They are fine this morning.



Extra, extra, read all about it! 7b

1 On the map above, find the streets where all the people mentioned in the article live.

Write down the map references below.

a Margaret _____

b Professor Seismo _____

c Jimmy _____

d Bruce _____

e Mary and Lee _____

f Star _____

2 Place the initials of the people on the map to indicate where they live.

3 Using the Modified Mercalli scale work out the MM number for the experience of each eyewitness mentioned in the article. Write the MM number beside the relevant paragraph of the article.

Judging eyewitness accounts

4 The epicenter was found to be east of the town.

Name the person whose account was unreliable. Justify your answer.

_____

_____

_____

_____

Taking precautions

5 Suggest how people could take precautions for a major earthquake. Think about you and your family; think about the whole town.

_____

_____

_____

_____

_____

_____

Simulating earthquake waves 8

Read the diary entry and follow the instructions below.

Dear Diary
Today Ms Smart explained and demonstrated the difference between **primary** and **secondary** earthquake waves. She said primary waves were **compression waves**, while secondary waves were **transverse waves**. At first I did not understand, but then Ms Smart showed us an activity that clearly demonstrated the difference between the two types of waves.

We were asked to select a partner; Ms Smart was my partner! In pairs, we stretched out a slinky spring about 5 metres across the floor. I held one end, while Ms Smart held the other end and gathered about 15 coils and let them go. She said that these were what compression waves looked like, similar to primary waves that travelled through rock. We also noticed that the primary waves travelled along the slinky faster than the secondary waves, reaching my hand sooner.

We stretched the slinky again about 5 metres. This time Ms Smart asked me to move my end of the slinky side to side, about 30 cm to each side, in a very quick movement. We saw a sideways pulse travelling down the slinky to the other end. Ms Smart said these were exactly what secondary earthquake waves were like.

When I got home, I showed Mum the different waves on my slinky, but she just said, "How interesting, now go and do your homework." Parents! Can't teach them anything!

Title:

Aim: _____

_____

Equipment:

Method: _____

_____

_____

_____

_____

_____

_____

_____

_____

Results:

Conclusion: _____

_____

_____

_____

1 Name the text type that the diary entry is written in? _____

2 Change the diary entry into an experimental record text type. Rewrite the text in the space provided above and complete it by suggesting possible results and conclusion.

3 State another name for:

a a primary wave. _____

b a secondary wave. _____

4 **a** Imagine a small rock in the earth's crust. Describe how the rock would move if a primary wave passed through it.

_____

_____

b Think of the same small rock again and describe how it would move if a secondary wave passed through it.

_____

_____

Locating the epicentre of an earthquake 9

Shown here is a map locating Shaketown and some of the surrounding towns that have seismograph stations. Seismographs are used to record the strengths of earthquakes. Information has been sent to Shaketown about the recent earthquake from three seismic stations. All information has been pooled and recorded in Table 1. You have been asked to analyse the information and work out where the epicentre of the earthquake is by drawing it on the map. The epicentre is directly above the origin of the earthquake. Work through the instructions below and locate the epicentre.

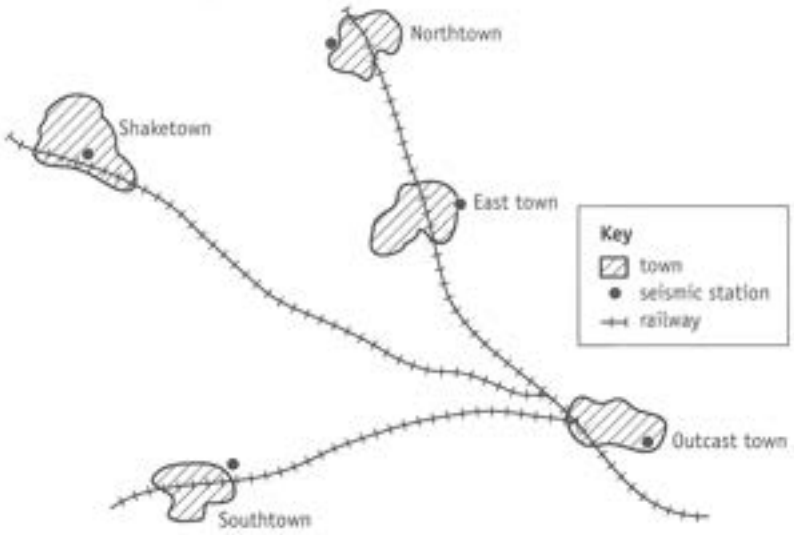


Table 1

Location of station	Arrival time of P waves	Arrival time of S waves	Time difference	Distance from epicentre	Radius of circle
Shaketown	07.06.10	07.07.30	1 min 20 s	1500 km	1.5 cm
Northtown	07.09.15	07.11.55			
East town	07.10.05	07.14.45			
Southtown	07.15.19	07.20.41			

1 Calculate the difference between the time of arrival of the P and S waves. The first one has been done for you. Write your answers in the 'Time difference' column of Table 1.

2 Use Table 2 to calculate the distance from the epicentre. Add your answers in the 'Distance from epicentre' column of Table 1.

Table 2

Difference in times between P and S waves	Distance in kilometres
40 seconds	500
1 minute 20 seconds	1500
2 minutes 40 seconds	2500
3 minutes and 20 seconds	3500
4 minutes and 40 seconds	4500
5 minutes and 20 seconds	5500

3 Calculate the radius of the circle using the scale 1 cm = 1000 km. Add your answers in the 'Radius of circle' column in Table 1.

4 On the map above, draw circles using a compass to indicate the distances. The seismic station will be the centre of the circle and the distance will be the radius measurement from Table 1. Draw the circles around each of the seismograph stations.

5 The epicentre is where all the circles meet. Mark the epicentre with a red cross on the map.

Making a volcano

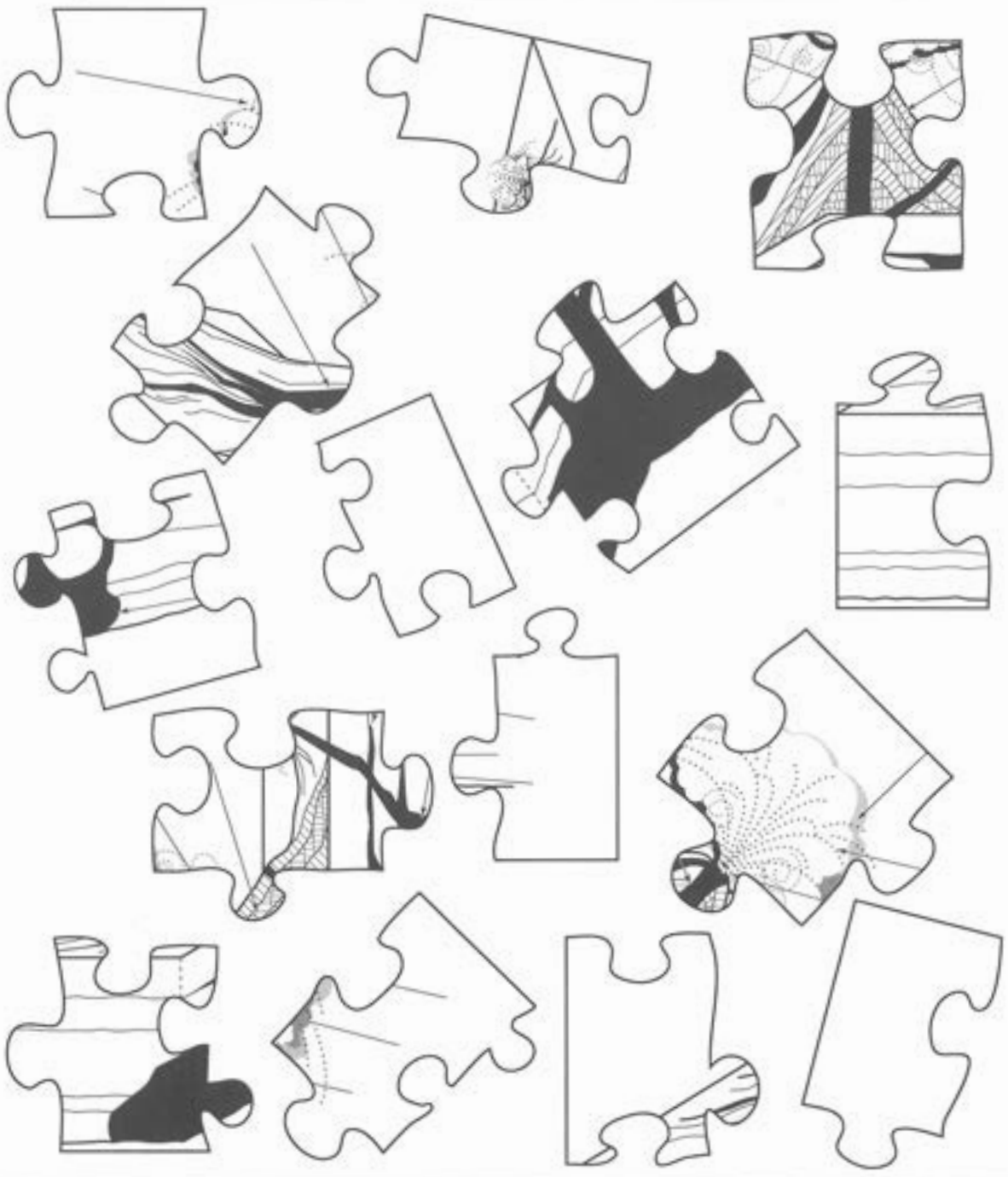
10

Volcanoes are the result of weaknesses in the earth's crust. Molten rock (magma) in the magma reservoir makes its way up through a vent to a crater. The vent is like a pipe that joins the crater to the magma reservoir. Cone shaped mountains form from the layers of ash and lava. Lava is the term given to the hardened molten rock that has come out of a volcano. Lava, rocks, ash, water vapour and other gases come out of the crater. Other features associated with volcanoes, which help volcanologists recognise extinct volcanoes, are dykes and sills. A dyke is an intrusion of igneous rock (solidified magma) that cuts across other layers of rock. A sill is an intrusion that cuts parallel through the rock layers.

a Cut out the jigsaw pieces and assemble them into a volcano.

b Use the text and the word bank below to label the parts of your assembled volcano.

ash	cone	crater	dyke	gases	lava	layers of old lava flows
magma reservoir	side vent	sill	vent	water vapour		



Studying volcanic explosions 11a

The different materials that erupt out of volcanoes can be classified into solids, liquids and gases.

Solids
Solid materials are thrown from volcanoes, ranging from huge blocks of solidified lava to fine dust particles. The volcanic solids are grouped according to their size.

Blocks	greater than 24 cm
Bomb	between 5 – 24 cm (mean 16 cm)
Lapilli	between 3 – 5 cm (mean 4 cm)
Ash	between 0.05 – 3 cm (mean 2 cm)
Dust	less than 0.05 cm

Liquids
The hot liquid material that (comes/came) out of a volcano (is called/are called) lava. Chemicals (in/on) the lava, such as silica, (affect/effect) (its/it's) viscosity. For example, lava with a high viscosity (moves/move) very (slow/slowly) and lava with a low viscosity (move/moves) very (fast/fastly).

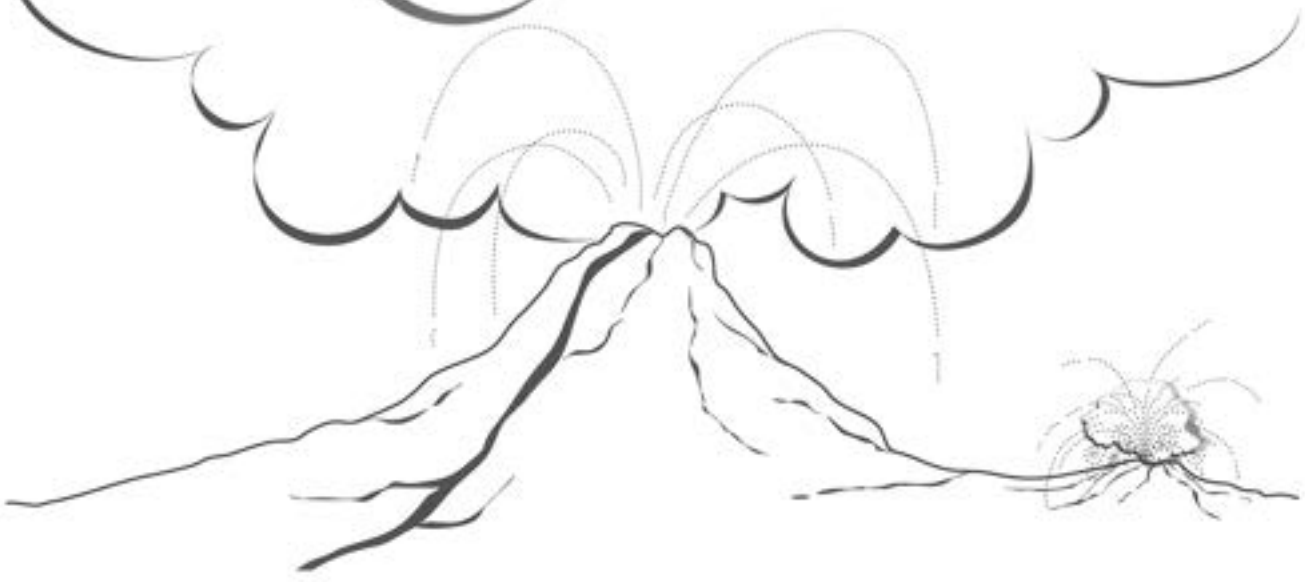
Lava that (have/has) a very high silica content (of/off) about 70–80% (is/are) very viscous. This lava (does not/does) flow very easily and (plugged/plugs) up volcanic vents. These types of lavas (are called/is called) **rhyolites**.

Lava with a high (silica/sillica) content of about 60–69% (produce/produces) **dacite** lava. This lava (flows/flow) slowly.

Andesite lava (has/have) a silica content of about 54–59% and (move/moves) much faster than dacite lava. **Basaltic** lava, (on/in) the other hand, (has/have) a relatively low silica content of about 45–58%. These lavas (is/are) the least viscous and (flow/flows) quickly for many (kilometers/kilometres) away from the volcanic (vent/went).

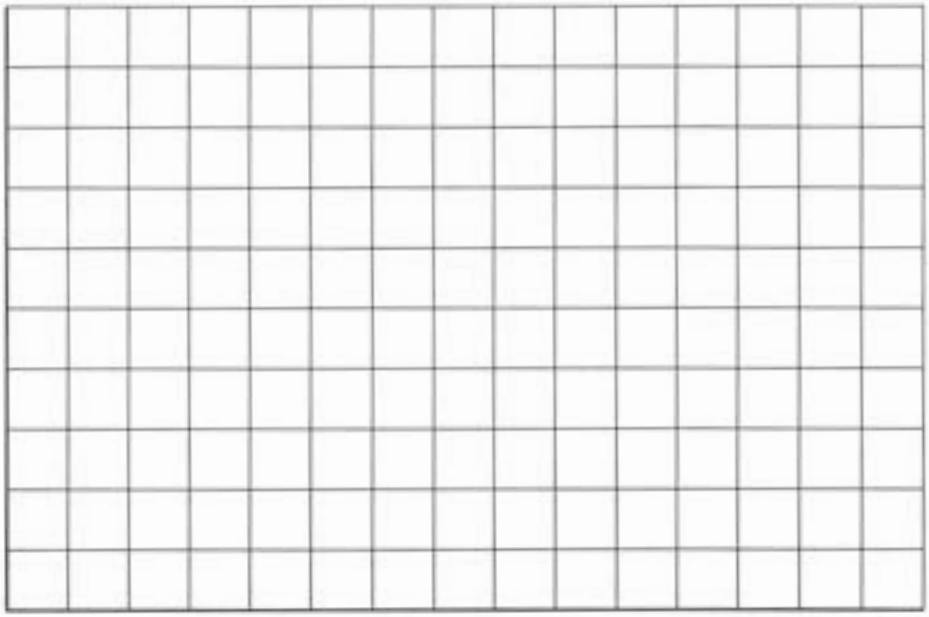
Gases
Volcanologists have collected samples of gas from different volcanoes and have come up with the following components of gases.

Water	**76%**
Carbon dioxide	**12%**
Sulfur dioxide	**6%**
Nitrogen	**3.4%**
Carbon monoxide	**1%**
Hydrogen	**1%**
Sulfur	**0.4%**
Chlorine	**0.1%**
Argon	**0.1%**



Studying volcanic explosions 11b

1 Draw a column graph in the space provided below to display the composition of volcanic gas. The gas components go along the horizontal axis.



2 Cross out the incorrect terms in the text on liquids on the previous page, leaving the correct term.

3 Complete the table below about the liquids being spewed out of a volcano.

Name of lava type	Viscosity (high, medium, low)	Speed of lava flow (fast, slow...)	Silica content (%)

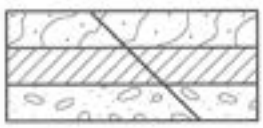
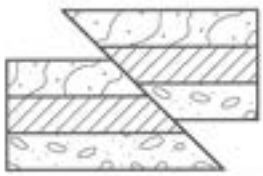
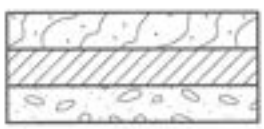
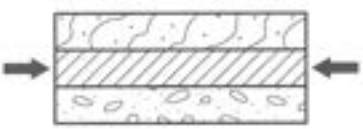
4 Draw a scaled diagram for each of the solids described in the text. Use the scale 1: 4 (ie, 1 scaled centimetre equals 4 real centimetres).

Folding and faulting

12a

Forming a reverse fault

1 Look at the sketches in the table below. They show the various stages when a reverse fault develops in the lithosphere. Order the sketches by writing numbers in the Sequence column. Make 1 the earliest stage and 5 the most recent stage.

Sequence	Sketch
	a 
	b 
	c 
	d 
	e 

Description
A A crack in the crust forms.
B A section of lithosphere is made up of several rock layers.
C Continued forces keep pushing the rock layers together.
D Compression forces in the crust push the rock layers together.
E The rock layers on one side of the crack slide up against the other side.

2 Match the sketches with the corresponding description by joining them with a ruled line.

Forming a fold

Folds in the lithosphere develop when plastic rock material is pushed together. A section of the lithosphere is made up of several layers of plastic rock, often sedimentary rock. When great forces push the layers together, they begin to bend up and down like ocean waves. Because the rock in the layers is plastic and not brittle, it does not break. As a result, over a long period of time, fold mountains are formed. Examples of fold mountains include the Alps in central Europe and the Appalachian mountains in east North America.

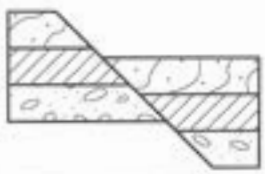
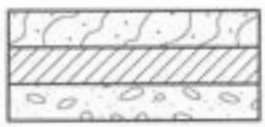
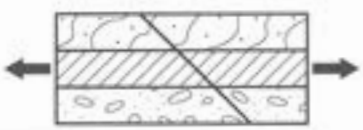
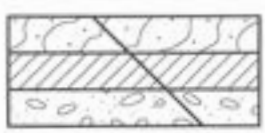
3 Using the information above, develop a series of statements and sketches identifying the various stages of the formation of fold mountains.

Statements	Sketch

Folding and faulting 12b

Forming a normal fault

4 Order the sketches showing how a normal fault forms by writing numbers in the Sequence column of the table below.

Sequence	Sketch	Description
	a 	A
	b 	B
	c 	C
	d 	D
	e 	E

5 Write matching statements for each sketch in the table above. You can use the descriptions from the table in question 1 as a guide.

6 Write an explanation about how normal faults form using the scaffold below. Remember to use time conjunctions, such as *when* and *then*, and cause conjunctions, such as *because* and *as a result*.

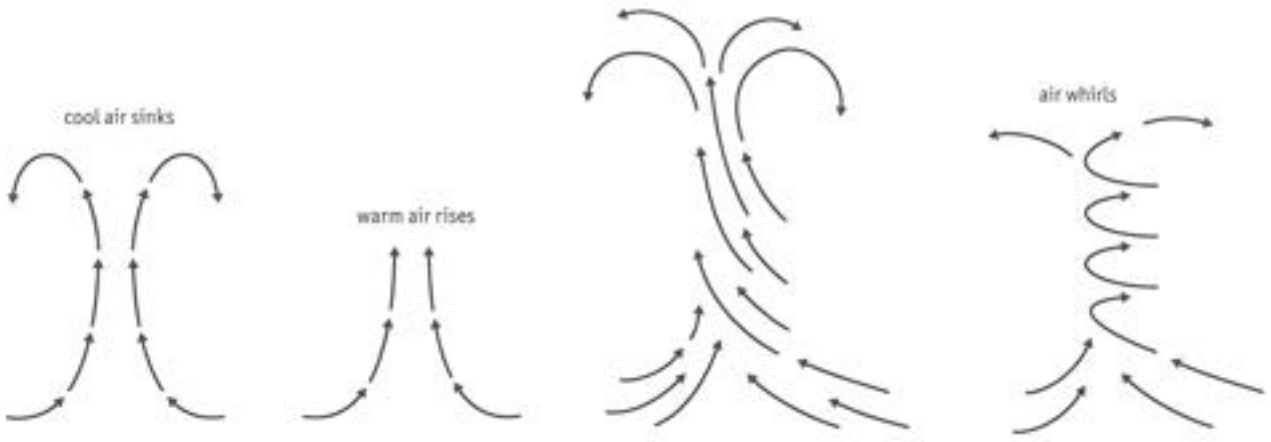
Title	
Overview	
Explanation sequence	

Cyclones

13a

1 Look at the four sketches below showing how a cyclone forms.

Unfortunately the diagrams are not in order. Number the drawings 1, 2, 3, 4 to show their correct order.



2 In the table below is an explanation about the formation of cyclones. However, each sentence has its parts all mixed up.

Title	a cyclone | forms | How
Definition	A cyclone | a severe low air pressure system | about a week | in the tropics | is | lasting |.
Explanation sequence	from tropical oceans | Due to the heat from the sun, | rises | warm moist air |. As | condenses | cools | into rain | its moisture | the high air |, |. a stronger updraft | causing | heat | releases | The condensation |. and | as a result | begins to rotate | into the updraft | rushes | the system | Warm air |. into the spiral | rushes | More and more warm moist air | more condensation and clouds | producing |. across the earth | at speeds of about 20 km/h | moves | The resulting cyclone |.
Description	A cyclone | about 100 km in diameter and about 20 km high | could be |. surround | the calm and narrow eye of a cyclone | Winds of 120 km/h and heavy rainfalls |.

Rewrite the explanation using ordered sentences. Don't forget to maintain the three paragraphs.

Cyclones

13b

3 Cyclones can cause a lot of damage. Tick the reasons below which are true, cross the ones which are not.

a Cyclone winds are more turbulent than other storms. _____

b Cyclone winds last for hours, and sometimes even days. _____

c Cyclone winds carry debris. _____

d Cyclone winds change direction. _____

e The path of cyclones is often unpredictable. _____

f Heavy rains are associated with cyclones. _____

4 Cyclones are also known by different names, and there are several types of cyclones as well. Match the names and their definitions by drawing lines between them.

Name	Definition
a Bagulo	A Funnel of rotating air that sucks water into the sky.
b Cyclone	B Low air pressure system over the Indian Ocean and north Australia.
c Hurricane	C Mass of air rotating rapidly around a vertical axis.
d Tornado	D Philippino name for cyclone.
e Twister	E Spiral of wind collecting dust in Australia.
f Typhoon	F Tropical cyclone above the western Pacific and Indian Oceans.
g Water spout	G Very powerful tornado.
h Whirlwind	H Violent tropical cyclone with wind speeds over 120 km/h in southern USA.
i Willy-willy	I Violent whirlwind over land with a funnel-shaped cloud.

5 In the space below draw your impression of one type of cyclone mentioned in question 4.

Fossils everywhere 14a

Types of fossils

1 Read the text about fossils and write the missing words into the spaces. The missing words are supplied below.

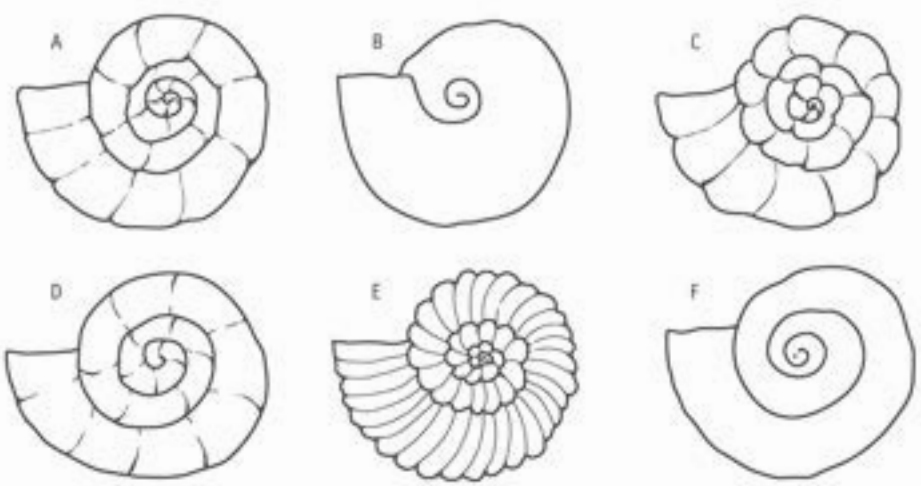
There are three types of fossils: Originals, moulds and casts. When an organism or some of its parts are covered by _____ like sand or mud, the sediments protect and preserve _____. The preserved organic part is an original fossil. Eventually the sediments harden into _____. Often the organic part _____ thus leaving a cavity in the rock material. This _____ is called a *mould;* detailed imprints of the organism can be seen in the rock. Sometimes this cavity is filled with materials which eventually harden into rock. This new material forms a cast of the original _____. Many things can become _____. Usually the hard parts of organism like *bones, teeth* and *tree trunks* become _____. But sometimes soft parts like hair, *feathers* and *leaves* also develop _____. *Animal droppings* may on occasions also become fossils, _____ *footprints*. It is often _____ for the untrained eye to recognise a fossil.

as well as	cavity	difficult	fossilised	fossils	into fossils	sedimentary rock
organism	rots away	sediments	the organic parts			

2 Using the italicised words from the text above, draw an example of each fossil.

Ordering fossils

3 Scientists believe that older fossils are simpler than younger ones. Look at the fossils of various ammonites. Ammonites were most common during the Mesozoic period, 248–65 million years ago. The animal that lived inside the shell was related to the present-day octopus and squid. Ammonites varied greatly in size, from those as small as a coin, to others as big as a tyre. Determine which is the oldest fossil (1) and which is the youngest fossil (6). Then determine the order of the other ammonites and indicate it by writing the numbers next to the drawings.

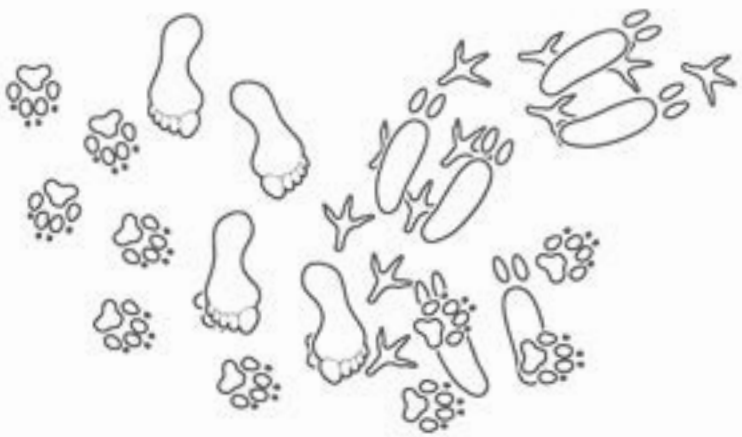


Fossils everywhere

14b

Sequencing imprints

4 Look at the prints in the mud. The prints come from a human, a seagull, a dog and a kangaroo.



a Determine which organism walked on the mud first. Justify your answer.

_____

_____

b Write down the names of the visitors in order, starting with the first visitor.

_____

_____

c Imagine the sequence of events that may have happened at this muddy place.

_____

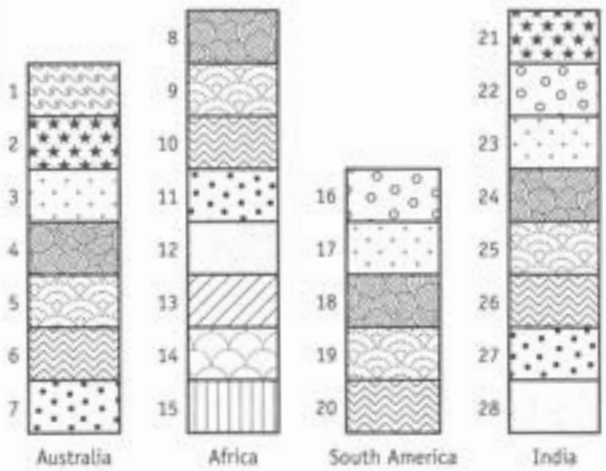
_____

_____

Matching rock layers

Scientists believe that rock layers beneath other rock layers are older than all the layers above. They also believe that rock layers which come from different places but contain the same kind of fossils are the same age.

5 Study the rock columns on the right and then perform the tasks below.



a Identify several index fossils between any two rock columns and join the matching rock layers with a line.

b Determine the oldest and youngest rock layer and label them.

c Deduce the order of layers from oldest to youngest and write their corresponding numbers down.

Oldest layer _____ youngest layer

d Suggest reasons why the highest column does not have the youngest rock layer at the top.

_____

_____

_____

e Explain why there is a rock layer missing in the column from Australia.

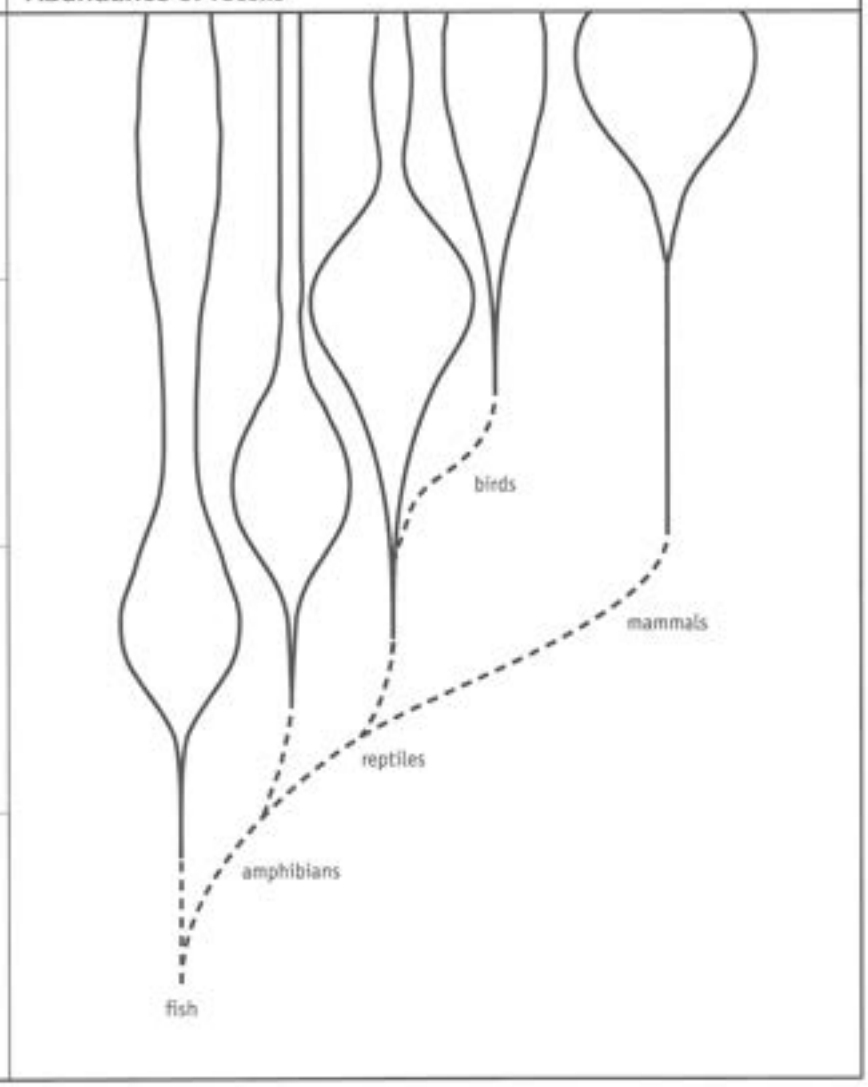
_____

_____

Abundance of fossils

16a

Scientists have been able to work out how many animals of various groups lived in the past. Their findings are based on fossil evidence and are summarised in the table below. Geological time of the earth is divided into eras, which in turn are divided into periods. The table shows the eras only.

Years ago	Era	Abundance of fossils
0	Cainozoic	
65 000 000	Mesozoic	
230 000 000	Paleozoic	
600 000 000	Precambrian	
3 000 000 000		

1 **a** The table above is not to scale, ie the eras have been allocated the same amount of space in the table, even though they are not actually equal lengths of time. Show the eras on the time line below by dividing the line into 500 000 000 year sections. Write the number of '*years ago*' below the time line, then mark the relevant years for each era and label the eras above the time line.

3 billion years ago — today

b Name some difficulties you would have to overcome if you had to redraw the table above to scale.

Abundance of fossils 16b

Answer the following comprehension questions about the table above.

2 *On the lines*

a When did the Mesozoic era start? _____

b When did the Paleozoic era finish? _____

c What was the most plentiful animal group during the Mesozoic era? _____

d Which is the most abundant vertebrate group during the Cainozoic? _____

3 *Between the lines*

a How long did the Precambrian era last? _____

b Which is the shortest era? _____

c Which is the longest era? _____

d What do the solid lines indicate? _____

e Which was the most abundant animal group about 3000 million years ago? _____

f Are the fish or reptiles more abundant during the Cainozoic era? _____

g Which era is the age of dinosaurs? _____

h Is it true that the age of dinosaurs lasted for about 150 000 000 years? _____

i When did vertebrates originate? _____

4 *Beyond the lines*

a Why should the Precambrian era be so much longer than the other eras? _____

b What do the dotted lines indicate? _____

c What does the dotted line indicate which is branching off the reptiles during the late Paleozoic era? _____

d Why did the abundance of fish decrease during the late Paleozoic era? _____

_____

e There is a theory that the reptiles died back because the earth became suddenly colder. Why didn't the mammals also die back? _____

_____

f Why did the mammals increase in numbers when the reptiles decreased? _____

_____

g Do the fish from the Paleozoic look the same as fish from the Cainozoic? _____

h What is a current example of each vertebrate group? _____

i What is an extinct example of each vertebrate group? _____

j What are the names of five other animal groups? _____

k What is the name of the kingdom and the phylum that the five classes in the table belong to?

_____

l Why did the increase in flowering plants occur at the same time as an increase in birds?

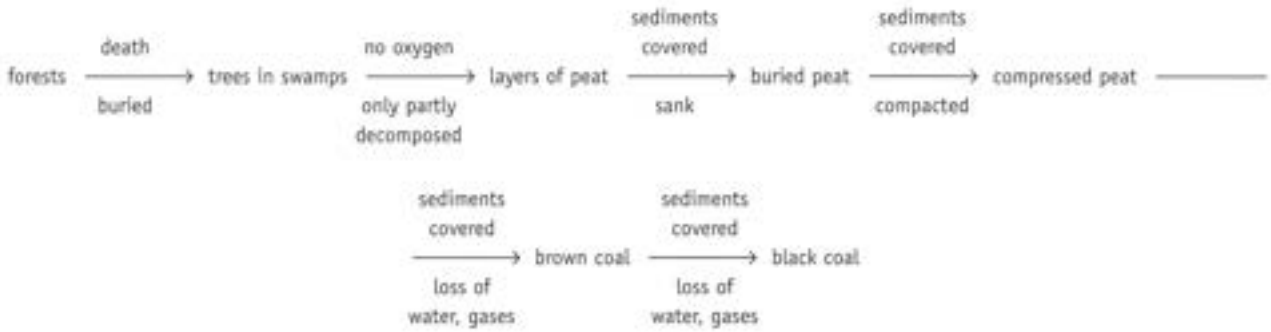
_____

About fossil fuels

17a

Formation of coal

The flow chart below shows how coal is formed from forests over millions of years.



1 In the flow chart a substance is changed repeatedly due to some causes which affect the substance in certain ways.

a Refer to the flow chart and give two examples each.

Substance: _____ _____

Cause: _____ _____

Effect: _____ _____

b Write an explanation about coal formation. Use the scaffold below.

Title	
Summary	
Explanation sequence	
Uses of coal	

About fossil fuels 17b

Burning coal

When coal, which is made up of carbon, is burnt, it reacts with oxygen gas to form oxides.

2 a State where the oxygen, which is needed for the burning of coal, comes from.

_____

b Name the two possible carbon oxides, when their formulas are CO and CO_2. (*Hint:* The Greek 'mono' means one and the Greek 'di' or 'bi' means two.)

_____ _____

c Suggest which oxide is produced when there is plenty of oxygen available.

_____

d Suggest which oxide is produced when there is only some oxygen available.

_____

e CO is a poisonous gas, while CO_2 is not. If inhaled, CO will kill you, while CO_2 will only make you unconscious. Many old houses in London and Sydney have air vents in the wall. These vents are about as big as two bricks and were installed when coal fires and gas lighting were common. Explain the need for those air vents.

_____

_____

Burning of other fossil fuels

The other two groups of fossil fuels are petroleum (or crude oil) and gas. Both of these belong to the chemical group hydrocarbons.

3 a State the two elements making up petroleum and gas.

_____ _____

b When hydrocarbons burn, both their elements react with oxygen to form oxides. Name these two oxides. _____ _____

c When there is insufficient oxygen for the complete combustion of hydrocarbons, a poison and a carcinogen can be produced. The poison is made up of only two atoms and the carcinogen contains only one atom. Suggest the two unhealthy products of incomplete combustion.

_____ _____

d Petrol is also a hydrocarbon, as it is derived from petroleum. When petrol is burnt in a car engine, there can be black exhaust emitted. Suggest which substance causes the exhaust to be black. _____

e State what could be done to a car engine so that it does not perform incomplete combustion.

_____

_____

Global warming

Excessive burning of fossil fuels causes global warming.

When fossil fuels are burnt, large amounts of greenhouse gases, including carbon dioxide, are produced. These gases spread out throughout the atmosphere. When the sun's heat rays penetrate the atmosphere, they warm up the ground. The warmed ground also produces heat rays which travel away from the earth. Most of these heat rays are absorbed by the carbon dioxide, which in turn produces new heat rays. Many of these heat rays travel back to the earth causing it to become warmer.

The extra greenhouse gases in the atmosphere are causing an enhanced greenhouse effect, resulting in global warming. It is predicted that global warming will change the weather patterns, expand the oceans and melt polar ice. As a result desert areas will increase and ocean levels will rise causing flooding of low lands.

About fossil fuels

4 **a** Look at the explanation text about global warming. State the function of each of the three paragraphs.

Paragraph 1: _____

Paragraph 2: _____

Paragraph 3: _____

b Develop a flow chart showing the events of the second paragraph. The flow chart should look like a chain.

c Develop a flow chart which shows the effects of extra greenhouse gases in the atmosphere. This flow chart should look like a hand, with arrows instead of fingers.

d Suggest how Australian society could reduce its greenhouse gas emission.

_____

_____

e State how you could reduce producing too much greenhouse gas.

_____

_____

_____

Plate tectonics

18a

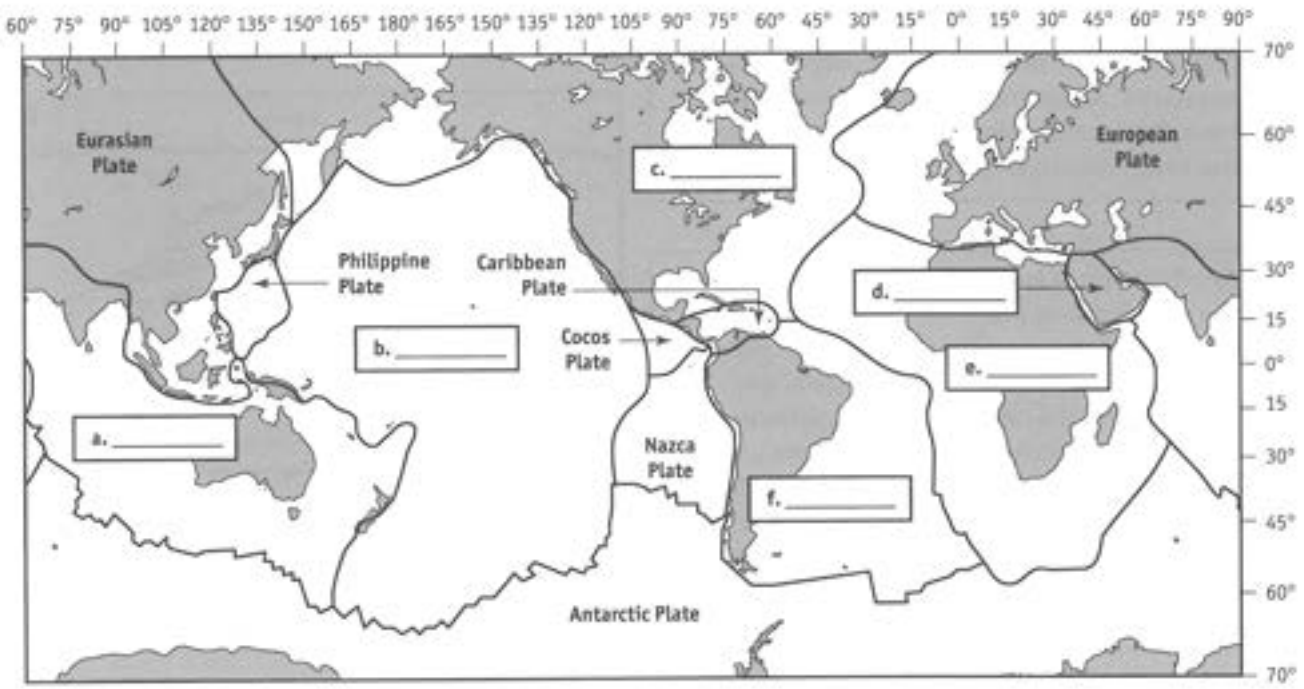
Labelling plates

You may have learnt that the earth is not completely solid and that the lithosphere is not the same thickness all the way through to the mantle. The earth's crust is not even, smooth and continuous but consists of twelve rigid main plates. These tectonic plates move continually over the semi-liquid layer in the mantle, the atmosphere. Geologists have identified the following twelve main tectonic plates:

Australian plate	Antarctic plate	Pacific plate
North American plate	Nazca plate	South American plate
African plate	Eurasian plate	Philippine plate
Caribbean plate	Cocos plate	Arabian plate

1 The map of the world below shows all the major plate boundaries. Only six plates have been labelled.

Label the other six plates. Use the plate names as clues to their locations.



2 Use the text on the next page (question 4) to label the different types of plate boundaries on the map in above. Use coloured pens for the different boundary types and draw a key.

3 Use the information to complete the summary table below.

Type of boundary	Description	Location	Earthquakes, volcanoes or both caused?

Plate tectonics 18b

Plate boundaries

All twelve tectonic plates interact with most of their surrounding plates. These interactions take place at the plate boundaries. There are three types of plate boundaries:

- subduction or convergent boundaries
- spreading or divergent boundaries
- transform fault boundaries.

Each type of boundary experiences earthquakes as the plates move past, under or over each other.

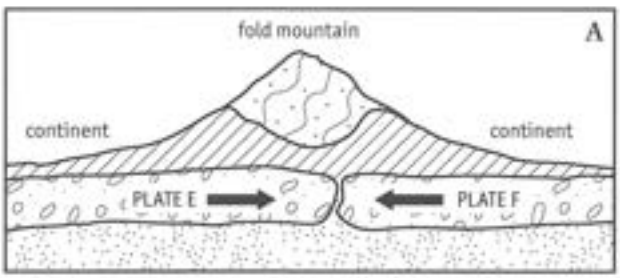
4 Read the information on the different plate boundaries, then match the text to the diagrams by joining them with lines.

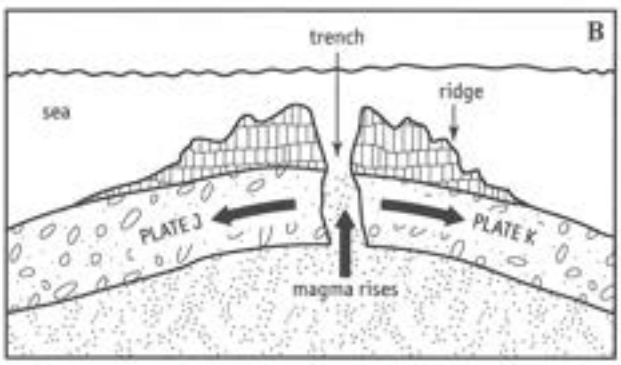
a Subduction or convergent boundaries occur when a thinner oceanic plate collides with a thicker continental plate. The oceanic plate is forced under the continental plate and down into the mantle. The movement of the plate causes great friction. Earthquakes and heat are generated causing the continental crust to melt and form volcanoes at the edge of the continent. An example of this type of plate boundary occurs between the western side of the South American plate and the Nazca plate.

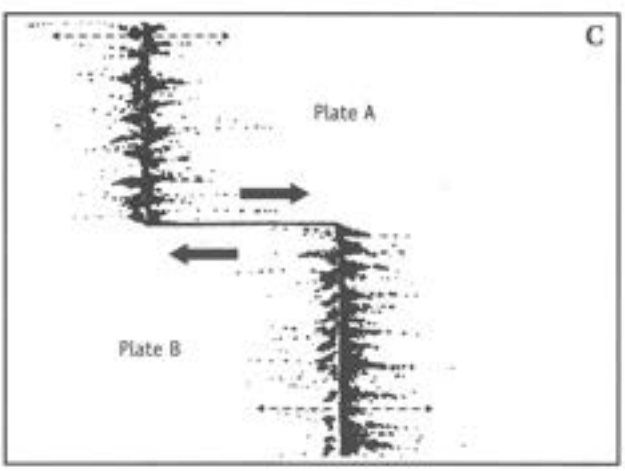
b Another type of subduction boundary is called the collision boundary. This occurs when two continental plates collide. When both plates are of a similar thickness, one plate is not forced under the other. Instead mountains form as the ground is pushed upwards and downwards. An example of this type of plate boundary is the Australian plate colliding with the Eurasian plate forming the Himalayan mountain range.

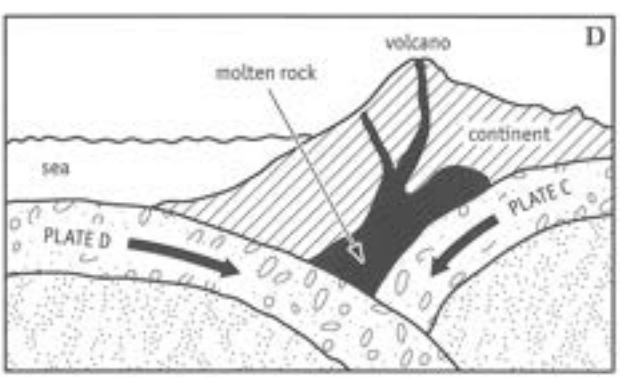
c Divergent boundaries form when two plates move away from each other. The gap that forms between the two plates allows molten material from the mantle to rise and form a chain of volcanoes along the ridges. As the plates move apart, new oceanic crust is produced. All these zones are found under oceans and are called mid-oceanic ridges. An example of a divergent boundary is between the South American plate and the African plate.

d Transform fault boundaries occur when two plates slide past each other forming a transform fault zone. An example of this fault is where the Pacific plate is moving past the North American plate.









Continental drift

19a

The shape of the continents as well as fossil evidence suggest that the continents were once joined together into one huge landmass about 250 million years ago. This huge landmass has been given the name Pangea. About 135 million years ago the northern section, named Laurasia, and the southern section, called Gondwana, are believed to have separated. Geologists believe that by about 70 million years ago Gondwana had broken up to form the continents Australia, Africa, India, South America and Antarctica.

Rebuilding Gondwana

a Label the continents making up Gondwana below.

b Read the descriptions of the fossils on the next page. Design a key for each fossil mentioned and mark the fossils on the continents below.

c Cut out the continents and try to arrange them as they would have appeared about 135 million years ago. Use the shape of the continents and the fossils that you have marked on the continents to help you.

Fossil key

Symbol	Name
☐	
☐	
☐	
☐	

Continents that made up Gondwana

d Complete this sentence: It is possible to rebuild Gondwana because _____

_____

2 The following information has been written in point form. Rewrite the information into text using complete sentences and paragraphs.

Continental drift

19b

Describing Gondwana fossils

Notes	Text
Cynognathus ■ Reptile ■ Skull and teeth look very dog-like ■ May have fed on other reptiles ■ Fossils dated about 240 million years ago ■ Fossils found in Southern Africa and South America	
Lystrosaurus ■ Reptile ■ About 75 cm long ■ Tortoise-like beak with 2 tusk-like teeth ■ Grazed on plants ■ Fossils date to about 240 million years ago ■ Fossil remains found in Central Antarctica, Southern Africa and Southern India	
Mesosaurs ■ Reptile ■ Semi-aquatic, about 40 cm long ■ Flexible tail, webbed feet ■ Efficient swimmer ■ Ate fish ■ Fossils dated about 240 million years ago ■ Fossils found in southern tip of Africa and South America	
Glossopteris ■ Plant ■ Primitive, seed bearing ■ Height of about 10 metres ■ Thick woody trunk ■ Large number of fossil leaves found ■ Fossils dated to about 250 million years ago ■ Fossils found in Southern Africa and India, Madagascar, Southern South America, Eastern Australia and Central Antarctica.	

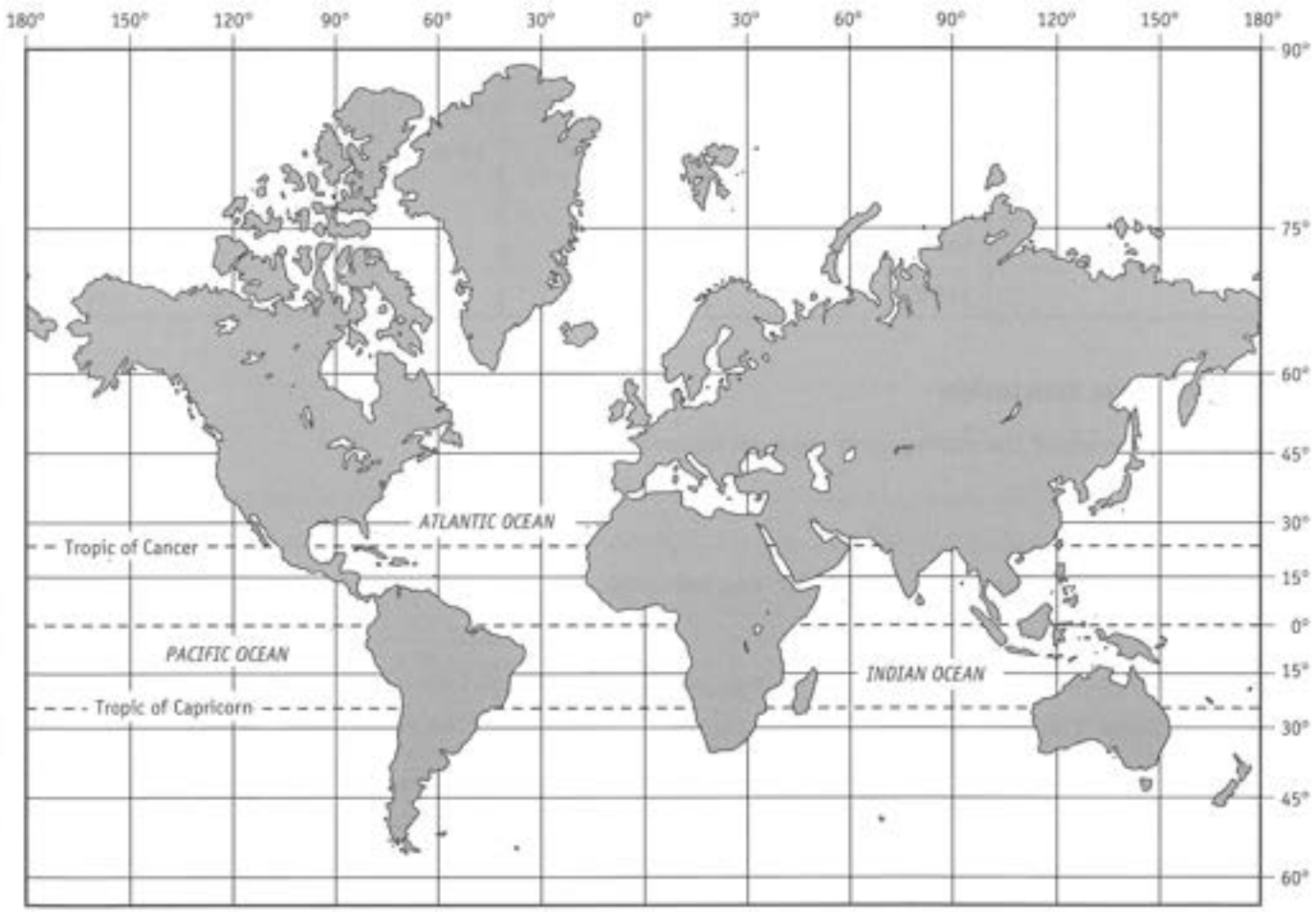
3 Using the notes about the fossils, draw what you think the organisms may have looked like in the spaces provided below.

Why are earthquakes and volcanoes where they are? 20a

Labelling a map of the earth

1 Label the map below using the underlined names and coordinates from the following information.

- The equator lies between the tropic of Cancer and the tropic of Capricorn. Its latitude is 0°.
- Starting at the equator the latitudes increase by 15°N in a northerly direction and by 15°S in a southerly direction.
- The latitude immediately above the tropic of Cancer is 30°N, the latitude immediately below the tropic of Capricorn 30°S. The South Pole has a latitude of 90°S.
- The longitude passing through London is called 0°.
- Beginning at 0° the latitudes increase by 30°E towards the east and by 30°W towards the west.
- Sydney in Australia has a latitude of 150°E. Alexandria in Egypt has a latitude of 30°E and a longitude of 30°N.
- The main landmasses are Africa, Asia, Australia, Europe, North America and South America.
- Label all other longitudes and latitudes.



Note: The southern and northern ends of the earth have been stretched sideways so that a round earth fits onto a rectangular map. As a result the northern island Greenland appears much bigger on the map than it really is.

Why are earthquakes and volcanoes where they are? 20b

Marking places of earthquakes

2 Place a red dot (•) on the map for the following major earthquakes.

Longitude	Latitude	Longitude	Latitude
20°W	70°N	80°E	10°S
40°W	40°N	20°E	40°N
70°W	60°S	60°E	20°S
75°W	30°S	70°E	30°N
75°W	40°S	80°E	10°S
75°W	50°S	90°E	20°N
90°W	0°	100°E	0°
110°W	20°N	110°E	30°N
115°W	30°N	130°E	40°N
120°W	50°N	140°E	0°
125°W	20°N	140°E	10°S
150°W	60°N	140°E	20°N
		160°E	50°N

Marking places of volcanic eruptions

3 Place a blue cross (x) on the map for the following major volcanic eruptions.

Longitude	Latitude	Longitude	Latitude
20°W	70°N	40°E	40°N
30°W	15°N	50°E	15°N
30°W	60°S	60°E	10°S
40°W	50°N	60°E	20°S
75°W	25°S	80°E	10°S
80°W	0°	100°E	10°N
80°W	10°N	130°E	30°N
100°W	25°N	140°E	10°S
115°W	30°N	140°E	40°N
150°W	60°N	140°E	45°N
		160°E	50°N

Making a first conclusion

4 a State where the earthquakes are in relation to the volcanoes.

b Describe where most earthquakes and volcanoes are.

c Suggest an explanation why the earthquakes and volcanoes are where they are.

Marking mountains and valleys

5 On the map above, draw thick lines in pencil to indicate where the following mountains and valleys are.

- The Rockies are along the west coast of North America.
- The Andes are all along the west coast of South America.
- The Himalayas are north of India on 30°N from 70°E to 90°E.
- The Urals separate Asia and Europe and run from 50°N to 70°N along 60°E.
- The Mid-Atlantic Ridge, which is continuously being formed, is on 20°W from 60°S to 90°N.

Why are earthquakes and volcanoes where they are? 20c

Drawing a second conclusion

6 a Describe where the mountains and valleys are compared to the volcanoes and earthquakes.

_____

_____

b Explain why the mountains and valleys are where they are. (Hint: refer to information on plate tectonics.)

_____

_____

c Explain what the tectonic plates are doing near the west coasts of North and South America.

_____

_____

d Explain what the tectonic plates are doing at the Mid-Atlantic Ridge.

_____

_____

7 Give the coordinates of the following locations:

a Cuba _____

b Iceland _____

c India _____

d Italy _____

e Japan _____

f Korea _____

g Madagascar _____

h New Zealand _____

i Papua New Guinea _____

j Spain _____

Extension exercise – Adding tectonic plates to the map

8 Refer to worksheet 18 *Plate Tectonics* to answer the following questions.

a In blue sketch the borders of the main tectonic plates on the map from question 1.

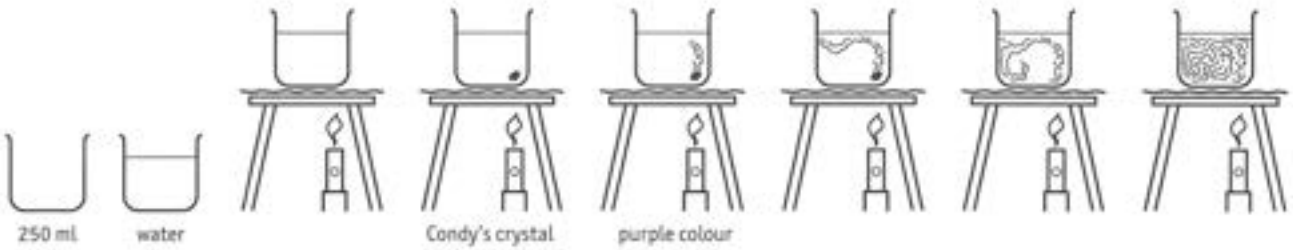
b Label the main tectonic plates.

c Indicate the subduction zones by drawing a red line along the relevant plate boundaries.

Convection currents 21

Convection experiment

Some students performed an experiment in their science class at school to demonstrate a convection current. Below are a series of diagrams to show what they did and what they observed.

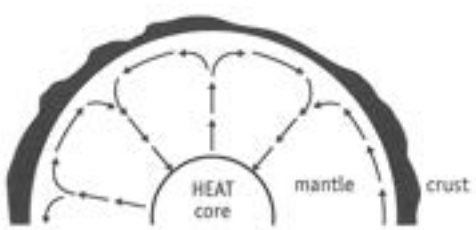


1 Look at the diagrams above about the experiment and write an experimental record. Use the scaffold below.

Title	
Aim	
Equipment	
Method	
Results	
Conclusion	

Translating a sketch into an explanation

The sketch below shows how a convection current in the mantle of the earth is responsible for the movement of parts of the crust.



2 Study the sketch and, on a separate piece of paper, write an explanation of how the plates in the crust are made to move.

Earth shattering memory game 22

Cut out the squares below into individual cards.

Rules of the memory game

1 Shuffle the cards to mix them up.
2 Place all the cards face down on the table.
3 Each player in turn picks up two cards.
4 If the two cards match (ie a word and its correct definition), the player keeps the pair and has another turn.
5 If the two cards don't match, turn them back over again. It is the next player's turn.
6 The game is finished when all cards have been taken up as pairs. The winner holds the greatest number of card pairs.

lithosphere	inner core	mantle
magma	lava	volcano
Mercalli scale	Richter scale	earthquake
epicenter	plate boundary	tectonic plate
convection current	fossil	carbon dioxide
global warming	carbon monoxide	December 1989
outer rocky layer of the Earth	solid centre of the Earth	thick semi-liquid layer of the Earth
molten rock inside the Earth	liquid rock from a volcano	site of expulsion of magma
scale that measures amount of damage caused by an earthquake	sudden movement of plates	measure of the strength of an earthquake using a seismograph
area above the focus of an earthquake	possible site of earthquakes and volcanoes	large stable land mass
movement in fluids due to heat	old remains of an organism	greenhouse gas
enhanced greenhouse effect	poisonous gas	Newcastle earthquake

Answers

1 Views of the earth

Teacher to check diagrams.

4 Thales of Miletus in Greece (550 BC) differed from Anaximandros. He believed that the earth was floating in an ocean like a huge piece of wood.

6 Eratosthenes from Greece (200 AD) was certain that the earth was an immovable globe surrounded by the atmosphere. Its circumference measured 40 000 km and it was the centre of the universe.

2 The rock layers of the earth

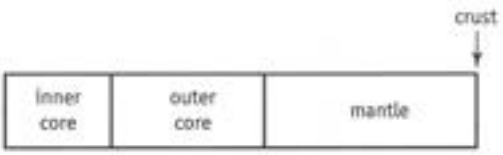
1 a Para 1: Structure of the earth; Para 2: crust; Para 3: mantle; Para 4: outer core; Para 5: inner core; Para 6: alternative technical terms

b Nouns: earth, ball, rock, diameter, km, layers, crust, mantle, core, crust, layer, thickness, oceans, mountains, crust's, temperature, °C, volume, mantle, material, paste.

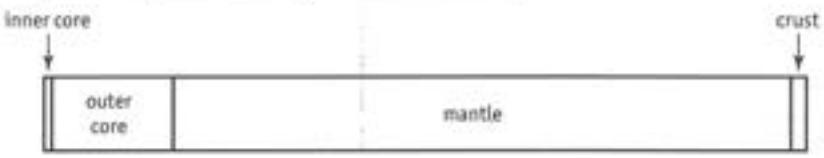
c Adjectives: outer, third, liquid, rock, inner, fourth, innermost, solid rock, other, great, radioactive.

2 a mantle b inner core c crust d outer core

3 inner core: 0 to 14 mm
outer core: 14–34 mm
mantle: 34–62 mm
crust: at 62 mm
(too small to show on this scale)



4 inner core: 0–1 mm
outer core: 1–17 mm
mantle: 17–98 mm
crust: 98–100 mm



5 Teacher to check graph.

6

Name	State of matter	Average thickness (km)	Outer temperature (°C)	Volume (%)
crust	solid	15	20	2
mantle	liquid	2800	800	81
outer core	liquid	2000	2200	16
inner core	solid	2800 (diameter)	3600	1
centre	solid	–	5000	–

7 a The radioactive decay at the centre produces the earth's heat.

b The outer core is so hot that the rock material melts and remains liquid.

c The crust is very cold and so the rock is solid.

d The mantle is too hot to be a solid; the rock material is melted.

e The mantle is just hot enough to melt the rock into a thick paste but not hot enough to make it like water.

f The great pressure from the layers above make the inner core solid.

3 Spheres of the earth

1 1 – D – iv;
2 – C – v;
3 – A – ii;
4 – E – i;
5 – B – iii

2 a biosphere
b atmosphere
c hydrosphere
d lithosphere
e asthenosphere

3

Example 1	Example 2	Example 3
asthenosphere	molten rock	magna
atmosphere	oxygen gas	nitrogen gas
biosphere	birds	worms
hydrosphere	oceans	rivers
lithosphere	continents	mountains

4 The rock cycle

1 a Types of rock material.

b Processes of rock materials.

c Causes for effects or processes.

2 a Different rock materials become smaller due to weathering.

b Broken pieces of rock collect together due to erosion by wind and water.

c Sediment is pushed together due to pressure from the sediments above.

d Rock becomes liquid due to great heat.

e Molten rock material hardens to become solid rock due to cooling.

3 a sedimentary rock, metamorphic rock
b sedimentary rock, igneous rock
c sediments
d sedimentary, metamorphic or igneous rock
4 Answers will vary.

5 Mercalli scale

I - 6, II - 9, III - 1, IV - 3, V - 2, VI - 4, VII - 12, VIII - 11, IX - 10, X - 5, XI - 8, XII - 7

6 Using a seismograph

1 Teacher to check.
2 A seismograph is the device that measures the strength of earthquakes.
A seismogram is the graph produced by a seismograph, displaying the earthquake strength. It looks like a squiggly line.
3 Teacher to check: a squiggly line ending in a straight horizontal line.
4 There is a straight horizontal line when there is no earthquake, and a wavy line during an earthquake.
5 The wavy lines are steeper and higher and closer together.
6 Teacher to check.
7 The table rocked too violently so that the weight also started to move.
8 Teacher to check.
9 Use a bigger weight, add a spring to the string, use a motor to pull the paper at a constant speed, etc.

7 Extra, extra, read all about it!

1 a Margaret: 5D or 5E
b Professor Seismo: 4A or 4B
c Jimmy: 9C or 8C
d Bruce: 2B
e Mary and Lee: 8D
f Star: 3E
2 Teacher to check.
3 para (2) – IV, para (3) - III, para (8) - II, para (9) - V, para (10) - I
4 Bruce. His description is too destructive; at that distance from the epicentre the earthquake waves could not have been so destructive. A value of I or II would be more likely, as described by Bruce's neighbours.

8 Simulating earthquake waves

1 recount
2 Teacher to check.
3 a compression wave
b transverse wave
4 a The rock would move forwards and backwards.
b The rock would move from side to side *or* up and down.

9 Locating the epicentre of an earthquake

1–3

Location of station	Arrival time of P waves	Arrival time of S waves	Time difference	Distance from epicentre	Radius of circle
Shaketown	07.06.10	07.07.30	1 min 20 s	1500 km	1.5 cm
Northtown	07.09.15	07.11.55	2 min 40 s	2500 km	2.5 cm
East town	07.10.05	07.14.45	4 min 40 s	4500 km	4.5 cm
Southtown	07.15.19	07.20.41	5 min 22 s	5500 km	5.5 cm

4 Teacher to check.
5 The epicentre is near Shaketown about one-third of the distance towards Northtown.

11 Studying volcanic explosions

2 comes, is called, in, affect, its, moves, slowly, moves, fast; has, of, is, does not, plugs, are called; silica, produces, flows; has, moves, on, has, are, flow, kilometres, vent

3

Name of lava	Viscosity (high, medium, low)	Speed of lava flow (fast, slow…)	Silica content Percentage
Rhyolites	high	not very much	very high (70–80%)
Dacite lava	medium	slow	high (60–69%)
Andesite lava	medium – low	fast	medium (54–59%)
Basaltic lava	low	quick	low (45–58%)

12 Folding and faulting

1 1 – c, 2 – e, 3 – a, 4 – d, 5 – b
2 a – A, b – E, c – B, d – C, e – D
3 Teacher to check.

4 1 – b, 2 – c, 3 – e, 4 – d, 5 – a
5 a The rock layers on one side of the crack slide down against the other side.
b A section of lithosphere is made up of several rock layers.
c Continued tension forces keep pulling the rock layers apart.
d Tension forces in the crust let the crack widen.
e A crack in the crust forms.
6 Teacher to check.

13 Cyclones

1 2, 1, 4, 3
2 How a cyclone forms
A cyclone is a severe low air pressure system in the tropics lasting about a week.
Due to the heat from the sun, warm moist air rises from tropical oceans.
As the high air cools, its moisture condenses into rain.
The condensation releases heat causing a stronger updraft.
Warm air rushes into the updraft and as a result the system begins to rotate.
More and more warm moist air rushes into the spiral producing more condensation and clouds.
The resulting cyclone moves across the earth at speeds of about 20 km/h.
A cyclone could be about 100 km in diameter and about 20 km high.
Winds of 120 km/h and heavy rainfalls surround the calm and narrow eye of a cyclone.
3 ticks for all
4 a – D, b – B, c – H, d – I, e – G, f – F, g – A, h – C, i – E

14 Fossils everywhere

1 sediments, the organic parts, sedimentary rock, rots away, cavity, organism, fossilised, fossils, into fossils, as well as, difficult
3 (oldest) 1 – B, 2 – F, 3 – D, 4 – A, 5 – C, 6 – E (youngest)
4 a The bird, as its tracks are covered by kangaroo, and the kangaroo tracks are covered by dog and then human tracks.
b bird (first), kangaroo, dog, human (latest)
c A seagull was walking on the mud and was frightened away by a kangaroo as it came bounding past. The kangaroo was then chased away by a dog, which was followed by its owner.
5 b oldest: 15, youngest: 1
c 15, 14, 13, 12-28, 7-11-27, 6-10-20-26, 5-9-19-25, 4-8-18-24, 3-17-23, 16-22, 2-21, 1
d It may have been pushed up, or the younger layers may have eroded away.
e It may have been eroded away at this site, or that particular rock or fossil may not have been found in Australia.

15 Fossilisation

1 3, 2, 5, 1, 4
2 a The dead organism must be buried quickly, must not decay, and must be left undisturbed for a long time.
b sediment
c sand, earth or volcanic ash
d sand or mud
e Vultures are scavengers and eat dead and decaying organisms.
f Scavengers must be kept away from the dead organism.
g millions of years
h Cliff faces are found near rivers, lakes or oceans.
i usually sand
3 a It would be buried quickly and more likely to be left undisturbed.
b decompose
c Harsh weather conditions, heat, pressure.
d scavengers and decomposers
e Fossilisation is the preservation of a dead organism in rock.
f Because it is so rare.
g It is covered as sand is washed over it by the current.
4 a ash, limestone, soil
b skin, flesh, eyes, organs
c Bacteria and fungi do not contain chlorophyll; they grow and survive by eating dead organisms. They are important in breaking down and cleaning up decaying matter.
d dingoes, sharks, cockroaches, dung beetles etc
e producers and consumers
f teeth and claws
g Lack of oxygen ensures that no other living organisms which may cause decay can survive.
h Acidity stops the growth of harmful organisms such as bacteria.
i Bacteria thrive in warmer temperatures, so their growth will be inhibited in low temperatures.
j footprints, animal tracks, insect holes, feathers, leaves

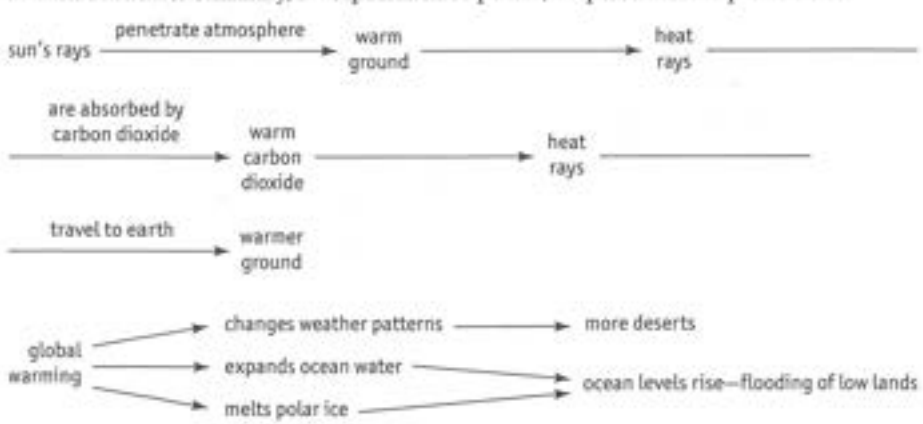
k Pressure from the layers of earth and rock that cover the sediment.
l limestone, gypsum, conglomerate, breccia, halite
m The surface of the earth is worn away.
n The action of water, wind, glaciers, waves etc.
o Other fossils may have been found, or geological conditions are right for formation of fossils.
p The soft parts of the fish have decayed.
q Erosion by the movement of the water may have uncovered the skeleton.
r Movement of the water is likely to have broken up the skeleton before it had a chance to fossilise.

16 Abundance of fossils

1 b The time scale in the table is not accurate enough; it would be difficult to show the abundance accurately.
2 a 230 000 000 years ago
b about 230 000 000 years ago
c reptiles
d mammals
3 a 2 400 000 000 years b Cainozoic c Precambrian
d Abundance of animal group. e There were no animals. f fish
g Mesozoic h yes i In the Precambrian era.
4 a Fewer events and developments. b Possible origin of animal group. c Mammals developed from reptiles.
d Because amphibians competed with them and ate their food and also ate the fish themselves.
e Mammals are endothermic/warm-blooded and cold climate does not affect them.
f Mammals were better adapted to the environment.
g no h eg bream, frog, snake, kookaburra, dog
i eg teleosts, stegocephalians, brontosaurus, dodo bird, diprotodon
j eg insects, spiders, starfish, round worms, jellyfish
k animals, chordates or vertebrates
l Birds pollinate many flowers so more seeds were produced.

17 About fossil fuels

1 a Substance: forest, peat; Cause: death, no oxygen, sediments covered; Effect: compacted, buried, loss of water
b Teacher to check.
2 a From the air
b carbon monoxide, carbon dioxide
c carbon dioxide
d carbon monoxide
e To allow oxygen to enter the room, and to allow carbon oxides to leave the room.
3 a hydrogen, carbon
b carbon dioxide, hydrogen oxide (= water)
c carbon monoxide, carbon
d carbon
e Have the engine tuned and cleaned frequently; use the correct petrol, etc.
4 a 1 – introduction or summary; 2 – explanation sequence; 3 – problems and predictions
b



c

d eg less driving of cars and trucks, less burning of coal, use wind generators, use solar cells
e eg walk/cycle instead of go by car, wear a jumper and not turn on heaters

18 Plate tectonics

1 a Australian b Pacific c North American
d Arabian e African f South American
2 Teacher to check.

3

Type of boundary	Description	Location	Earthquakes, volcanoes or both caused?
Subduction or convergent boundary	A thinner plate collides with a thicker plate, causing the plate down into the mantle, creating great heat and friction.	Between the South American and Nazco plates.	Both
Spreading or divergent boundary	Two plates move apart and the gap that forms allows molten material from the mantle to rise.	Between the South American and African plates.	Volcanoes
Transform fault boundary	Two plates slide past each other, forming a transform fault zone.	Pacific plate moving past North American plate.	Earthquakes

4 a – D, b – A, c – B, d – C

19 Continental drift

1 **d** It is possible to rebuild Gondwana because the coast shapes of the continents fit into each other and the fossils on different continents match.

2 **a** eg, Cynognathus is an ancient reptile.
Cynognathus lived about 240 million years ago in the southern parts of Africa and South America.
Cynognathus had a skull and teeth which look like those in a dog. It probably hunted and ate other reptiles.

21 Why are earthquakes and volcanoes where they are?

1–3 Teacher to check.

4 **a** Earthquakes and volcanoes are in the same areas.
b Earthquakes and volcanoes are near the west coast of North America, along the east coast of Asia.
c The ground is moving causing earthquakes and cracking open causing volcanoes.

5 Teacher to check.

6 **a** The mountain chains, earthquakes and volcanoes are all in the same areas.
b The mountains are near plate boundaries.
c The plates are crashing against each other.
d The plates are moving apart allowing liquid rock to move up and form underwater ridges.

7 **a** 25°N, 80°W **b** 65°N, 20°W **c** 20°N, 75°E **d** 40°N, 15°E **e** 40°N, 135°E
f 40°N, 130°E **g** 25°S, 45°E **h** 45°S, 170°E **i** 10°S, 140°E **j** 40°N, 0°E

8 Teacher to check.

21 Convection currents

1

Title	Convection experiment
Aim	To demonstrate a convection current.
Equipment	250 mL beaker, gauze, tripod, burner, water, Condy's crystal
Method	1. Fill a 250 mL beaker with 200 mL water. 2. Set the beaker on a gauze on a tripod. 3. Heat the side of the beaker with a burner. 4. Drop a Condy's crystal in the water above the flame.
Results	The Condy's crystal gave off a purple colour. The purple colour went up above the flame, then across under the surface and down the other side of the beaker. At the end all the water was purple.
Conclusion	Warm water rises and cool water drops, thus forming a convection cycle.

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