Mining and quarrying exhibition (Plenary 3 in Topic 8He)

In the table below, examples of how levels might be interpreted for this activity are given. It is suggested that a student needs to demonstrate work at a level in two different strands to achieve that level. The task is by its nature open-ended and so students are expected to use the task to demonstrate what they know and at what levels. They are, however, not expected to cover all the statements below.

Level	Recalling	Explaining	Using knowledge	Using evidence	Applications and implications
Working towards Level 4	Students state some uses for stones and metals.	Students state that stone is obtained from quarries.			Students recall that quarries can cause pollution/damage habitats.
Level 4	Students state some uses of cement and other products from limestone. Students name some rocks with interlocking grains and some with rounded grains. Students state that rocks such as limestone contain calcium carbonate.	Students describe how physical and biological weathering affects rocks. Students describe how igneous and sedimentary rocks are formed. *Exemplar: students state that igneous rocks are formed when molten rock cools down, and that sedimentary rocks are formed when small pieces of rock become cemented together.*	Students explain why some rocks are porous and/or more easily worn away by referring to their texture. *Exemplar: students state that rocks with interlocking grains are generally more resistant than rocks formed from rounded grains cemented together.* Students link the properties of some rocks to their uses.		Students describe some of the environmental effects of quarrying and mining. *Exemplar: students state that mining and quarrying can cause pollution.*
Level 5	Students describe how metamorphic rocks are formed. Students describe how chemical weathering affects rocks. Students describe some different ways in which rocks can be eroded *Exemplar: students state that rock fragments can be transported in rivers and streams, by the wind, by gravity or by glaciers/ice.*	Students explain why certain rocks are used for certain applications. Students explain the factors that affect the cooling rate of lava and how this affects crystal size. *Exemplar: students state that lava and magma forced into narrow gaps cool quickly and form rocks with small crystals.* Students explain the link between water/wind speed and the size of fragments carried.	Students use knowledge of the grain structures of different types of rock to explain how to classify a rock as igneous, sedimentary or metamorphic. *Exemplar: students state that rocks made from interlocking grains are igneous or metamorphic, and that grains in metamorphic rocks are often lined up or in layers.* Students use their knowledge of grain structure to explain why sedimentary rocks are more susceptible to weathering and erosion than igneous and metamorphic rocks.		Students recall that some metals are found in their native states so that no chemical changes are needed to extract them. *Exemplar: students state that gold can be found in its native state.* Students explain some advantages of recycling metals. *Exemplar: students state that recycling can make our supplies of metals last longer and/or reduce the costs and energy needed for extraction.*

Level	Recalling	Explaining	Using knowledge	Using evidence	Applications and implications
Level 6		Students explain physical weathering using ideas about expansion and contraction.	Students use knowledge of crystal sizes and factors affecting cooling rates to describe the crystal sizes found in intrusive and extrusive rocks.	Students explain how the sizes of crystals in igneous rocks can indicate where the rock was formed. *Exemplar: students explain that granites/ gabbros are formed when magma cools underground, or that basalt is formed when lava cools on the surface or magma cools in dykes or sills.*	
Level 7		Students explain how formulae are used to show the ratios of the different elements in a mineral.	Students explain the difference in crystal size within an intrusion in terms of cooling rate and particles. They explain why the method used to extract a metal, and the cost of this, is related to its position in the reactivity series. *Exemplar: students explain that aluminium is more expensive to extract than iron because it is more reactive.*	Students use density measurements to show that the density of igneous rocks depends on the minerals they contain.	

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You have been asked to produce a series of posters or a computer presentation to be used in a mining and quarrying exhibition. You should include:

- how the different types of rock are formed
- some uses for rocks
- how metals are obtained from the Earth
- how quarrying and mining can affect the environment.

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Now that you have completed the activity, circle the number of stars next to each of these sentences to describe how well you did.

I have…	
stated some uses for rocks.	* * * * *
stated some effects of quarrying.	* * * * *
stated some uses of cement and other products made using limestone.	* * * * *
described how igneous and sedimentary rocks are formed.	* * * * *
described how physical and biological weathering affect rocks.	* * * * *
explained why some rocks are porous and more easily worn away.	* * * * *
described at least two environmental effects of quarrying and mining.	* * * * *
described how metamorphic rocks are formed.	* * * * *
described how chemical weathering affects rocks.	* * * * *
described at least two ways in which rocks can be eroded, and how the fragment sizes carried depends on the speed of a fluid.	* * * * *
explained how magma or lava can cool at different rates and how this affects crystal size.	* * * * *
explained how to use the texture of a rock to classify it as igneous, sedimentary or metamorphic.	* * * * *
explained why sedimentary rocks are more easily weathered by referring to the texture.	* * * * *
explained some advantages of recycling metals.	* * * * *
explained at least one type of physical weathering in terms of the effects of expansion and contraction on the rock.	* * * * *
explained how the sizes of crystals in igneous rocks can show where the rock was formed.	* * * * *
explained the differences in crystal sizes within an intrusion in terms of cooling rate and particles.	* * * * *
explained why the method and cost of extracting a metal depends on the position of the metal in the reactivity series.	* * * * *
used density measurements to show that the density of igneous rocks depends on the minerals they contain.	* * * * *

What could you do to improve? _____

_____

Quick Quiz

	Answers				Marks
Topic	**Q1**	**Q2**	**Q3**	**Q4**	
8Ha	B	D	C	B	
8Hb	B	C	A	B	
8Hc	B	D	A	D	
8Hd	A	D	C	A	
8He	C	A	B	A	

End of Unit Test Mark Scheme Standard (S)

Question	Part	Level	Answer	Mark scheme
1		**3**	Any two from: colour, textures, hardness/ crumbliness, porous, layers.	**2 marks** – one mark for each point.
2	**a**	**3**	B	**1 mark**
	b	**3**	A and C	**1 mark** – both needed for one mark. No marks if more than two given.
3	**a**	**4**	Any sedimentary rock (the ones mentioned in the unit are sandstone, mudstone, limestone).	**1 mark**
	b	**4**	Any metamorphic rock (the ones mentioned in the unit are slate, schist, gneiss). Accept phonetic mis-spellings (e.g. slayt, shist, nice).	**1 mark**
	c	**4**	made from interlocking crystals crystals aligned/in layers	**1 mark** **1 mark**
	d	**4**	E will be permeable/let water through and F will not. E will be softer/more easily worn away than F. Accept single points (such as E is permeable without reference to F), but note this as something for students to be more careful with in future.	**1 mark** **1 mark**
4	**a**	**4**	0.05, 0, 0.06	**1 mark**
	b	**4**	H It has not absorbed any water.	**1 mark** – correct rock and explanation both required for the mark.
	c	**5**	I It has absorbed the most water per gram of rock.	**1 mark** – correct rock and explanation both required for the mark.
	d	**5**	To make a fair comparison/because a bigger rock will absorb more water than a smaller rock/any equivalent explanation.	**1 mark**
5	**a**	**5**	The metal is found as an element/not as part of a compound.	**1 mark**
	b	**4**	ore	**1 mark**

Question	Part	Level	Answer	Mark scheme
	c	5	Any from: makes supplies of metals last longer/reduces pollution from mining/reduces pollution from landfill/doesn't fill up landfill as fast/doesn't use as much energy.	**1 mark**
6	a	5	Dissolved carbon dioxide. do not accept: (dissolved) acid	**1 mark**
	b	5	It reacts with minerals in the rock.	**1 mark**
7	a	5	Rock from L is smaller than rock from J. Rock from L is more rounded/smoother than rock from J.	**1 mark** **1 mark**
	b	5	Bits got knocked off as the rocks bumped into each other in the river.	**1 mark**
8	a	5	bigger crystals	**1 mark**
	b	6	Slow cooling allows more time for particles to move to crystals that are forming; so bigger crystals can grow.	**2 marks** – 1 mark for each point.
	c	5	metamorphic It only occurs next to the magma, so must have been caused by heating of the rock that was already there.	**1 mark** – correct type and explanation both needed for the mark.
9	a	6	Water is present and it gets cold enough to freeze the water.	**2 marks** – 1 mark for each point; accept equivalent answers.
	b i	6	Weathering due to temperature changes.	**1 mark** – accept equivalent answers, e.g. shattering or onion skin weathering.
	ii		T has the largest temperature difference between day and night.	**1 mark** – accept equivalent answers.

Final Level Calculation

Marks	Level	Marks	Level
0–4	2 or lower	15–16	4 (high)
5–6	3 (low)	17–18	5 (low)
7–8	3 (secure)	19–20	5 (secure)
9–10	3 (high)	21–22	5 (high)
11–12	4 (low)	23+	6+
13–14	4 (secure)		

End of Unit Test Mark Scheme Higher (H)

Question	Part	Level	Answer	Mark scheme
1	a	5	It has not absorbed any water; it must be made from interlocking crystals.	**2 marks** – 1 mark for each point.
	b	5	C It has absorbed the most water per gram of rock.	**1 mark** – correct rock and explanation both required for the mark.

Question	Part	Level	Answer	Mark scheme
	c	**5**	To make a fair comparison/because a bigger rock will absorb more water than a smaller rock/ any equivalent explanation.	**1 mark**
2	**a**	**5**	Rock from F is smaller than rock from D. Rock from F is more rounded/smoother than rock from D.	**1 mark** **1 mark**
	b	**5**	Bits got knocked off as the rocks bumped into each other in the river.	**1 mark**
3		**5**	Any two from: makes supplies of metals last longer/reduces pollution from mining/reduces pollution from landfill/doesn't fill up landfill as fast/doesn't use as much energy.	**2 marks** – 1 mark for each point.
4	**a**	**6**	Particles can move around in a liquid; slow cooling allows more time for particles to move to crystals that are forming; so bigger crystals can grow.	**3 marks** – 1 mark for each point.
	b	**5**	metamorphic It only occurs next to the magma, so must have been caused by heating of the rock that was already there.	**1 mark** – correct type and explanation both needed for the mark.
	c	**7**	Crystals will be bigger at I than at J. Magma at J will have cooled faster because it was in contact with the colder rock around the intrusion.	**1 mark** **1 mark** – both parts of explanation needed for the mark.
5	**a**	**6**	Water is present and it gets cold enough to freeze the water.	**2 marks** – 1 mark for each point; accept equivalent answers.
	b	**6 i**	Weathering due to temperature changes.	**1 mark** – accept equivalent answers, e.g. shattering or onion skin weathering.
		ii	O has the largest temperature difference between day and night.	**1 mark** – accept equivalent answers.
6		**6**	P was formed at higher temperatures or pressures than Q; because these conditions produce bigger crystals/crystals in coloured bands.	**2 marks** – 1 mark for each point.
7		**7**	Any three points from: the grain size varies from large to small going upwards; this would represent fast flow depositing larger grains in the spring and smaller grains in the summer; the pattern repeats, and each repeat probably represents a year's deposition; the grains are not very smooth, so they have probably not spent very long in water. Answer written in a sensible order, with good spelling and grammar.	**3 marks** – 1 mark for each point. **1 mark**

Final Level Calculation

Marks	Level	Marks	Level
0–7	4 or lower	14–15	6 (low)
8–9	5 (low)	16–17	6 (secure)
10–11	5 (secure)	18	6 (high)
12–13	5 (high)	19+	7+

Quick Check answers

Quick Check	Answers
8Ha	**A** L4 – 1 (or 12), 3 (or 8), 10 (or 9) **B** L4 – 2, 6 (or 5), 7 **C** L4 – 3 (or 8), 4, 5 (or 6) **D** L4 – 1 (or 12), 10 (or 9), 11
8Hb	Possible answers include: **1** L4 …and this forms magma/…and the molten material forms igneous rocks when it cools down again/…but if it is not quite hot enough to melt the rock, metamorphic rocks may form instead. **2** L4–5 …when it cools and solidifies/…and so does lava/…such as granite, gabbro or basalt. **3** L5 …and forms rocks with small crystals/…when it is in contact with much cooler air or water/…and so does magma if it forms thin sheets between existing rocks/…but large bodies of magma often cool very slowly. **4** L5 … and this can form metamorphic rocks/…and rocks beneath the surface can also be very hot. **5** L4 …but metamorphic rocks often have layers of crystals/…and are made from interlocking crystals.
8Hb (Lit)	**1** and **2** L5 adjectives underlined, strong verbs in italics You think that only developing countries suffer from devastating landslides and flooding? Think again! Imagine being caught in a flood, but this flood *rushes* along at over 70 kilometres per hour and is a lethal mix of suffocating mud and death-dealing rocks. It would be like being buried in speeding concrete – if you didn't drown in the mud or get *battered* to death by the rocks, you would be buried alive. This concrete-like monster is what geologists call a lahar, and one could be *unleashed* at any time by Mount Rainier. The weakened slopes of this volcano are a disaster waiting to *pounce* on thousands of unwary residents of Washington State. Spring is a lovely season with melting snow and flowers beginning to bloom, but this is a more sinister season on this threatening mountain. Melting water from the snow cover *oozes* through the volcano and further weakens the already-fragile rocks. It would only take a small tremor to set off an annihilating landslide that would *engulf* towns and *destroy* or *entomb* buildings, animals and people. **3** L5 Possible answer: A lahar is a fast-moving mixture of mud and rocks that can destroy buildings and kill people. The slopes of Mount Rainier are weak, and the water from melting snow can weaken them further. A small tremor could set off a lahar that would endanger several towns in the area. **4** L6 Any two from: – information about how the facts were obtained – how likely it is that a lahar would happen – some balanced opinions about the disaster, such as how much warning people would get, whether they could be safely evacuated, whether there is a plan for managing a lahar, etc.

Quick Check	Answers
8Hc	**1** **a** L5 abrasion **b** L4 acid **c** L4 biological weathering **d** L5 chemical weathering **e** L5 erosion **f** L5 expand **g** L5 freeze–thaw **h** L4 physical weathering **i** L4 sediment **j** L5 transport **2** L4–5 Any sensible clues for the words.
8Hd	L4–5 Possible questions: **1** What is the name for the process that squeezes water from between the grains in sediments? What process comes before cementation when sedimentary rocks are being formed? **2** Describe the shape of the grains in conglomerate. Describe the shape of the grains in sediment that has been transported by water for a long time. **3** How do scientists know about extinct plants and animals? What is the name for the shapes of dead animals or plants preserved in rock? How can scientists work out how old sedimentary rocks are? **4** What is formed when limestone is metamorphosed? Name a rock often used for making statues. Name a metamorphic rock made from calcium carbonate. **5** What kinds of rock can be heated and/or squashed to make metamorphic rocks? What kind of rock can be melted to form magma? What kind of rock can be weathered and eroded to form sediments? **6** Name a rock that can easily be split into layers. What is formed when mudstone is heated and compressed? Name a rock that can be used to make roofs.
8Hd (WS)	L5–6 **A** – hypothesis; **K** supports, **G** disproves. **K** does not prove because there is no evidence that all of the stories in the Bible are factually correct. **M** – hypothesis; **I** would support (if true), **B** disproves. **I** does not prove (even if true) because there could be other explanations for this, and there might be examples of granite above other rocks in parts of the Earth that have not been explored. **D** – hypothesis; **E** would support (if true), **L** disproves. **E** does not prove (even if true) because there could be other explanations for this, and there may be examples of basalt below other rocks in parts ofs the Earth that have not been explored. **J** – hypothesis; **N** supports, **F** disproves (and is not correct). **N** does not prove as there may be older fossils with hard parts that have not been discovered. **H** – hypothesis; **O** supports, **C** disproves (and is not true, although it is possible there could be even older rocks with fossil fish and no birds). **O** does not prove as there may be older rocks with fossil birds that have not been discovered.
8He	L5–6 When rock grains are glued together – cementation; A metamorphic rock that can be easily split for roofing – slate; When rock grains are squashed together – compaction; A metamorphic rock formed from limestone or chalk – marble; This process breaks down rocks into smaller pieces – weathering; The process that carries pieces of rock from one place to another – transport; Rocks formed when magma turns to a solid – igneous; A way of reducing the amount of new metals that need to be mined – recycling; An igneous rock with large crystals – granite; A sedimentary rock containing calcium carbonate – limestone; An igneous rock with very small crystals – basalt; The process that drops sediments – deposition; A place where magma flows out of the Earth as lava – volcano; When a metal is found in the Earth as a pure element – native state; The chemicals that make up rocks – minerals; Hot, molten rocks within the Earth – magma; A sedimentary rock formed from very tiny particles of mud – mudstone; The process that forms magma from solid rock – melting; Rocks formed from layers of sediment – sedimentary; These shapes are often found in sedimentary rocks – fossils; A metamorphic rock formed from sandstone – quartzite; These will be formed in igneous rocks when magma cools slowly – large crystals; Type of rock formed from other rocks because of high temperature and pressure – metamorphic; A rock containing enough metal or metal compound to be worth mining – ore.

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1 Val found the mass of some rock samples and then put them in a bowl of water for half an hour. She took them out and dried them with a paper towel, and found their masses again. The table shows her results.

Rock sample	A	B	C
Mass at start (g)	400	425	300
Mass at end (g)	420	425	318
Difference in mass (g)	20	0	18
Difference in mass ÷ mass at start	0.05	0	0.06

a Explain how this information shows that rock B is a metamorphic or igneous rock.

_____

_____

[2 marks]

b Which rock had the biggest gaps between the grains? _____

Explain your answer.

_____

[1 mark]

c Explain why Val needed to find the difference in mass ÷ mass at start for each rock.

_____

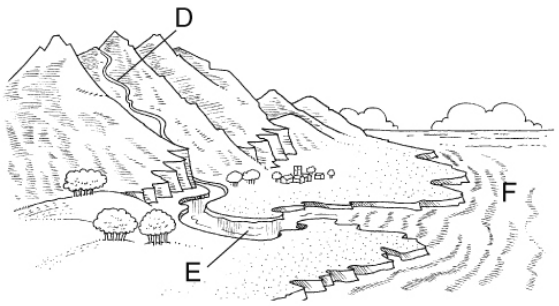
_____

[1 mark]

2 The bottom of this river is covered in rocks and stones.

a Draw a sketch of a piece of rock you might find at D and one you might find at F.

There should be *two* differences between your two drawings.



Rock from D **Rock from F**

[2 marks]

b Explain what caused the changes in the rocks.

_____

_____

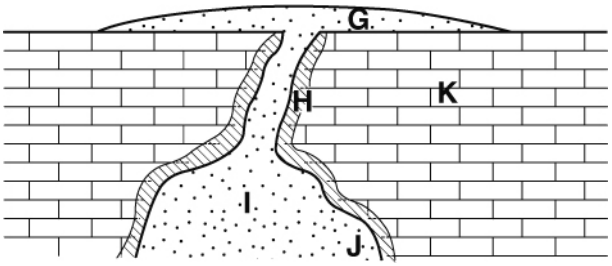
[1 mark]

3 We obtain some metals from the Earth by mining ores. Metals can also be recycled.

Describe *two* advantages of recycling metals.

[2 marks]

4 The rocks at G and I were formed when molten rock (liquid rock) cooled down.
The magma at I cooled down more slowly than the lava at G.



a Explain why the rocks at I have larger crystals than the rocks at G, using ideas about particles.

[3 marks]

b Is rock H sedimentary, igneous or metamorphic? _____

Explain your choice.

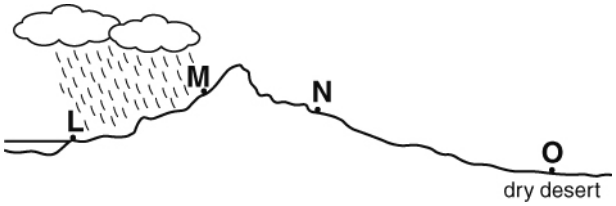
[1 mark]

c How will the texture of the rocks differ at I and J? Explain your answer.

[2 marks]

5 This diagram shows four places – L, M, N, and O. Each has different weather conditions.

Place	Average temperature (°C)	
	Day	Night
L	20	15
M	10	–5
N	10	0
O	30	10



a Why is freeze–thaw action most likely to happen at place M?

_____

_____

[2 marks]

b **i** Which type of weathering is most likely to happen at O?

_____

[1 mark]

ii Explain your answer.

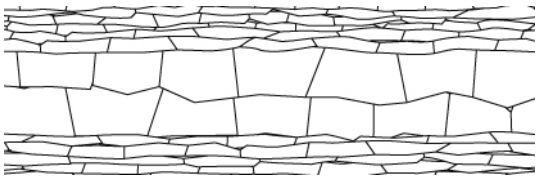
_____

_____

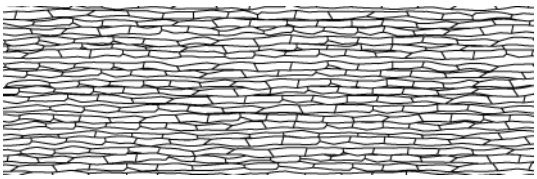
[1 mark]

6 The drawing shows the textures of two metamorphic rocks.

P



Q



Describe the differences in the conditions in which the two rocks were formed. Explain how you worked out your answer.

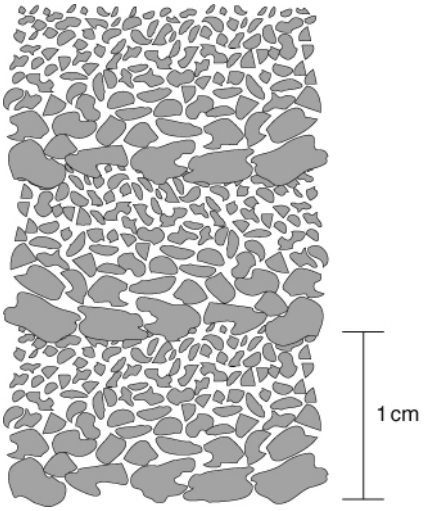
_____

_____

_____

[2 marks]

7 The drawing shows the sketch that a geologist made of the grains in part of a cliff face.



This is how she thinks the grains that made the rocks were deposited.

The grains were deposited over a number of years by a river that got most of its water every spring from melting snow. The sediments were deposited fairly close to the mountains from which they were eroded.

Explain how the evidence supports the geologist's explanation. One mark is for writing your answer in a sensible order using correct spelling and grammar.

[4 marks]

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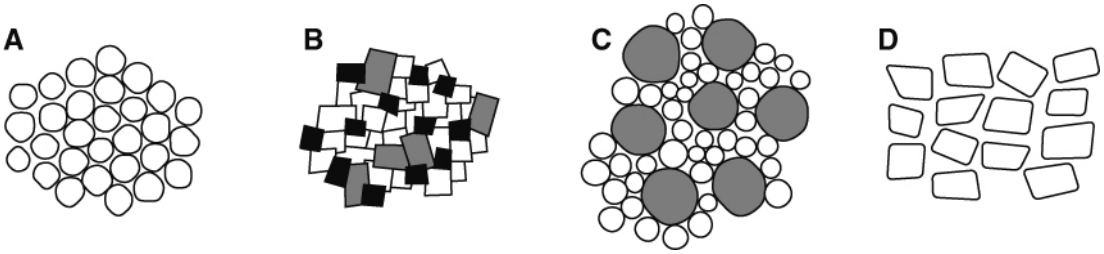
1 Rocks have different properties. Write down *two* ways in which the properties of two rocks may be different.

_____

[2 marks]

2 These diagrams show the textures of four different rocks



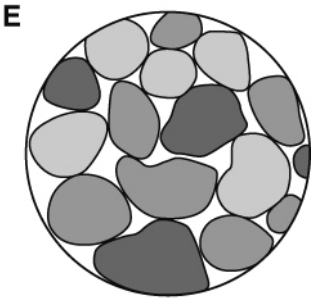
a Which diagram shows a mixture of three different minerals? _____

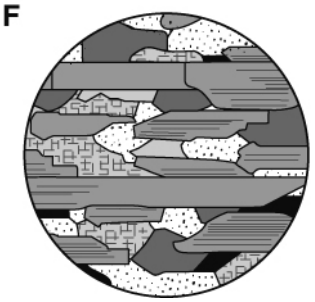
[1 mark]

b Which two rocks are made from rounded grains? _____

[1 mark]

3 The drawings show two different rocks. Rock **E** is a sedimentary rock and rock **F** is a metamorphic rock.





a Suggest the name of sedimentary rock **E**. _____

1 mark]

b Suggest the name of metamorphic rock **F**. _____

[1 mark]

c Write down *two* features of the texture of rock **F** that show it is a metamorphic rock.

_____

_____

[2 marks]

d Write down *two* ways in which the properties of rocks **E** and **F** will be different.

_____

_____

[2 marks]

4 Val found the mass of some rock samples. She then put them in a bowl of water for half an hour. She took them out and dried them with a paper towel, and found their masses again. The table shows her results.

Rock sample	**G**	**H**	**I**
Mass at start (g)	400	425	300
Mass at end (g)	420	425	318
Difference in mass (g)	20	0	18
Difference in mass ÷ mass at start			

a Work out the difference in mass ÷ mass at the start, and write your answers in the table.

[1 mark]

b Which rock was made of interlocking crystals? _____

Explain your answer.

_____

[1 mark]

c Which rock had the biggest gaps between the grains? _____

Explain your answer.

_____

[1 mark]

d Explain why you needed to find the difference in mass ÷ mass at start for each rock.

_____

_____

[1 mark]

5 We obtain many materials from the Earth.

a Some metals, like gold, are found in their 'native state'. What does this mean?

_____

[1 mark]

b Other metals are extracted from rocks. What is the name for a rock that is mined so that the metal can be extracted?

_____

[1 mark]

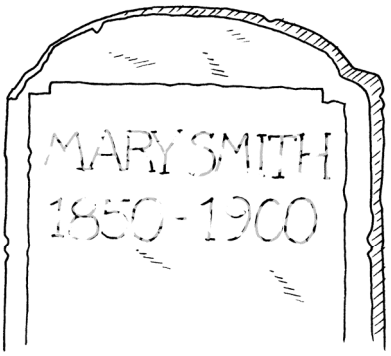
c Give *one* advantage of recycling metals.

_____

_____

[1 mark]

6 This gravestone has been standing for over 100 years. It is made from limestone. Rain has fallen on it, and chemical weathering has worn parts of it away.



a What makes all rain water acidic?

_____

_____

[1 mark]

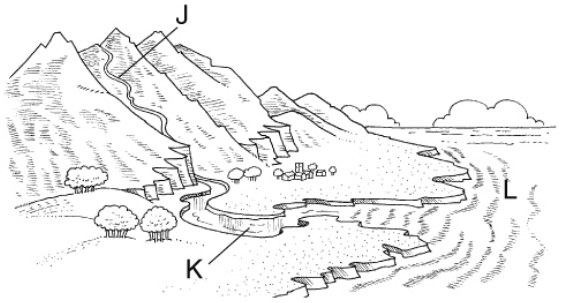
b What happens when rainwater weathers the gravestone?

_____

_____

[1 mark]

7 The bottom of this river is covered in rocks and stones.



a Draw a sketch of a piece of rock you might find at J and one you might find at L.

There should be *two* differences between your two drawings.

Rock from J **Rock from L**

[2 marks]

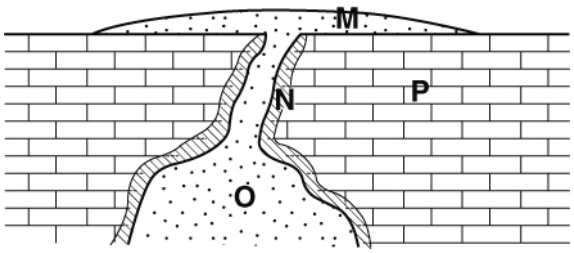
b Explain what caused the changes in the rocks.

_____

_____

[1 mark]

8 The rocks at M and O were formed when molten rock (liquid rock) cooled down. The magma at O cooled down more slowly than the lava at M.



a What evidence in the rocks at O would show that the magma cooled down slowly?

_____

_____

_____

[1 mark]

b Explain your answer to part a, using ideas about particles.

[2 marks]

c Is rock N sedimentary, igneous or metamorphic? _____

Explain your choice.

[1 mark]

9 This diagram shows four places – Q, R, S and T. Each has different weather conditions.

Place	Average temperature (°C)	
	Day	Night
Q	20	15
R	10	–5
S	10	0
T	30	10

a Why is freeze–thaw action most likely to happen at place R?

[2 marks]

b **i** Which type of weathering is most likely to happen at T?

[1 mark]

ii Explain your answer.

[1 mark]

WSI Assessment: Runny lava (Exploring 3 in Topic 8Hb)

Level	Planning	Obtaining	Presenting	Considering	Evaluating
Working towards Level 4	Students state an aim. They state a prediction without a reason. They decide on any simple method. They state a piece of apparatus that they will use (*e.g. 'I will use a ramp'*). They identify at least one appropriate control variable from a list of choices.	With help, or following the instructions on worksheet 8Hb-2, students make a limited number of observations (*e.g. record how far each jelly mixture moves*).	They record results in a simple table.	Students provide a simple description of what was found (*e.g. 'thicker jelly flows a shorter distance than runny jelly'*). They may use incorrect terminology.	Students make a simple statement as to how to improve the practical (*e.g. 'use the same amount of jelly for each test'*).
Level 4	Students make a prediction with a reason. They select appropriate apparatus (*e.g. ramp, different jelly mixtures, stopclock*). They decide on an appropriate approach including using a fair test to answer a question. They plan to change one variable and measure another. They write a method as a series of steps, including what they will look for (*e.g. decide to measure time it takes each jelly to run a certain distance on a ramp with a fixed slope*). They state one way in which they and/or others will remain safe.	Students use simple apparatus appropriately and follow instructions carefully. In fair tests, they vary one factor while keeping others the same (which may require some assistance) (*e.g. they use different jelly mixtures and keep other factors the same*). If questioned, they are able to state clearly the intervals between measurements and the range of measurements. Following instructions, they take action to control obvious risks to themselves.	Students plot simple bar charts where possible (*bar charts may have small errors, such as missing units, axes labels and slightly inappropriate scales. However, the bars should be plotted accurately, e.g. number of cubes of jelly vs. time taken to reach 15 cm down the slope*).	Students draw a straightforward conclusion and identify the evidence that they have used. They identify simple patterns in their data and relate their conclusions to those patterns (*e.g. 'thicker chemicals are more 'sticky' and don't move as easily, so they will not run as fast'*). They communicate their conclusions using appropriate scientific language (*e.g. use the word 'speed' correctly*).	Students suggest improvements in their work, giving simple reasons (*e.g. 'I should repeat experiment 1 because I spilt some of the jelly; I should use the same amount of jelly for each test to make this a fair test'*).

Level	Planning	Obtaining	Presenting	Considering	Evaluating
Level 5	Students state a prediction with a reason using scientific knowledge. They select appropriate apparatus and explain why it is appropriate and what it does. They state what they will look for and explain why they will look for these things (*e.g. they will see if there is a connection between the number of cubes of jelly used to make a mixture and the distance it travels down a ramp in a set time*). They plan a systematic approach, which includes the number and the overall range of measurements. (*e.g. they plan their own investigation, possibly with the help of Worksheet 8Hb-3; they plan to test at least five different jelly mixtures, and explain the need to keep slope, volume or mass of jelly and temperature of jelly the same*). They state some ways in which they will remain safe and how they will ensure others stay safe.	Students accurately record readings from scales. They identify when measurements should be repeated and carry out those repeats. They act on simple suggestions to control risks to others as well as themselves (*e.g. identify the need to mop up any spilled water*).	Students use more complex bar charts or scatter graphs to present data, as appropriate (*e.g. any simple bar charts will be accurately drawn with all the appropriate features. Or a scatter graph may be attempted, e.g. with jelly mass on the x-axis and time taken to travel 15 cm on the y-axis*).	They interpret numerical data and draw conclusions from them. They analyse findings to draw scientific conclusions that are consistent with the evidence (*e.g. 'the concentrated jelly is not as runny as the less-concentrated ones, so it takes longer to run a certain distance'*). They point out inconsistencies and anomalies in their data. They communicate these using scientific and mathematical language and conventions (*e.g. use terms such as 'volume' and 'concentrated' correctly*).	They evaluate their working methods to make practical suggestions for improvements backed up with scientific reasons (*e.g. suggest warming the ramp to the temperature of the jelly to reduce any effects due to cooling of the jelly while it is still flowing*).

Level	Planning	Obtaining	Presenting	Considering	Evaluating
Level 6	Students state a prediction with a reason using scientific knowledge. They explain their hypothesis, including the relationship between independent and dependent variables. Students identify an appropriate approach in investigatory work (*e.g. run preliminary trials with ramp and jelly to find the angle that gives a suitable spread of results, or to find an appropriate range of concentrations*). They explain how their chosen apparatus will allow them to collect data to appropriate degrees of accuracy and precision. They take account of some less obvious variables that need to be controlled. They state the number and range of measurements that they will make, justifying their choices. They identify hazards and describe how to reduce the risks from those hazards, both to themselves and to others.	They use methods to collect adequate data for the task, measuring with precision, using instruments with fine-scale divisions (*e.g. measure starting temperature of jelly and angle of ramp as well as the time*). They identify the need to repeat measurements and observations (*e.g. repeat results or compare results with those from other groups*). They recognise a range of familiar risks and take action to control them.	They record data and features effectively, choosing scales for graphs and diagrams (*e.g. choose scales for graph to allow graph to occupy majority of graph paper. Express concentration in units such as grams of jelly/volume of water, and draw an accurately plotted scatter graph*). They decide whether to include or ignore inconsistencies and anomalies in their charts and graphs, pointing these out where appropriate.	They analyse findings to draw conclusions that are consistent with the evidence and use scientific knowledge and understanding to explain them and account for any inconsistencies in the evidence (*e.g. 'I think that the jelly in the second experiment had too much water in it and this is what caused it to travel faster than I would have expected'*). They manipulate numerical data to make valid comparisons and draw valid conclusions (*e.g. calculate concentrations in g/cm^3 and use the measured distance and time to calculate speed*). They communicate qualitative and quantitative data effectively using scientific language and conventions (*e.g. calculate the speed of the different jellies, and use words such as 'viscous' correctly*).	They evaluate evidence, making reasoned suggestions about how their working methods could be improved (*e.g. 'I could measure how far the jelly went every second to see if the speed changed during the experiment'*). They discuss the usefulness of the jelly as a model for lava.

Level	Planning	Obtaining	Presenting	Considering	Evaluating
Level 7	Students plan appropriate approaches and procedures by synthesising information from a range of sources (*e.g. discuss the need to repeat readings to reduce inaccuracies and anomalies*). They identify key factors in complex contexts and in which variables cannot readily be controlled (*e.g. discuss the difficulty in keeping the jellies at constant temperature, and explain how cooling jelly might become more viscous*). They explain how their methods will allow them to account for potential sources of error that they have identified, so that they can collect good quality evidence.	They use methods to obtain reliable data, including making systematic observations and measurements with precision, using a range of apparatus (*e.g. they plan to repeat the experiment with a different slope to check that the jelly concentration has the same effect at different angles*). They recognise the need for, and carry out, a simple risk assessment.	Students record data in scatter graphs, using a curve of best fit.	Students analyse findings to draw conclusions that are consistent with the evidence (*e.g. 'there are more jelly particles in a certain volume of the more concentrated jelly, so the attraction between them makes the jelly more viscous and makes it flow more slowly'*). They use scientific knowledge and understanding to explain these conclusions (*e.g. 'the more viscous jellies take longer to flow, so they have more time to cool down during the experiment, which will make them even more viscous and slow-moving'*).	Students begin to consider whether the data they have collected are sufficient for the conclusions they have drawn (*e.g. comment on similarities and differences between jelly and lava, for instance that lava's viscosity is determined by its chemical composition, not on the concentration of a solution*).

Name _____ **Class** _____ **Date** _____

Draw a ring around a number of stars for each statement. If you are very confident about a statement, draw your ring around all the stars. If you do not know anything about a statement do not draw a ring.

Topic	At the end of the unit:	
8Ha		
	Recall some uses for rocks.	* * * * *
	State what minerals are.	* * * * *
	Describe the textures of some rocks.	* * * * *
	Explain why some rocks are porous.	* * * * *
	Relate features of a landscape to the wearing away of different rocks.	* * * * *
8Hb		
	Name some igneous rocks and describe how igneous rocks are formed.	* * * * *
	Explain how the crystal size in igneous rocks depends on cooling rate.	* * * * *
	Explain where you might find igneous rocks with small or large crystals.	* * * * *
	Name some metamorphic rocks and describe how metamorphic rocks are formed.	* * * * *
	Describe the textures and properties of igneous and metamorphic rocks.	* * * * *
8Hc		
	Explain how the three types of weathering break up rocks.	* * * * *
	Recall how weathered rocks are eroded and abraded.	* * * * *
	Explain why different rock fragment sizes are carried by water and wind.	* * * * *
8Hd		
	Describe the textures and properties of sedimentary rocks.	* * * * *
	Name some sedimentary rocks and describe how sedimentary rocks and fossils are formed.	* * * * *
	Use the rock cycle model to link the formation of different types of rock.	* * * * *
8Hd WS		
	Describe how the scientific method is used for sciences such as geology.	* * * * *
8He		
	Recall that some metals are found in their native states.	* * * * *
	Recall how metals are extracted from ores taken from the Earth's crust.	* * * * *
	Explain the advantages of recycling metals.	* * * * *
	Describe some of the environmental effects of mining.	* * * * *

What could you do to improve? _____

_____

Copy these sentences and complete them using one of the linking words or phrases in the box.

Write more than one ending for each sentence if you can.

and	because	but	however	so	such as
	therefore	to	when	which	

1 Rocks in the Earth can get hot enough to melt …

2 Magma forms igneous rocks …

3 Lava cools quickly …

4 Movements within the Earth can squeeze rocks …

5 Igneous rocks do not have layers …

EXPLORING SCIENCE WORKING SCIENTIFICALLY 8Hb Quick Check

Copy these sentences and complete them using one of the linking words or phrases in the box.

Write more than one ending for each sentence if you can.

and	because	but	however	so	such as
	therefore	to	when	which	

1 Rocks in the Earth can get hot enough to melt …

2 Magma forms igneous rocks …

3 Lava cools quickly …

4 Movements within the Earth can squeeze rocks …

5 Igneous rocks do not have layers …

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Name _____ **Class** _____ **Date** _____

Read the newspaper article below.

Washington News

Are you prepared??

You think that only developing countries suffer from devastating landslides and flooding? Think again!

Imagine being caught in a flood, but this flood rushes along at over 70 kilometres per hour and is a lethal mix of suffocating mud and death-dealing rocks. It would be like being buried in speeding concrete – if you didn't drown in the mud or get battered to death by the rocks, you would be buried alive.

This concrete-like monster is what geologists call a lahar, and one could be unleashed at any time by Mount Rainier. The weakened slopes of this volcano are a disaster waiting to pounce on the residents of thousands of unwary residents of Washington State. Spring is a lovely season with melting snow and flowers beginning to bloom, but the season is more sinister on this threatening mountain. Melting water from the snow cover oozes through the volcano and further weakens the already fragile rocks. It would only take a small tremor to set off an annihilating landslide that would engulf towns and destroy or entomb buildings, animals and people.

1 Use a red pencil to underline all the emotive adjectives used.

2 Use a blue pencil to underline all the strong verbs.

3 Rewrite the article in three sentences using unemotive language and to achieve a plain, factual style.

_____

_____

_____

_____

_____

4 Write down two more things that would be needed to make this into a trustworthy report.

_____

_____

_____

On your answer sheet, write in or circle the correct letter for each question.

8Ha

1 A mineral is:

A another name for a rock.

B a chemical compound found in rocks.

C a hard piece of material.

D a type of salt.

2 In science, the texture of a rock is:

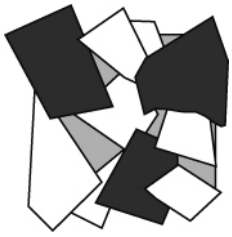
A the way it feels.

B whether it is hard or crumbly.

C its colour.

D the size and shape of the grains.

3 Which statement describes this rock?



A rounded grains of three different minerals

B interlocking grains of two different minerals

C interlocking crystals of three different minerals

D rounded grains with gaps between them

4 Some rocks are permeable because:

A the rock dissolves in water.

B water can get into gaps between the grains.

C animals have dug burrows in the rock.

D the rock is made of interlocking crystals.

8Hb

1 Igneous rocks are formed when:

A magma or lava is put under pressure.

B magma or lava cools down.

C magma or lava is heated up.

D magma or lava evaporates.

2 When an igneous rock is forming:

A large crystals will form if the magma heats up quickly.

B small crystals will form if the magma cools slowly.

C large crystals will form if the magma cools slowly.

D small crystals will form if the magma evaporates quickly.

3 According to the particle theory, large crystals will form if:

A lots of particles have time to bond together into a regular pattern before the liquid cools.

B the particles are kept as far apart as possible.

C the particles have time to collect together before they melt.

D the particles cool quickly and don't have time to move apart.

4 Metamorphic rocks are formed by the effects of:

A high pressures or low temperatures.

B high pressures or high temperatures.

C low pressures or high temperatures.

D low pressures or low temperatures.

8Hc

1 Physical weathering happens to rocks when:

A the weather is always hot.

B the weather keeps changing between hot and cold.

C the weather is always cold.

D the rock gets struck by lightning.

2 Freeze–thaw action damages rocks because:

A the rocks melt.

B the rocks freeze.

C water expands when it thaws.

D water expands when it freezes.

3 Which of these statements is true?

A Chemical weathering always involves water.

B Physical weathering always involves water.

C Chemical weathering depends on temperature changes.

D Biological weathering happens because rain water is slightly acidic.

4 Which statement is true?

A Ice can transport only small rocks.

B Wind can transport larger particles than water.

C The slower water is moving, the larger the particles it can carry.

D Water can transport larger particles than wind.

8Hd

1 Which is the best statement to complete this sentence?

Sedimentary rocks are formed when:

A sediments are compacted and then cemented.

B sediments are cemented and then compacted.

C sediments are buried and compacted.

D rocks are weathered and eroded.

2 Fossils are usually:

A skeletons of animals.

B different layers of sediment.

C very old animals.

D the shapes of dead animals or plants that were buried in sediments.

3 Which statement describes some of the ways in which metamorphic rocks are different from sedimentary rocks?

A Metamorphic rocks do not contain crystals and are very porous.

B Metamorphic rocks are softer, more porous and have large grains.

C Metamorphic rocks may be harder, less porous and have crystals that may be lined up.

D Metamorphic rocks are softer, less porous and may contain clear fossils.

4 These statements are about the rock cycle. Which one is correct?

A Any of the three types of rock can change into any of the other types.

B All the processes in the rock cycle happen very slowly.

C The rock cycle only describes how rocks are worn away.

D The rock cycle only describes what happens to molten rock.

8He

1 Which is the best description of an ore?

A a mineral that contains a metal.

B a rock that contains minerals.

C a rock that contains enough of a valuable mineral to make it worth extracting.

D a mineral that contains iron.

2 How do we obtain metals such as iron?

A They are extracted from their ores using chemical reactions.

B They are extracted from their ores using physical methods.

C They are found in rocks in their native state.

D They are made from other metals.

3 Which statement about mining is *not* true?

A Mines can cause pollution to water supplies.

B Mining is cheaper if steps are taken to control pollution.

C Digging a mine leads to destroying habitats.

D Mines can cause noise and dust.

4 Which statement describes an advantage of recycling metals?

A It will make our supplies of metal ores last longer.

B It increases the energy needed to produce metals.

C It increases the amount of material sent to landfill sites.

D It costs money to collect and sort scrap metals.

Quick Quiz Answer Sheet

Name _____ **Class** _____ **Date** _____

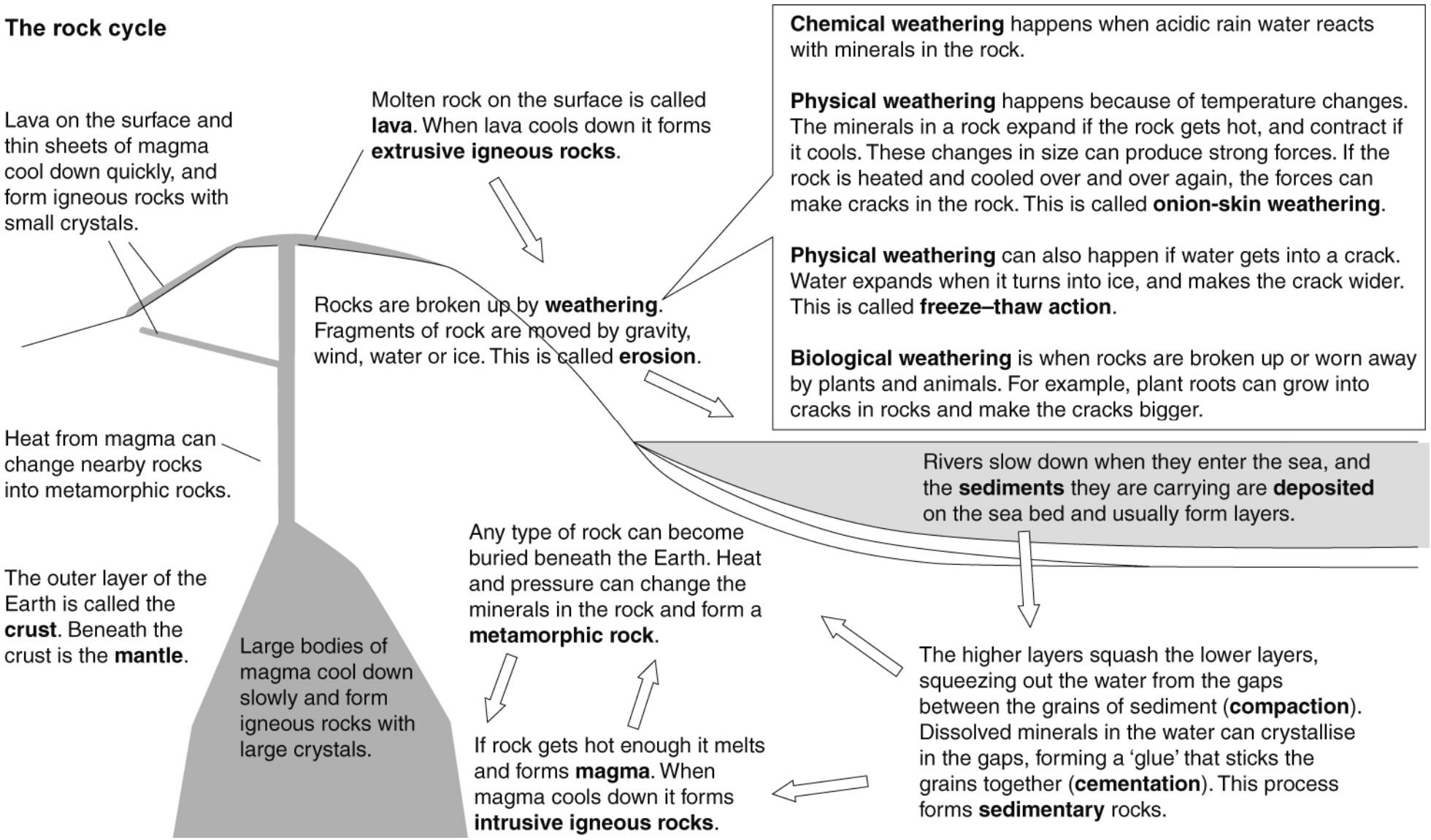
The Quick Quiz is to see how much you already know about a subject. It also gives you some idea of the things you will soon be learning about. Record your answers in the answers column. Shade in or tick the ones you get right.

Topic		Answers	I can already…
8Ha	**1**		Describe what minerals are.
	2		Explain what 'texture' means.
	3		Describe the textures of different rocks.
	4		Explain why some rocks are permeable.
8Hb	**1**		Describe how igneous rocks are formed.
	2		Explain why igneous rocks can have different sized crystals.
	3		Use the particle theory to explain the different sizes of crystals in igneous rocks.
	4		Describe how metamorphic rocks are formed.
8Hc	**1**		Recall the conditions under which physical weathering happens.
	2		Describe how freeze–thaw action can weather rock.
	3		Explain the different kinds of weathering.
	4		Describe the particle sizes that can be transported by wind, water and ice.
8Hd	**1**		Explain how sedimentary rocks are formed.
	2		Explain what fossils are.
	3		Describe how metamorphic rocks are different from sedimentary rocks.
	4		Describe the rock cycle and the different processes by which rocks are formed.
8He	**1**		Explain what an ore is.
	2		Describe how we get metals from the earth.
	3		Recall some effects of mining on the environment.
	4		Explain the advantages of recycling metals.

Quick Quiz:	**/20**	At the start: 0–5 = I didn't know much; 6–10 = I knew something; 11–15 = I knew a fair bit; 16–20 = I already knew a lot

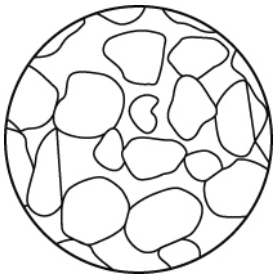
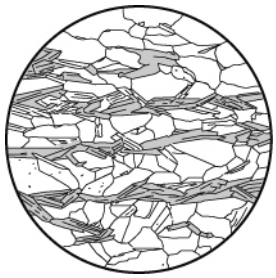
Rocks

The rock cycle



Rock textures

Rocks are made of **grains**. Each grain is made of a naturally occurring compound called a **mineral**. The **texture** of a rock is a description of the size and shape of the grains.

Type of rock	Sedimentary	Igneous	Metamorphic
Examples	limestone, sandstone, mudstone, chalk	basalt, gabbro, granite	marble, quartzite, slate, schist, gneiss
Grains or crystals?	separate grains	interlocking crystals that are not lined up	interlocking crystals, often lined up in bands of different colours
Hard or soft?	often soft or crumbly	hard	hard
Porous?	often	not usually	not usually
Example of texture			

Fossils

Fossils can form when dead plants or animals fall to the bottom of the sea. If their remains get covered by other sediments they do not rot. As the sediments turn into sedimentary rock, the shape of the organism is preserved in the rock. When a dead organism forms a fossil, its form can still be seen because its hard parts have been turned into stone.

Materials from the Earth

Many of the materials we use are obtained from the Earth. We use stone for building. **Cement** is made from **limestone**, and **concrete** is made by mixing cement, sand and **gravel** with water.

We also obtain metals from the Earth. Unreactive metals like gold and silver are found in their **native states**. Other metals are found as parts of minerals. An **ore** is a rock with enough of a particular mineral in it to make it worth mining. Pure metals are obtained from minerals using chemical reactions.

Mining for metals can destroy habitats and cause pollution.

If we **recycle** metals we will:

- make supplies of metals last longer
- reduce amounts of mining (and so reduce the pollution and environmental damage this causes)
- reduce pollution caused by putting metals in landfill sites.

8Ha – Disaster!

Word	Pronunciation	Meaning
eruption		When lava or ash comes out of a volcano.
volcano		A mountain that shoots out molten rock.

8Ha – Rocks and their uses

Word	Pronunciation	Meaning
cement		A building material made using limestone and other materials. It also means 'to stick things together'.
compound		A substance that can be split up into simpler substances, since it contains the atoms of two or more elements joined together.
concrete		A building material made by mixing sand, cement and gravel with water.
crystal	***kris**-tal*	A grain in a rock that interlocks with other grains.
earthquake		When the ground shakes.
gabbro		A type of igneous rock with large crystals.
geologist		A scientist who studies rocks and the Earth.
grain		A distinct part of a rock, made of one or more minerals.
granite	***gran**-it*	A type of igneous rock with large crystals.
gravel		Small pieces of rock used in building.
interlocking		When crystals fit together with no gaps between them.
limestone		A sedimentary rock made from the shells of dead sea creatures. It consists mainly of calcium carbonate.
mineral (chemistry)		A naturally occurring mineral or compound that can form distinct grains in rocks.
mixture		Two or more substances jumbled together but not joined to each other. The substances in mixtures can often be separated from each other.
permeable		Permeable rocks let water soak through them.
porous		Porous rocks have tiny holes in them.
quartz	*kwartz*	The mineral that forms the grains in sandstone.
rock		A naturally occurring substance made of one or more minerals.
sandstone		A sedimentary rock made out of grains of quartz.
sinkhole		A large hole in the ground caused by limestone dissolving. Sinkholes can sometimes form in other types of rock as well.
texture		The scientific word used to describe the shapes and sizes of grains in a rock and how the grains are packed together.

8Hb – Igneous and metamorphic rocks

Word	Pronunciation	Meaning
basalt	***bas**-salt*	An igneous rock with very tiny crystals.
bond		A force that holds some atoms tightly together.
crust		The solid rocks at the surface of the Earth.
extrusive		Igneous rocks formed when lava freezes above the ground.
gneiss	***nice***	A metamorphic rock formed when schist is heated and squashed more. It usually has bands of different coloured minerals.
igneous rock	***igg**-nee-us*	Rock made from interlocking crystals that are not in layers. Formed when magma or lava cooled down and solidified.
intrusive		Igneous rocks formed when magma freezes underground.
lava	***lar**-va*	Molten rock that runs out of volcanoes.
magma		Molten rock beneath the surface of the Earth.
mantle	***man**-tel*	The part of the Earth below the crust.
metamorphic rock	*met-a-**mor**-fik*	A rock formed from interlocking crystals that are often lined up in layers. It is formed when existing rocks are heated or compressed.
particles	***part**-ick-als*	The tiny pieces of matter that everything is made out of.
schist	*shist*	A metamorphic rock formed when slate or other rocks are heated and squashed more. It is usually shiny with flat crystals in wavy layers.

8Hc – Weathering and erosion

Word	Pronunciation	Meaning
abrasion	*a-**bray**-shun*	When rock fragments bump into each other and wear away.
biological weathering		When rocks are worn away or broken up due to the activities of living things. For example, growing plant roots can split rocks apart.
chemical weathering		When rocks are broken up or worn away by chemical reactions, usually with rainwater.
contract		Get smaller.
erosion	*eh-**ro**-shun*	The movement of loose and weathered rock.
expand		Get bigger.
freeze–thaw		A type of physical weathering that happens when water gets into a crack in a rock and freezes. The freezing water expands and makes the crack bigger.
glacier		Ice that fills a valley and moves slowly downhill.
landslide		Sudden movement of rocks and/or soil downwards.
onion-skin weathering		A type of physical weathering that happens when a rock is heated and cooled over and over again.
physical change	***fiz**-zi-kal*	A change in which no new substances are formed (e.g. changes of state).

Word	Pronunciation	Meaning
physical weathering		When rocks are worn away or broken up by physical processes such as changes in temperature.
sediment		Rock grains and fragments dropped by moving air or water.
transport		The movement of rock grains and fragments by wind, water or ice.
weathering		When rocks are broken up by physical, chemical or biological processes.

8Hd – Sedimentary rocks

Word	Pronunciation	Meaning
cementation	*sem-en-**tay**-shun*	A process in which water is squeezed out of the spaces between pieces of rock, leaving mineral salts behind that stick or cement the rock pieces together.
compaction		When layers of sediment or rock are squashed by the weight of sediment above them.
deposit		When moving wind, water or ice drops rock fragments or grains.
fossil		The remains of a dead animal or plant that became trapped in layers of sediment and turned into rock.
marble		A metamorphic rock formed from limestone.
mudstone		A sedimentary rock made of tiny particles
rock cycle		All the processes that form sedimentary, igneous and metamorphic rocks linked together.
sedimentary rock		A rock formed from grains stuck together. The grains are often rounded.
slate		A metamorphic rock with tiny crystals that are lined up. It is formed from mudstone, and can be split into layers.

8Hd WS – The scientific method in geology

Word	Pronunciation	Meaning
scientific method		Any way of testing that involves collecting information in order to show whether an idea is right or wrong. This is often done by developing a hypothesis that is tested by using it to make a prediction. The prediction is then tested using experiments.

8He – Materials from the Earth

Word	Pronunciation	Meaning
mining		Obtaining metal ores or other substances from the Earth.
native state		When a metal is found in the Earth as an element.
ore		A rock that contains enough of a certain mineral or metal to make it worth mining.
recycling		Using a material again, often by melting it and using it to make new objects.
toxic		A toxic substance is poisonous.