Chapter 2: Rocks and minerals

2.1 Rocks have different properties

Student book answers (pages 18–19)

Check your learning 2.1

Remember and understand

1 Use Table 2.1 and Figure 2.6 to name these rocks.

a I am light in colour with a fine grain. I am considered soft.

Limestone or pumice

b I am light in colour with holes in the surface.

Pumice

c I am soft, shiny and dark in colour. I am often used for flooring.

Slate

d I have mixed grains and my colour can vary.

Conglomerate

2 What properties are used to identify different types of rocks?

Colour, crystal or grain size, layers, weight and density

3 Name two different uses for different types of rocks.

Student answers will vary.

4 Why must properties other than colour be used to identify a rock?

Colour is not a reliable guide for identifying minerals because many minerals are impure, causing a colour change.

5 What branch of science is the study of rocks?

Geology

Apply and analyse

6 Pumice has a density of 0.6. Water has a density of 1. Would you expect the pumice stone to float or sink? Explain your reasoning.

A pumice stone would float in water because it has a lower density (0.6 g/mL) than water (1.0 g/mL).

2.2 Rocks are made up of minerals

Student book answers (pages 20–21)

Check your learning 2.2

Remember and understand

1 Define:

a hardness

How easily a mineral can be scratched

b lustre

Shininess of the surface of the mineral

c streak

Colour of the powdered or crushed mineral

d cleavage

Tendency of a mineral to break into a number of smooth planes

2 What does it mean if a mineral has a hardness of 1 on the Mohs scale?

A hardness of 1 indicates the mineral is very soft.

3 Name a mineral that has a Mohs hardness of 10.

Diamond

4 How would you describe the lustre of gold?

Metallic

Apply and analyse

5 Obsidian has a hardness of 6 on the Mohs scale and was prized by ancient peoples for its sharp edge. Describe what type of minerals would damage the sharp edge of an obsidian blade.

Minerals with a hardness of greater than 6 would damage obsidian. These include quartz, topaz, corundum and diamond.

2.3 Minerals are a valuable resource

Student book answers (pages 22–23)

Check your learning 2.3

Remember and understand

1 What is a mineral?

A mineral is a naturally occurring solid substance with its own chemical composition, structure and properties.

2 What is an ore?

An ore is a mineral with a large amount of useful metal in it.

3 Name two uses of copper.

Any two of the following: pipes, electrical cables, saucepans, radiators, decorative uses (jewellery, on buildings), doorknobs, coins etc.

4 What are five of Australia’s most important minerals?

Any five of the following: lead, bauxite, alumina, diamonds, ilmenite, rutile, zircon, tantalum, uranium, zinc, nickel, iron ore, lignite, silver, manganese, gold, black coal, copper, aluminium

Apply and analyse

5 Use the graph in Figure 2.15 to describe how the global demand for copper will change after 2042. Suggest a reason for this change in demand.

After 2042 the demand for copper will still be increasing but at a lower rate than between 2012 and 2042. This may be because plastic pipes are more commonly used that copper pipes, which will reduce the amount of copper used. The recycling of copper is also becoming more common.

2.4 Igneous rocks develop from magma and lava

Student book answers (pages 24–25)

Check your learning 2.4

Remember and understand

1 What does the term ‘igneous’ mean?

Igneous comes from the Latin word *ignis*, meaning ‘fire’.

2 How do igneous rocks form?

Cooling magma and lava from volcanic eruptions solidify to form igneous rocks.

3 What type of rock is produced by magma that cools deep below the Earth’s crust?

Intrusive igneous rocks form below the Earth’s surface.

4 Name an igneous rock that would float on water.

Pumice

Apply and analyse

5 The ancient civilisations that discovered obsidian had a competitive advantage over those who didn’t. Explain why.

Obsidian can be used to make blades that are much sharper than those made from steel.

2.5 Sedimentary rocks are compacted sediments

Student book answers (pages 26–27)

Check your learning 2.5

Remember and understand

1 How do sedimentary rocks form?

Sedimentary rocks are formed when loose particles are compacted by the weight of the overlying sediments.

2 How do stalactites and stalagmites form?

Stalagmites and stalactites form when limestone rocks are dissolved by acids in water. The acid and dissolved limestone form a solution that drips through the ceiling of the cave and is deposited.

3 How do chemical sedimentary rocks form?

Chemical sedimentary rocks form when water evaporates, leaving behind a solid substance. If the layer of solid substance is compressed under the pressure of other sediments, it may eventually form rock.

Apply and analyse

4 A student claims that sandstone is made up of sand. Do you agree or disagree? Explain.

Agree. The sand was laid down as sediment, which was compacted by the weight of the overlying sediments and eventually turned into sandstone rock.

5 What do plants have to do with coal?

Coal is formed from dead plants that were buried before they had completely decayed. Pressure from the layers above can change the plant material into the rock we know as coal.

2.6 Metamorphic rocks require heat and pressure

Student book answers (pages 28–29)

Check your learning 2.6

Remember and understand

1How do metamorphic rocks form?

Metamorphic rocks form when other types of rocks are changed by heat and pressure.

2 Where do metamorphic rocks form?

Metamorphic rocks form deep within the Earth.

3 A student claimed that a rock had to be igneous because it had quartz crystals. Are they correct? Explain.

No they are not correct because some minerals, such as quartz, can withstand the high temperatures and pressures and can sometimes be found in metamorphic rocks.

4 Describe a foliated rock.

Foliated metamorphic rocks have twisted bands or layers.

Apply and analyse

5 Which type of rock is stronger: sandstone or marble? Explain your reasoning.

Student answers will vary. Typically, marble is soft because it is used in sculptures and must be able to be carved. Sandstone is used in buildings, so it must be hard.

2.7 The rock cycle causes rocks to be re-formed

Student book answers (pages 30–31)

Check your learning 2.7

Remember and understand

1 Describe the different stages in the rock cycle. Use the rock cycle diagram in Figure 2.30 to assist you.

The different stages of the rock cycle are as follows:

• layers form by the deposition of particles and the layers are compacted by pressure from overlying layers to form sedimentary rocks

• heat and pressure transform sedimentary and igneous rocks into metamorphic rocks

• if too much heat or pressure is applied, the rocks melt and form magma

• magma and lava cool and solidify to form igneous rocks

• rocks brought to the surface of the Earth are weathered and particles are transported and deposited.

Apply and analyse

2 Write a creative story of the ‘life of a rock’. Rocks change with time, as do humans. However, unlike humans, rocks are never truly ‘born’, nor do they ‘die’ – they can move through the rock cycle, covering the same stage many times in many different ways. What life does your rock experience?

Student answers will vary.

2.8 Science as a human endeavour: Weathering and erosion can be prevented

Student book answers (pages 32–33)

Extend your understanding 2.8

1 What is the difference between weathering and erosion?

Weathering is the breaking down of rocks and minerals through the movement of water and animals and the extremes of temperature. Erosion is the movement of the sediment to another area.

2 Name two ways erosion can affect food production.

Flooding and mudslides

3 What does a soil engineer do?

A soil engineer works to solve the problems caused by soil erosion.

4 How could an engineer prevent erosion of soil by water?

Student answers will vary. Typically, an engineer could be involved in the building of dams and levees, groynes, terraces, new products that allow water to move through them etc.

5 Find an area near your school that has been affected by erosion. Suggest a way that you could prevent further erosion.

Student answers will vary.

2.9 Science as a human endeavour: Rocks are studied by geologists

Student book answers (pages 34–35)

Extend your understanding 2.9

1 What are fossils?

Fossils are the remains (or imprints) of animals or plants preserved in rock.

2 How are fossils formed?

If an organism dies near water, it has a greater chance of being covered by sediment. Over millions of years, more sediment is deposited and the remains of the organism are gradually transformed into sedimentary rock.

3 What can fossils show us or tell us about the Earth’s history?

Fossils can provide evidence of past life, including how animals lived, what they ate and the environment they lived in.

4 What are the geologists who study fossils called and what sorts of things do they do as part of their job?

Geologists who study fossils are called palaeontologists. As part of their job they search for remains of plants and animals and conserve the sites where they are found, collect specimens noting how and where they are found, make copies of the fossil remains to preserve the original pieces, reconstruct the plant or animal from the pieces of animals, make inferences about what the environment was like and how living organisms were adapted to living in the environment and compare reconstructed organisms with specimens from other places so a more complete history of life on Earth can be obtained.

5 How do scientists find out how old a rock is?

Radioactive dating

Review 2

Student book answers (pages 36–37)

Remember and understand

1 Copy and complete the following sentences.

a An \_\_\_\_\_\_ is a mineral with a large amount of useful metal in it.

Ore

b \_\_\_\_\_ rocks are formed when loose particles are pressed together by the weight of overlying sediments.

Sedimentary

c \_\_\_\_\_\_ rocks are formed when other types of rocks are changed by heat and pressure inside the Earth.

Metamorphic

d \_\_\_\_\_\_ rocks form when magma and lava from volcanic eruptions cool and solidify.

Igneous

2 Define:

a lustre

Lustre is the shininess of the surface of the mineral.

b streak

Streak is the colour of the powdered or crushed mineral.

c hardness.

Hardness is how easily a mineral can be scratched.

3 What is the difference between magma and lava?

Magma is the hot molten rock inside the Earth. Lava is the flow of magma on the Earth in a volcanic eruption.

4 How do geologists identify minerals?

Geologists identify minerals by how they look. This includes properties such as grain size, hardness, lustre, density, streak, the shape of the crystals and the usual colour.

5 Why is colour not a reliable guide for identifying minerals?

Colour is not a reliable guide for identifying minerals because many minerals are impure, causing a colour change.

6 What properties of gold made it valuable to early civilisations, such as the Incas of South America?

The properties of gold that made it so valuable to early civilisations include its lustre, density, colour, chemical stability and ease of use.

7 How would you tell the difference between intrusive and extrusive igneous rocks?

Intrusive igneous rocks form slowly beneath the Earth when magma becomes trapped in small pockets. Because the cooling process takes a long time, the crystals in these rocks are relatively large. Extrusive igneous rocks are formed when lava cools quickly on the Earth’s surface. Because of the speed of cooling, only small crystals can be formed. Some extrusive igneous rocks cool too quickly for crystals to form.

8 Cave systems in limestone rock follow the course of underground rivers. Why is water necessary to form caves?

Water is necessary to form caves because the pressure of the water erodes the rock over long periods of time.

9 Explain why only simple fossils are found in the oldest types of rocks, whereas younger rocks have fossils of mammals.

Only simple fossils are found in the older rocks because mammals and higher-order life forms didn’t exist until more recent times in Earth’s history. Hence, fossils of mammals would only be found in younger rocks.

10 Design a flow chart of how fossils are formed.

Student answers will vary. Figure 2.45 on page 35 shows some of the steps.

Apply and analyse

11 Why do sedimentary rocks form at the Earth’s surface?

Sedimentary rocks form at the Earth’s surface because they rely on the deposition of sediment, which is usually done by flowing water.

12 Why does pumice have no crystal structure even though it is a rock?

Pumice has no crystal structure because the cooling process occurs too quickly for crystals to form.

13 Explain the difference between weathering and erosion.

Weathering is the breaking down of rocks and minerals through the movement of water and animals and the extremes of temperature. Erosion is the movement of the sediment to another area.

Evaluate and create

14 If you were a palaeontologist searching for fossils, which types of rocks would you look for? Explain.

Palaeontologists look for fossils in sedimentary rocks because fossils are usually only formed when sediments cover them and sedimentary rocks are made from sediments.

15 A kitchen scourer can be used to clean stainless steel cutlery, but this type of scourer should not be used to clean silver-plated cutlery. Explain why.

A kitchen scourer can be used to clean stainless steel cutlery because it doesn’t scratch it (it is softer than stainless steel); however, it is harder than silver-plated cutlery and so will scratch it.

16 Explain a way to remember which way stalactites and stalagmites grow.

One way to remember the difference between stalactites and stalagmites is that stalac*tites* hang on *tight* and so they are the ones that hang down from the ceiling.

17 Why should we recycle minerals? What minerals can be recycled? What forms can they be used in once they have been recycled?

We need to recycle minerals to reduce the cost to the environment. Minerals that can be recycled include aluminium, gold, silver, platinum, copper, nickel and chromium. These minerals have a range of uses once recycled, such as in building products and jewellery.

18 Some famous works of art are made of marble. What are the properties of marble that make it ideal for sculpture? What are some of the properties of marble that may not make it appropriate for all works of art?

Marble is relatively soft, making it easy to work with, and the intertwined mineral crystalline structure also makes it less likely to fracture when struck with a tool. Marble can also be polished and has a translucency that gives it a pleasing appearance. However, it is not suitable for all works of art because of its heavy weight.

Critical and creative thinking

19 Some people say that Australia is a huge quarry. This is because Australia mines so many minerals and sells them. Working on your own, list the advantages and disadvantages of mining and selling minerals. Join with a classmate and combine your lists. Then join with another group and prepare another list containing the three best reasons for mining and the three best reasons against mining.

Student answers will vary. Typically, advantages include economic benefits, generating employment, extracting useful elements etc. Disadvantages include environmental damage, cost, dangerous activities etc.

20 Look at Figure 2.48, which shows the Twelve Apostles. Use this image to describe how these rocks were formed. Prepare a poster to show how the rocks were formed and would have changed over time. How will they look in 1000 years’ time?

Student answers will vary. Typically, the Twelve Apostles were formed by water erosion of the rock to form caves in the cliffs. With further erosion the caves became arches that collapsed, leaving the rock stacks still standing. The current stacks are susceptible to further erosion from the wave motion and the stacks continue to collapse as time passes.

21 Imagine you are a geologist who is going to discover minerals in a remote part of Australia. You will need to take a test kit to help you identify the minerals you find. What items should go into your kit to allow you to test for streak, hardness and so on?

Student answers will vary. Typically, items needed to identify minerals include common objects of known hardness to test the hardness of minerals, sandpaper or a ceramic plate to test streak, an identification key for comparison against known minerals, a rock hammer, hand lens, notebook and pen to record information and label samples, tape measure or ruler, bags to carry samples etc.