Rocks and minerals

2.1 Rocks have different properties

Teacher notes (pages 18–19)

Introducing the chapter

This topic looks at the properties of rocks. It helps students identify a variety of common rocks according to properties such as grain size, hardness, colour and density. Earth is subject to change within and on its surface over a range of time scales as a result of natural processes and human use of resources. Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within the Earth over time.

Teaching tips: Field trip

A field trip to an area that has a rich geology or geological history is recommended. Students can observe firsthand different types of rocks and geological formations, and apply their understanding in a practical sense.

Teaching tips: Classification

Students should be given an opportunity to view the minerals listed in the student book on page 19 to help them form an understanding of how minerals differ in terms of particle size, hardness and lustre. If a rock kit is not an option, there are many images of each mineral available online. An alternative is for students to research one or more of the minerals and present their findings to the class.

Additional activity: Common misconceptions

Discuss some common misconceptions about rocks. These are some examples:

• ‘All rocks are the same, and it’s hard to tell how they originated’. (Rocks differ depending on how, when and where they were made.)

• ‘Humans can fabricate rocks and minerals.’ (Rocks and minerals are naturally occurring and are usually crystalline and solid).

• ‘Rocks must be heavy.’ (Not all rocks are heavy.)

• ‘Pebbles and stones are thought of as “not rocks”.’ (Pebbles and stones are rocks.)

• ‘Rocks and minerals are the same thing; distinguishing them is not important.’ (Minerals are the building blocks of rocks.)

Additional activity: Everyday uses

Students could identify where we use some of the minerals listed in the student book on page 19. Examples include buildings (sandstone), bench tops (marble) and flooring (slate).

Teaching tips: Checking knowledge

Many students are likely to have come from primary school with some concept of the rock cycle and the different types of rocks. An informal pre-test would be ideal to determine those students who may need extra help, or those who already have a good understanding and require extension work. General discussion about each main heading in the sections, as well as discussion about the images presented throughout, will assist you to determine prior knowledge in an informal way. These discussions are also likely to provide students with an idea of where the chapter is going. There are some amazing images of rocks and minerals available. Encourage students to find these images and perhaps decorate the classroom with them.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**Rock identification**  
This website contains information about 12 rock types, which students can try to name from a key.

2.2 Rocks are made up of minerals

Teacher notes (pages 20–21)

Introducing the topic

This topic looks at the properties of minerals. It helps students identify minerals according to properties such as lustre, streak, hardness and cleavage.

Teaching tips: Minerals in day-to-day life

A common misconception is that minerals are not important to our lives; in fact, minerals are very important resources in our lives. They are used in electronics, coins, cars, jewellery, sunscreen and medicine.

Teaching tips: Common misconceptions

A common misconception is that any crystal that scratches glass is a diamond. In fact, there are many minerals that will scratch glass, including quartz, garnet and topaz.

Differentiation

For less able students:

Less able students are introduced to a number of new words in this section. Creating flashcards to assist them to remember these would be beneficial. Lustre, transparency and cleavage should be included.

For more able students:

More able students should be able to explain and teach other students or students in younger year levels about the properties of rocks, including how they are classified. This could be a peer lesson assignment involving other classes.

Additional activity: Types of rocks

Brainstorm the different uses of rocks by humans, and the purposes these rocks serve or served. Examples are sandstone carvings in Egypt, marble sculptures, slate floors and coal for heating. Students could choose one of these uses and explain why that rock is used, and the history associated with its use.

Additional activity: Computer dissection

Students can use video of old computers or mobile phones being taken apart to identify the minerals used in the creation of each. It is important to note that these ‘dissections’ should only be viewed online – actually taking them apart in person is dangerous as they contain toxins and other dangerous materials.

Additional activity: Uses of rocks and minerals

Students can complete the following table, which demonstrates the (sometimes) unexpected uses of various rocks and minerals. Give students the first column only and ask them to complete the second by stating whether they think the statement is true or false.

|  |  |
| --- | --- |
| Statement | True or false |
| Talcum powder is made of rock. | true (Talc is a very soft rock.) |
| Minerals are found in some medicines. | true (e.g. zinc) |
| Table salt does not contain rocks or minerals. | false |
| Dentists never used rocks in dentistry. | false (Small chips of rocks were used to plug fillings.) |
| Make-up often contains rocks and minerals. | true |
| It takes an average of 10 minerals to create a computer. | false (It takes an average of 35!) |

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**ABC environment: Rare supply**  
This ABC website contains an article about the trace minerals found in gadgets.

2.3 Minerals are a valuable resource

Teacher notes (pages 22–23)

Introducing the topic

This topic looks at the rich mineral resources of Australia and how minerals are used in our everyday lives. An ore is a mineral with a large amount of useful metal in it. Some minerals, such as iron ore, have to be treated before they can be used.

Teaching tips: Australia’s gold

Using the example of gold could be a good way of establishing the value of our mineral resources. ‘Has anyone ever found gold?’ should elicit considerable class interest, especially if there is a positive response.

Teaching tips: Common misconceptions

A common misconception is that minerals are not important to our lives; in fact, minerals are very important resources in our lives.

Teaching tips: Australia’s resources

Australia has rich deposits of iron ore that are mined and exported to many countries around the world. Iron is one of the most abundant rock-forming elements and makes up approximately 5% of the Earth’s crust. It is the fourth-most abundant element after oxygen, silicon and aluminium. Most iron-ore rocks mined today comprise the iron-oxide minerals hematite, goethite, limonite and magnetite. Most of the world’s iron-ore resources occur in iron-rich sedimentary rocks, which are usually more than 600 million years old. This information links the rock type with the mineral content and places it in the context of a useful mineral resource to our country. Establishing this link is clearly made in this section.

Additional activity: Mineral resources

Students can research where key minerals are mined in Australia. Students should create a map of Australia with the major mining sites highlighted and include a legend. Students can discuss their findings, including where most mines are found and how mines affect local communities and the natural environment.

Additional activity: Career profile

Students could be asked to create a career profile for a geologist or palaeontologist. Currently, there are many good jobs available in Australia in geology in particular, with many being very highly paid. Students could include what subjects they need to study (and excel in) in order to become a geologist or palaeontologist. Which universities offer these qualifications? What does the normal working day of a geologist or palaeontologist entail? This activity could also involve interviewing a geologist or palaeontologist, or an incursion.

Additional activity: Mining versus the environment

Students could debate (or write an essay) on the importance of mining versus the preservation of the natural environment. This could include the activity ‘cookie mining’, which is a basic introduction of the effects of open-cut mining. Students work in pairs to mine the chocolate chips (the ore) out of a cookie (the land) using two toothpicks. After all the ore is mined, students attempt to put the cookie back together. This activity demonstrates to students the detrimental effects of mining on the natural environment.

Assessment

Students could research and debate the use of open-cut mining versus other methods of mining. How do we determine all of the costs involved in each method, including the environmental costs?

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**Melbourne Museum: Dynamic Earth**  
This video explains the applications of minerals today.

2.4 Igneous rocks develop from magma and lava

Teacher notes (pages 24–25)

Introducing the topic

Rocks are broadly classified according to how they are formed. The three main types of rocks – igneous, sedimentary and metamorphic – form in different ways. Igneous rocks form when magma and lava from volcanic eruptions cool and solidify.

Additional activity: Rock kits

Most schools will have basic ‘rock kits’. These provide small samples of a range of rocks and minerals for students to observe and handle. Simple tests can be carried out to identify types of rocks; this can include a hardness test and observations of lustre, transparency, the shape of crystals, density and streak.

Additional activity: ‘Rock’ song

Students could write and perform a song to explain the different types of rocks and how they are formed.

Assessment

Landforms are created when rocks are weathered and eroded, and the whole process is modelled as a cycle whereby there is no start or finish; rocks are continually recycled. Ask students to explain the role igneous rocks play in the overarching rock cycle.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**How stuff works: Types of volcanic rock**  
This video explains the different types of volcanic rocks.

2.5 Sedimentary rocks are compacted sediments

Teacher notes (pages 26–27)

Introducing the topic

Sedimentary rock is formed when sediments are deposited in layers, such as on a riverbed or ocean floor. This can take thousands or millions of years. The weight of the overlying rock can cause the formation of hard rock.

Differentiation

For less able students:

Learning how to identify different rocks can be challenging, so keeping the classification of rocks to the three main groups (sedimentary, igneous and metamorphic) is probably the best idea.

For more able students:

Detailed rock identification is probably within their grasp, so extend these students where applicable.

Additional activity: Sand under the microscope

Sand looks fascinating under the microscope and students find it an engaging way to explore sedimentary rocks. Ask students why the individual grains of sand look so different? What has happened to them? This discussion of erosion can lead to a better understanding of the formation of sedimentary rocks. Water and wind corrode the sediments over time, and these layers can then form sedimentary rock over thousands or millions of years.

Additional activity: Use of images

Sedimentary rock layers are visually striking. Use of images in this section is recommended. A See, Know, Wonder activity could complement this. See, Know, Wonder activities always involve a visual cue like a photo or video. Give students an image to consider, for example, an image of a cross-section of a sedimentary rock. Students draw a three-column table (with the headings See, Know and Wonder) and start by working individually, listing three things that they can see in the image, for example, four distinct colours in each layer. They then complete the column for Know – what do they know when they look at the image? For example, ‘I know that this rock is made up of sediments deposited over time’. The final column is Wonder – what does the image make them wonder? For example, ‘What are sedimentary rocks used for?’ Students then pair up and, in a different coloured pen, add any See, Know, Wonder points that their partner had that were different from their own. This comparison can be repeated in different pairs or even among the whole class. See, Know, Wonder activities help students to develop observational skills as well as questioning and working with others.

Assessment

Experiment 2.5 ‘Making sedimentary rocks’ can be used as an assessment tool for understanding sedimentary rocks. A full experiment report could demonstrate a student’s understanding and practical skills.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**Australian Museum: Classification of sedimentary rocks**  
This website contains information about different sedimentary rocks.

2.6 Metamorphic rocks require heat and pressure

Teacher notes (pages 28–29)

Introducing the topic

Metamorphic rock is formed when igneous, sedimentary or older metamorphic rocks are changed by intense heat and pressure inside the Earth.

Teaching tips: Metamorphic rock samples

Students will benefit from some examples of metamorphic rocks to touch and investigate. The differences between sedimentary and metamorphic rocks are easily observed.

Teaching tips: Common misconceptions

Some common misconceptions:

• ‘Soil must have always been in its present form.’ (Soil is weathered and eroded.)

• ‘Mountains, seas and continents have always been where they are now.’ (The Earth is constantly changing.)

Differentiation

For less able students:

Students may believe that metamorphic rocks are from melting rock. It is important they realise that melting rock forms igneous rocks, not metamorphic rocks.

For more able students:

Marble is a very famous metamorphic rock. Ask students to research how marble is formed, and why it is so popular for making buildings and statues.

Assessment

An investigation into the rock cycle may be done using multimedia or making a physical three-dimensional model.

Experiment 2.6 ‘Making metamorphic rocks’ can be used as an assessment tool for understanding metamorphic rocks. A full experiment report could demonstrate a student’s understanding and practical skills.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**BBC Bitesize: Metamorphic rocks**  
This website contains information about metamorphic rocks.

2.7 The rock cycle causes rocks to be re-formed

Teacher notes (pages 30–31)

Introducing the topic

The rock cycle is an ongoing process that describes the formation and destruction of the different rock types. 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 sediment to another area.

Teaching tips: The rock cycle

Students should understand that rocks are formed by dynamic transitions over time. The rock cycle explains how the three rock types are related to each other and how processes change rocks from one type to another over time.

Students have no real experience with the recycling of rocks, so using an analogy with other forms of recycling is a useful approach. However, keep in mind that other forms of recycling are not equivalent to the recycling of rocks. A comparison of similarities and differences will illustrate to students the use of a model. One major difference is that rocks are always being recycled (24 hours a day). Rocks are not ‘placed’ into the cycle, as is recycled waste at home. A new rock is not ‘produced’ from an old rock in the same way that a new plastic container is produced by domestic recycling.

Teaching tips: The changing Earth

Students may or may not be familiar with the Earth changing over time, so some gauge should be made of their starting knowledge through short questions to prompt class discussion. Good starter questions include: ‘Has the Earth always been as it is now?’, ‘How do you know?’ and ‘What is the evidence?’

Differentiation

For less able students:

Students could research and present a report about the Great Wall of China. The Great Wall of China was begun in 214 BC, varying in height between 5 and 9 metres. The Great Wall of China is around 21,000 kilometres long and many parts have weathered the test of time.

For more able students:

Students should be able to research and explain some basic stoneworking techniques.

Additional activity: Ancient buildings

Students choose one ancient structure built out of rock to investigate. Some examples of these are the Great Sphinx, St Sophia in Istanbul, the Taj Mahal, the Great Wall of China and Angkor Wat.

Additional activity: Class discussion

Discuss some common misconceptions with the class. These are some examples:

• ‘Earth is molten, except for its crust.’ (The inner core is solid and unattached to the mantle; it is suspended in the molten outer core.)

• ‘Soil can be several kilometres deep under the Earth's surface.’ (Soil forms a very shallow layer on the Earth’s surface, typically only a few metres deep, and in some places it is much thinner.)

• ‘Volcanoes bring lava from the centre of the Earth.’ (Lava comes from the mantle, which is much closer to the surface.)

• ‘At the centre of the Earth is a big fire or a huge magnet.’ (No such structures exist.)

• ‘The Earth’s crust is the land only.’ (The crust extends from 7 to 50 kilometres and includes the land under the oceans.)

Additional activity: Draw a diagram

Ask students to draw a diagram of the internal structure of the Earth. Discuss the nature of each component of the Earth, including inner core, outer core, mantle and crust.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**Interactives rock cycle**  
This website contains information, diagrams, animations and a quiz about the rock cycle.

2.8 Weathering and erosion can be prevented

Teacher notes (pages 32–33)

Introducing the topic

This section investigates how weathering and erosion can be prevented. Human interference has caused the rate of rock weathering and erosion to change. Soil-erosion engineers are helping to solve this problem.

Teaching tips: Common misconceptions

A common misconception is that rocks stay the same forever. In fact, rocks are always changing.

Another common misconception is that diamond and other expensive gems are the rarest minerals on Earth, when in fact something like the mineral painite, which has been found in Myanmar, may be the rarest.

Differentiation

For less able students:

Students can write their own definitions of the bold glossary terms as they appear throughout the text. Encourage them to write their own definitions rather than just copying an existing glossary definition. Paraphrasing definitions is a good skill and demonstrates real understanding of the terms.

For more able students:

More able students could further investigate how Uluru was formed. Uluru is one of Australia’s most recognised and respected landmarks and is made of sandstone, which appears to change colour in different light.

Additional activity: Acid rain

Acid rain is a significant environmental problem in many places in the world. Acid rain is corrosive and affects limestone and marble buildings and sculptures. Ask students to find examples of images of damage to buildings or statues from acid rain. The image can be put on the centre of the page and annotated to show how the damage occurs, along with some basic information about acid rain.

Additional activity: Minute paper

At the end of this section/topic, give students a small piece of paper (an eighth of an A4 page at the most) and ask them to summarise what they have learnt in one minute. This minute paper can allow you to gauge how well students understood the concepts introduced and focus on aspects that they may benefit from revisiting at the start of the next lesson. Minute papers can have the students’ names on the back or handed in anonymously.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**Geoscience Australia**  
This website is the home page for the Government agency called Geoscience Australia. The site contains many links to scientific topics, education, publications and news and events.

2.9 Rocks are studied by geologists

Teacher notes (pages 34–35)

Introducing the topic

For scientists, fossils, bones and artefacts provide clues to the past. They are undeniably engaging. Who hasn’t been intrigued by a dinosaur skeleton? Simple objects can point to a wealth of information and scientific concepts. It was Glossopteris fossils that inspired Alfred Wegner to first propose the concept of Pangaea and continental drift.

Teaching tips: Fossils

A palaeontologist is someone who studies fossils. Most students will associate the word ‘palaeontologist’ with someone who researches dinosaurs. It is important that students recognise that palaeontologists also work with other animals’ bones and even plants. Videos about palaeontologists can be found on the Internet. Examples of fossils can be found at museums, and most students will have seen a complete skeleton. Students could discuss the types of skeletons they have seen and where they saw them. ‘Have you ever found a fossil?’ should start an interesting class discussion. They may think they have never found a fossil, so discuss how they probably rely on fossils everyday by using fossil fuels such as oil, gas or coal to power cars, lights and heat or cool their houses. Fossil fuels are organic carbon from ancient plants and marine life that lived millions of years ago.

Teaching tips: Common misconceptions

Some common misconceptions about fossils to discuss:

• ‘Fossils are pieces of dead animals and plants.’ (Fossils are the remains of dead plants or animals preserved in rock.)

• ‘Soft tissue can never be fossilised.’ (Sometimes it is.)

Common misconceptions regarding the Geologic Time Scale to discuss:

• ‘The Geologic Time Scale was originally developed to match the “periods” and “eras”.’ (It was defined as sequences of sedimentary rock strata that were later given ‘time scale’ labels.)

• ‘The rock strata systems of the Geologic Time Scale are the same all over the world.’ (Data shows that 77% of the Earth’s surface is missing seven or more of the strata levels, and 94% of the Earth’s surface is missing three or more of the strata levels; ironically the entire ‘geologic column’ diagram of 10 complete strata systems exists only in diagrams.)

• ‘The Earth’s strata systems always occur in the order depicted by the Geologic Time Scale.’ (Scientists have studied thousands of locations across the world where the strata levels are repeated or missing.) Furthermore, contrary to what all the textbooks say, the Geologic Time Scale and the position of the fossils within its levels do not in any way prove evolutionary theory. In fact, the geologic column contains no transitional fossils whatsoever.

Additional activity: Create a dinosaur

Students can ‘recreate’ the work of a palaeontologist by piecing together their own mystery dinosaur. It is possible to find three-dimensional dinosaur skeleton kits that are made of wood or cardboard at hobby stores; another easier option is finding worksheets online that show a finished skeleton and then a cut-out worksheet of the separate bones. Students work in small groups to piece together their skeleton using a finished example as a guide if necessary.

Additional activity: Plaster-cast fossils

There is opportunity here for a cross-curriculum task or project with Art. Students can make plaster-cast fossils, learning about fossils in Science and then making them in Art. These fossils can be made using simple equipment like a plastic tray (or ice-cream tub) and plaster of Paris. Students press their ‘fossil’ object into modelling clay or plasticine and then remove it, leaving an indent. The plaster mixture is then poured over and left to set for at least 24 hours. When removed, students have their own ‘fossil’, which can be painted and displayed. The fossilisation process is easier to understand because they have made a model of a fossil themselves.

Additional activity: Geologic time

A toilet roll analogy to geologic time may be useful. Instructions can be found online. The roll should be marked up before class with the major events in the history of the Earth. The roll is unwound to the back of the room and around the room, and new events reveal themselves as the roll unwinds. These are some interesting questions you could pose to your class before starting this topic:

• ‘If you had a time machine and could travel back to when the Earth was formed, what do you think the Earth would look like? (correct answer: gas, magma, unsuitable for life, no atmosphere)

• ‘How many years back in time would you have travelled?’ (correct answer: 4–5 billion)

• ‘Would there be any living things? If so, which organisms do you think you might encounter?’ (correct answer: no)

• ‘The line below represents from the time when the Earth formed to today. Please mark on the timeline when first life, dinosaurs and humans appeared.’ (There should be a line extending across a page or across the whiteboard; the correct answer: humans at far right end, dinosaurs in last one-quarter; first life in the first one-third.)

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**BBC Nature: Fossils**  
This website contains information about the history of palaeontology, the different types of fossils, how fossils are formed, the history of life on Earth as well as other interesting links.