Science Rocks

Queensland **the Smart State**

Queensland Government
Natural Resources and Mines

QUEENSLAND resources COUNCIL

Published by:
Queensland Resources Council
Department of Natural Resources and Mines

Author Kathleen Gordon
Illustration Steve Axelsen
Editing and design Web and Publishing Services, Department of Natural Resources and Mines.

For copies of this resource contact:

Queensland Resources Council
Education Adviser
Queensland Resources Council
Level 13, 133 Mary Street
Brisbane, Qld 4000

Telephone 07 3295 9560
Facsimile 07 3295 9570
Email education@qrc.org.au
Web site http://www.qrc.org.au

The Department of Natural Resources and Mines
Manager
Strategic Networks, Information and Liaison
Department of Natural Resources and Mines
Level 3, Mineral House
41 George Street
Brisbane Qld 4000

Telephone 07 3237 1888
Facsimile 07 3229 7770
Email mines@qld.gov.au
Web site http:// www.nrm.qld.gov.au

QNRM 05296
ISBN 0 957870140
#27528

Contents

Preface

Mining has been vital to the development of Queensland. It has led to the establishment of inland towns and cities, provided jobs and generated billions of dollars in export earnings. Additionally, the products of mining help to make many of the items that we use every day.

The Queensland Resources Council (QRC), through its education program, aims to give teachers and students a balanced and informed understanding of our state's mineral and energy resources industry. It produces teaching materials in the Key Learning Areas of Science, SOSE, and Technology, and offers free in-school presentations to primary and secondary students throughout Queensland and professional development opportunities for teachers. Bookings can be made and further information obtained by contacting the Education Adviser.

The Department of Natural Resources and Mines (NR&M) plays a central role in the mining industry, providing a number of services such as promoting the state's potential, assisting in land access negotiations, developing geological data, managing safety and health standards, and encouraging environmental best practice.

Through *Science rocks*, QRC in conjunction with NR&M aims to provide teachers and students with a practical and enjoyable resource that will enhance their understanding of the importance of minerals in our daily lives.

Acknowledgments

Author

Kathleen Gordon, Education, Training and Curriculum Services

Illustrator

Steven Axelsen

Project managers

Robert Wilson, Queensland Resources Council

Cheryl Petith, Department of Natural Resources and Mines

Claire Greer-Wilson, Department of Natural Resources and Mines

Katrina Keay, Queensland Resources Council

Nicole Worrall, Queensland Resources council

Special thanks

David Charmichael, Department of Natural Resources and Mines

Linda Dobe, Department of Natural Resources and Mines

Chris Towsey, Citigold Corporation Ltd

Doug Young, Australian Institute of Geoscientists

Lauren Keilher, Department of Natural Resources and Mines

Andrew Mutton, GeoDiscovery Group Pty Ltd

Colleen Bettles CSIRO Manjfacturing & Infrastructure Technology

Neroli Gilmore, Wendy Jones and the students of Yarilee State School

Overview

Science Rocks

Science rocks provides middle and upper primary school students with opportunities to explore earth science, particularly geology and mineralogy. The material is organised around strands and outcomes from the *Years1–10 science syllabus.*

Relationship with *Years 1–10 science syllabus*

Teaching and learning activities in this resource have been designed to enhance student understanding of six science syllabus key concepts. The activities provide opportunities for students to demonstrate the outcomes associated with these concepts at levels two, three and four. The strands and key concepts examined are:

Strands	Key concepts
Earth and beyond	• The Earth, solar system and universe are dynamic systems. • Living things use the resources of the Earth, solar system and universe to meet their needs.
Natural and processed materials	• The properties and structure of materials are interrelated. • The uses of materials are determined by their properties, some of which can be changed.
Science and society	• Science as a 'way of knowing' is shaped by the way humans construct their understandings. • Decisions about the ways that science is applied have short and long term implications for the environment, communities and individuals.

Structure

Science rocks is organised around a series of focus questions about rocks and minerals. These were developed from some frequently asked questions from middle and upper primary school students in response to handling a selection of rocks and minerals. It is hoped that the activities in this resource can be used to explore the questions that your students ask.

The resource kit is divided into four chapters, each of which has the following sections:

- Index
- Background notes for teachers
- Teaching and learning activities/ teaching procedures
- Resource sheets

The index includes focus questions, outcome statements from the Years 1-10 science syllabus and a list of resource sheets. This is followed by a description of the teaching and learning activities and teaching procedures.

The background notes for teachers provide a general overview of the science content covered in each chapter. They recognise that primary school teachers may not have studied science themselves and so provide a starting point from which they may develop their knowledge of earth science.

The resource kit contains 60 activities in total. Each chapter includes between six and ten teaching and learning activities. At least three of these activities relate directly to the outcome for that key concept at each of the three levels. The remainder of the activities in each section provide opportunities to further explore the concept, without limiting students to a specific level or outcome. In some instances, there are strong links between activities in different sections. As a

result, some activities are best completed following others. Where relevant, this is noted in the teaching procedure section.

Demonstrating outcome
NPM 3.1

Icons have been used to indicate when an activity is directly related to an outcome. These occur in both the 'Background notes for teachers' and 'Resource sheets' sections.

SAFETY ALERT

In the case when an activity requires additional concentration and supervision, an icon has been inserted to alert the teacher to the need to follow certain safety considerations.

The resource sheets may be copied for classroom use. Each section has between 9 and 22 resource sheets, some of which include multiple pages. These have been written at different levels to cater for a range of abilities.

Levels

Science rocks has been written for students operating at outcome levels two, three and four. These levels commonly span the range of conceptual development of students in middle and upper primary school. Because each of the six key concepts is examined at three levels, teachers can cover similar content with all students in their class, irrespective of their level of conceptual development. In most cases, general activities can be completed with all students. After this, teachers can provide students working at different levels with an appropriate activity (at level two, three or four) to demonstrate their understanding of the concept.

Outcomes

The resource provides teaching and learning activities that address 18 science outcomes. These outcomes are drawn from three of the five science syllabus strands. For each of the six syllabus key concepts examined in this resource, there is an activity at levels two, three and four. (The first numeral of each outcome indicates the level of that outcome. The second numeral indicates the number of the key concept.) For example, the activity entitled 'Rock cycling' provides an opportunity for students to demonstrate an understanding of the Earth as a dynamic system at level three. The table on pages 3 and 4 lists the activities that specifically address each of the 18 outcomes covered in this resource.

Assessment

It must be stressed that the activities in this resource do not, on their own, provide enough information for teachers to make decisions about students' demonstrations of outcomes. Activities stating a particular outcome at the top of an activity/resource sheet may be used in conjunction with other assessment pieces to gather information about students and make decisions regarding their demonstrations of outcomes.

Resources

The resources required for each activity and experiment are listed within activity descriptions and on resource sheets. All activities, including experiments, can be completed with little or no specialised science equipment. Although a study of rocks and minerals could be undertaken with those found in the local area, it is recommended that a basic set of rocks and minerals be obtained either from your school, a high school in your area or from a specimen supplier.

It would be useful to have at least one set of the following:

- igneous rocks
- sedimentary rocks
- metamorphic rocks
- minerals

The rock and mineral sets can be purchased from:

Geological Specimen Supplies
PO Box 387
Archerfield Qld 4108
Phone: (07) 3345 4253

Web site: http:// www.treasureenterprises.com

Your collection can be augmented with specimens bought from markets, gem clubs and gift shops. If you have a large selection of found and unidentified specimens, invite a science teacher from your local high school or member of a gem club to identify the rocks for you. Label them clearly with a number and record their names on a list to which you can add.

Opportunities for students to demonstrate outcomes

Science strand	Science outcome	Chapter	Activity	Resource sheet
Earth and beyond	2.1 Students identify and describe changes in the obvious features of the Earth and sky.	Chapter 1: Our amazing Earth	E Restless Earth	6 Birth of a volcano
	3.1 Students identify and describe some interactions that occur within systems on Earth and beyond.		I Rock cycling	11 Rock cycle flowchart
	4.1 Students recognise and analyse some interactions between systems of Earth and beyond.		J Interactions between rocks and water	12 Rock and water experiment
	2.3 Students discuss how their community uses resources and features of the Earth and sky.	Chapter 4: Using minerals in our lives	A What things are made from	1 What are things made from?
	3.3 Students collect information that describes ways in which living things use the Earth and the sun as resources.		B Collecting information about the origins of things	
	4.3 Students summarise information to compare ways in which different communities use resources from the Earth and beyond.		I Looking at recycling	20 Change is possible

Opportunities for students to demonstrate outcomes (continued)

Science strand	Science outcome	Chapter	Activity	Resource sheet
Natural and processed materials	2.1 Students group materials on the basis of properties (including solubility, texture and hardness).	Chapter 2: Exploring rocks and minerals	B Grouping rocks	4 Rock experiments
	3.1 Students examine and describe the smaller visible parts of common materials and relate these to the properties of the materials.		D Examining rocks and minerals more closely	7 My rock
	4.1 Students collect information and propose ideas to explain the properties of materials in terms of each material's underlying structure.		F Examining the structure of salt	9 Salt: up close and personal
	2.3 Students explain why common materials are used in particular situations.	Chapter 4: Using minerals in our lives	C Exploring the contents of toothpaste	3 Why did they use that?
	3.3 Students collect information to illustrate how combining different materials influences their usefulness.		D Researching a product	4 Toothpaste at a glance
	4.3 Students examine and assess ways that materials can be changed to make them more useful.		I Looking at recycling	18 Does degradable plastic really degrade?
Science and society	2.2 Students identify some ways scientists think and work.	Chapter 3: Scientists at work	E Summarising interview responses	9 Graphic organisers
	3.2 Students recognise the need for quantitative data when describing natural phenomena.		C How do scientists find things out? E Summarising interview responses	6 How do scientists find things out? 9 Graphic organisers
	4.2 Students use the elements of a fair test when considering the design of their investigations.		G Designing a fair test	10 Sample investigation design
	2.3 Students explain some of the ways that applications of science affect their community.	Chapter 4: Using minerals in our lives	H Examining packaging	14 Garbage graph
	3.3 Students make predictions about the immediate impact of some applications of science on their community and environment, and consider possible pollution and public health effects.		H Examining packaging	15 When packaging becomes litter
	4.3 Students present analyses of the short and long-term effects of some of the ways in which science is used.		J The impact of plastic on our lives	21 The impact of plastic in our lives

Chapter 1

Our amazing Earth

Strand: **Earth and beyond**

Key concept: **The Earth, solar system and universe are dynamic systems**

Index

Our amazing Earth

Focus questions

How are rocks formed?

How long do rocks take to form?

What are the different types of rocks?

What is the rock cycle?

Resource sheets

1. Science rocks map
2. What do you know about the Earth?
3. Cross section of the Earth
4. Geological timeline
5. Volcano demonstration
6. Birth of a volcano
7. Igneous slips
8. Sedimentary experiment
9. Rocky recipes
10. The rock cycle
11. Rock cycle flowchart
12. Rock and water experiment
13. The effect of water on rocks

Outcomes

The following outcomes can be achieved in your classroom by following the activities and using the resource sheets provided in *Science rocks*. The overview at the beginning of this book also explains which of the activities demonstrate each outcome.

Science outcomes: Earth and beyond	
2.1	Students identify and describe changes in the obvious features of the Earth and sky.
3.1	Students identify and describe some interactions that occur within systems on Earth and beyond.
4.1	Students recognise and analyse some interactions between systems of Earth and beyond.

Background notes for teachers

Our amazing Earth

The Earth

The **crust** of the Earth is made of rocks and minerals from the tallest mountains to the floor of the deepest ocean. It makes up less than 1% of the Earth's mass. The continental crust is up to 50 km thick while the oceanic crust is, at most, 15 km thick. Most of the rocky crust is covered by either water, sand, soil or ice. The soil is a mixture of small, inorganic particles and organic material (plant and animal remains), which supports the growth of plants such as grass and trees. Most of the crust is made from only eight elements—oxygen, magnesium, aluminium, silicon, calcium, sodium, potassium and iron. These elements along with others are combined to form thousands of rocks and minerals that are very different.

The **mantle** is the solid casing of the Earth and is about 2900 km thick making up almost 70% of the Earth's mass. It consists of silicon, oxygen, aluminium and iron.

The **core** is mainly made of iron and nickel and makes up about 30% of the Earth's mass. The liquid **outer core** is approximately 2200 km thick. The solid **inner core** is about 1220 km thick.

Rocks

A rock is made up of minerals that have been cemented together, squeezed and heated, or melted and cooled. Rocks are divided into three main groups:

- igneous
- sedimentary
- metamorphic.

They are classified into these groups because of the way they were formed.

Igneous rocks are formed from melted rock that has cooled and solidified. When rocks are buried deep within the Earth, they melt because of the high pressure and temperature. If this molten rock (called magma) cools slowly, usually at depths of thousands of metres, coarse-grained rocks form with large crystals (for example, granite and gabbro). If the magma cools quickly, usually on the surface after a volcano erupts, the crystals are very small and fine-grained rocks are formed (for example, basalt, rhyolite and obsidian). Some examples of other igneous rocks are: pumice, tuff and andesite.

Sedimentary rocks are formed from the cementing together of small pieces of rocks or shells. They are formed at the surface of the Earth, either in water or on land. They are usually made up of many layers of sediments, which include fragments of rocks, minerals and animal or plant material. Sandstone, limestone, shale, gypsum, conglomerate, coal, chert and flint are all sedimentary rocks.

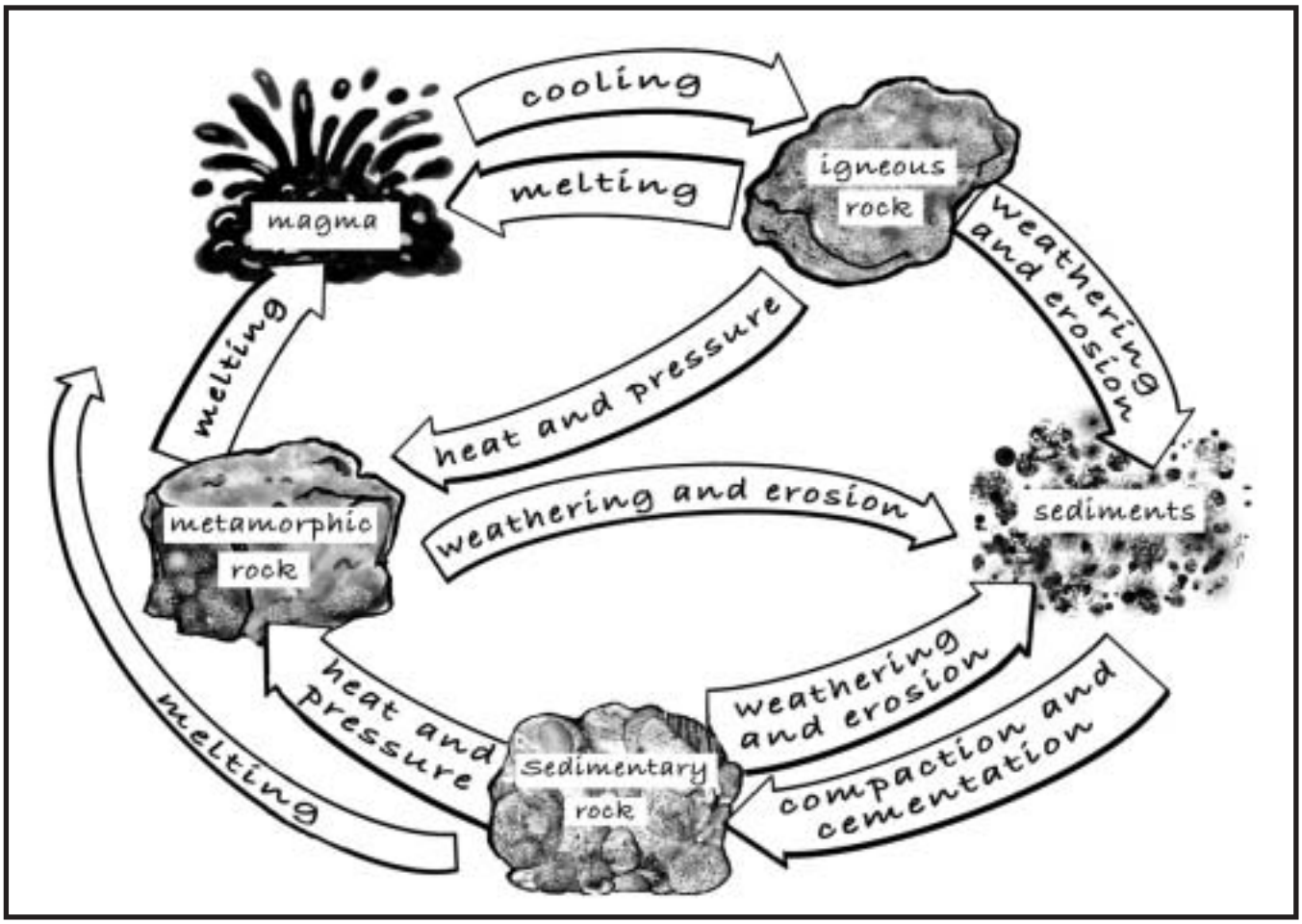
Sometimes igneous and sedimentary rocks are subjected to pressures so intense or heat so high that they change. They become **metamorphic** rocks, which form while buried within the Earth's crust. The process of metamorphism does not melt the rocks, but changes them into denser, more compact rocks. Slate, marble and gneiss are metamorphic rocks. They are transformed from shale, limestone and granite respectively.

shale	→	slate
limestone	→	marble
granite	→	gneiss

The rock cycle

The geological process that forms rocks is cyclical. Each type of sedimentary, igneous or metamorphic rock can be changed into each other type of rock. This is known as the rock cycle. The following explanation starts with igneous rocks.

Igneous rocks start as magma. When magma—molten rock under the Earth's surface—and lava—molten rock on the Earth's surface—cools and hardens, it forms **igneous** rock. The igneous rock is broken down over time through the weathering process. These particles of broken rock, or soil, are washed away by water and accumulate in lakes or oceans and harden into rock again—this time as **sedimentary** rock. As the sedimentary rock is buried under more and more sediment, or comes into contact with magma, the pressure and heat can cause metamorphism to occur. This transforms the sedimentary rock into a **metamorphic** rock. If metamorphic rock is buried more deeply, temperatures and pressures continue to rise. If the temperature becomes hot enough, the metamorphic rock melts and forms the molten rock called magma and so the cycle continues.



Teaching and learning activities

Our amazing Earth

Activity A Outcomes, activities and journal

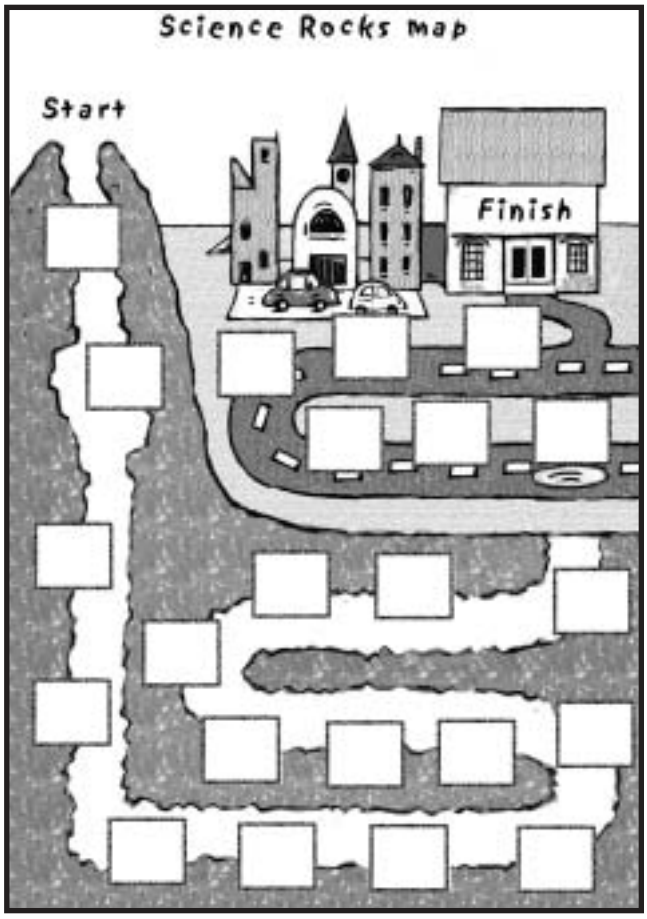
Students consider unit outcomes, decide the direction of their investigations and begin a journal.

Purpose

To make students aware of the unit outcomes through scientific investigation and journal writing.

Teaching procedure

- Make an OHT of the outcome/s on which you will focus and explain the types of activities students will do to demonstrate them. You may need to rewrite outcomes to make them student-friendly.
- Decide on the activities students will do. You can follow the order of activities provided in this book, make selections yourself or negotiate with students regarding which direction to take. Here are some options for recording the activities students complete:
  - Provide students with a copy of *Resource 1: Science rocks map*.
  - Students can write in the names of selected activities from this book (and any others) as they are undertaken.
- Using Resource 1 as a model, invite students to design their own map of the learning activities they do.



- In addition to mapping their journey through this chapter, encourage students to keep a science journal. Vary the type, frequency and length of entries to maintain student interest. Give students a choice about which activities they respond to or how they respond to them in their journal. Two possible formats are given over the page.

The thing that interested me most was _____

_____

The thing I'm still not sure about is _____

_____

_____

_____

I still want to find out _____

_____

_____

Name of activity	What are you ranking? Enjoyment/interest/difficulty	Ranking Low High 1 2 3 4 5	What did you do? OR What did you learn?

Activity B Journey to the centre of the Earth

Students are introduced to ideas about the inside of the Earth and label a cross-section of the Earth.

Purpose

To engage students' interest and discover their existing ideas about the Earth.

Teaching procedure

- Provide students with an example of how some writers/artists have imagined the inside of the Earth by reading or viewing a section from one or more of the following:

– *Journey to the Centre of the Earth* by Jules Verne (1872 novel)

– *Journey to the Centre of the Earth* directed by Henry Levin (1959 movie) or directed by Rusty Lemorande (1987 movie)

– *The Magic School Bus: Inside the Earth* by Joanna Cole (1987 information text)

– *The Core* directed by Jon Amiel (2003 movie)

– *Journey from the centre of the Earth* by Isobel Carmody and Marc McBride (2003 picture book)

– *What's Under the Bed?* by Mick Manning and Brita Granstrom (2004 information text)

- Facilitate a class discussion about the text that the students have read/heard/viewed. Consider the factual and fictional elements of the text/s by asking students what they think might be real and imaginary in them. Invite students to consider how we know whether something is real or not.
- Provide students with a copy of *Resource 2: What do you know about the Earth?* Invite students to record their ideas about the Earth around the globe.
- Provide students with a copy of *Resource 3: Cross section of the Earth*. Display the words crust, mantle, inner core and outer core where students can clearly see them. Explain that these are the names of the four layers of the Earth. Either read or ask students to read the following text twice. Then ask them to use the clues to label the diagram.

The Earth has four main layers. These are the **crust**, the **mantle**, the **outer core** and the **inner core**. The crust is the rock layer we live on and is made up of the lightest material. The mantle is made up of molten rock. The heat in the mantle melts the rock. The outer core is made up of very hot molten iron and nickel. The inner core is made up of solid iron and nickel. It is solid because of the extreme pressure at the centre of the Earth.

Activity C Rocky questions

Students compose questions about rocks after examining a variety of rocks.

Purpose

To engage students' curiosity about rocks.

Teaching procedure

- Provide a variety of rocks to small groups of students.
- Invite students to examine and write questions about the rocks. Encourage students to write different types of questions such as what, when, where, why, who and how questions. Provide examples for each type of question and elicit further examples from the students. Groups may swap rocks so they can examine a greater variety.
- Ask groups to share their questions with the whole class. These questions, reflecting student interest, can be used to guide students' investigations throughout the unit.

Activity D Journey through time

Students participate in a visualisation exercise then contribute to a group mural or multimedia display.

Purpose

To encourage students to explore the idea of geological time.

Teaching procedure

- Prior to the lesson, collect a selection of pictures of well-known Australian landforms such as Uluru, Blue Mountains, Wilson's Promontory, Mt Kosciusko, Mt Bartle Frier, Mt Warning, Nullarbor Plains and the Glasshouse Mountains. (Calendars and travel brochures are a good source of these pictures.) Show students these pictures and together mark the selected locations on a wall map. Ask students if they know how old the formations are and how they were formed.
- Invite the students to come on a journey through time to learn about these landmarks and how the Earth has changed over time. This activity can take place inside the classroom or outside in a quiet, shady location. Read the text on *Resource 4*: *Geological timeline*. You might like to use a sound effect (buzzer, chime, or computer generated) to indicate each time you move to another time zone.
- Invite students, working in groups, to research one of the time periods and present the information in a mural or multimedia presentation. When each group has finished, their work can be combined to form a journey through time.

Activity E Restless Earth

Demonstrating outcome EB 2.1

Students observe a demonstration of how volcanoes are formed.

SAFETY ALERT

Take special care when using vinegar. If vinegar does splash on skin or into eyes, wash affected area with water immediately. Seek medical advice if discomfort persists.

Purpose

To show students how volcanoes change the landscape.

Teaching procedure

- Before you begin the demonstration, organise a student to record each step of the demonstration using a digital camera. These photos could be:
  - used as a display in your room
  - printed, laminated and used as a stimulus for a sequencing activity or for recalling the steps of the demonstration
  - imported into a computer program such as PowerPoint to record the demonstration in sequence.
- Begin the volcano demonstration described in *Resource 5: Volcano demonstration*. Invite selected students to assist at each step.
- After the demonstration invite students to discuss their observations. Students could also record their observations in their science journal.
- Show students video or internet footage of erupting volcanoes. Discuss the changes to the landscape caused by a volcano. Some good internet sites include:
  - *Volcano world's kids' door* at: <http://volcano.und.edu/vwdocs/kids/kids.html>
  - *FEMA for kids* at: <http://www.fema.gov/kids/volcano.htm>
  - Provide younger students with a copy of *Resource 6: Birth of a volcano* and ask them to complete it individually. Collect sheets for student portfolios.

Activity F Exploring igneous rocks

Students observe a cooking demonstration that shows how some igneous rocks are formed.

Purpose

To enable students to discover how igneous rocks are formed.

Teaching procedure

- Invite students to form groups of four. Provide each student with one of the four igneous slips from *Resource 7: Igneous slips*. Invite students to read the box in their groups and decide on their correct order. Ask one group to read their correctly ordered slips to the whole class.
- Explain to students that this demonstration will show them how two kinds of igneous rock are formed. Make the **igneous rock lollies** in *Resource 9: Rocky recipes.*
- Before eating the lollies, ask each group to identify which rocks the two lollies represent. They may need to refer back to their boxes for clues.
- Invite students to record what they have learnt in their journals.

Activity G Exploring sedimentary rocks

Students conduct experiments that show how sedimentary rocks are formed.

Purpose

To enable students to discover how sedimentary rocks are formed.

Teaching procedure

- Explain to students that sedimentary rocks are made in layers. These layers of mud, sand and shells are built up over a long time. They are squeezed and cemented together to make new rocks.
- Provide students with a copy of *Resource 8: Sedimentary experiment* and masking tape to make it easier for students to label their jars. Conduct the experiment.
- The next day, assist students to describe what they can see. (Layers have been produced by different materials.) Invite students to discuss what they think happened. (The heavier materials sank to the bottom of the jar first. The lighter materials sank last. The different materials formed layers according to their weight.) Explain to students that sedimentary rocks are made in this way when water carries sediments to lakes and oceans. There over time, pressure can force the sediments together so they become sedimentary rocks.
- Make the **sedimentary slice** in *Resource 9: Rocky recipes*. Before eating the slice, ask students to describe how the slice was made. (Layers were placed in the pan. The ingredients melted but you can still see the layers.)

Activity H Exploring metamorphic rocks

Students observe a demonstration that shows how metamorphic rocks are formed.

Purpose

To enable students to discover how metamorphic rocks are formed.

Teaching procedure

- Tell students that metamorphic rocks are made when heat and pressure sometimes change a soft rock into a much harder rock (e.g. sandstone into quartzite). This cooking demonstration will show how metamorphic rocks can be formed.
- Use the recipe for **metamorphic munchies** on *Resource 9: Rocky recipes*. You could do the first stage of baking (up to step 7) in advance to speed up the process.
- Invite students to feel and eat the biscuits before they are baked again. After the second baking ask students to describe how the biscuits changed. (The soft biscuits become much harder.) Explain that soft rocks, such as sedimentary rocks, that are squeezed and heated for a long time can change into harder metamorphic rocks.
- Invite students to record their observations in their journals.

Activity I Rock cycling

Demonstrating outcome EB 3.1

Students sing a rock cycle song (in a round) and create a flowchart to represent the rock cycle.

Purpose

To enable students to discover how rocks are continually cycled.

Teaching procedure

- Provide students with a copy of *Resource 10: The rock cycle* and sing the rock cycle song.
- As a whole group, read through the description of the rock cycle in Resource 10.
- Provide students with a copy of *Resource 11: Rock cycle flowchart*. Read through the sheet. Ask students to cut out the cards.
- Re-read the rock cycle description in Resource 10 and invite students, working in pairs, to organise the cards to represent the rock cycle. Encourage discussion and questions while this process is taking place.
- When the pairs think they have all the cards in the right place, encourage them to read the rock cycle description again and check their placement. Moving around the room, invite students to explain their flowcharts to you.
- Invite students working in groups to plan and act out the rock cycle process. Provide students with the time to develop their ideas, practise and make any props before making their presentation to the class. Walk among the groups as they are creating their performances and check that their representations fit in with the rock cycle process.

Activity J Interactions between rocks and water

Demonstrating outcome EB 4.1

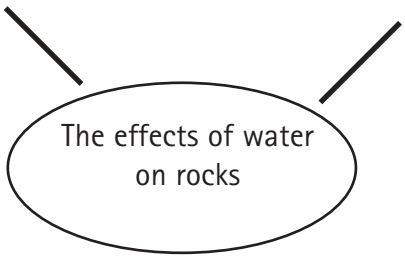
Students conduct an experiment to explore one of the effects of water on rocks and then summarise information about other effects, such as temperature, by creating a concept web.

Purpose

To enable students to explore some of the interactions between rocks and water.

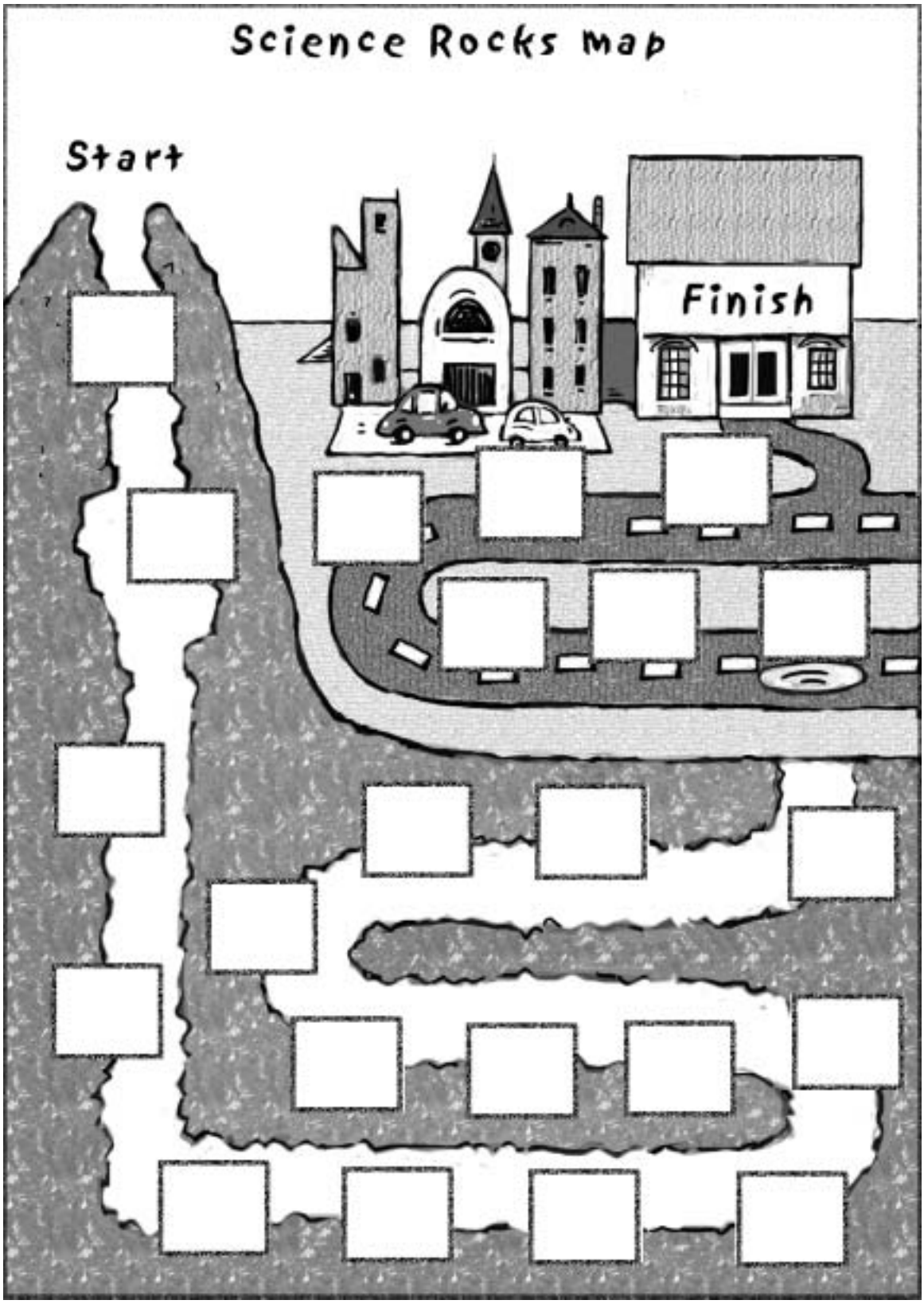
Teaching procedure

- Provide students with a copy of *Resource 12: Rock and water experiment*. Ask students to bring to school the items they need for the experiment. Students can either work in pairs at school, or conduct this experiment at home.
- When students have completed the experiment, invite them to share their findings with the class. (They will probably find that the rocks that have holes in them break down fastest. This is because the holes are gaps between the grains of the rock or cracks. Water gets into the holes and when it freezes, it expands forcing the rock apart a little. When it melts, more water gets in and when it freezes next time it expands more. Eventually the rocks break apart.)
- Provide students with a copy of *Resource 13: The effect of water on rocks*. Invite students to summarise the information by drawing a concept map, for example:



Resource 1 Science rocks map

As you complete each activity, record it's title in the boxes on the map below.

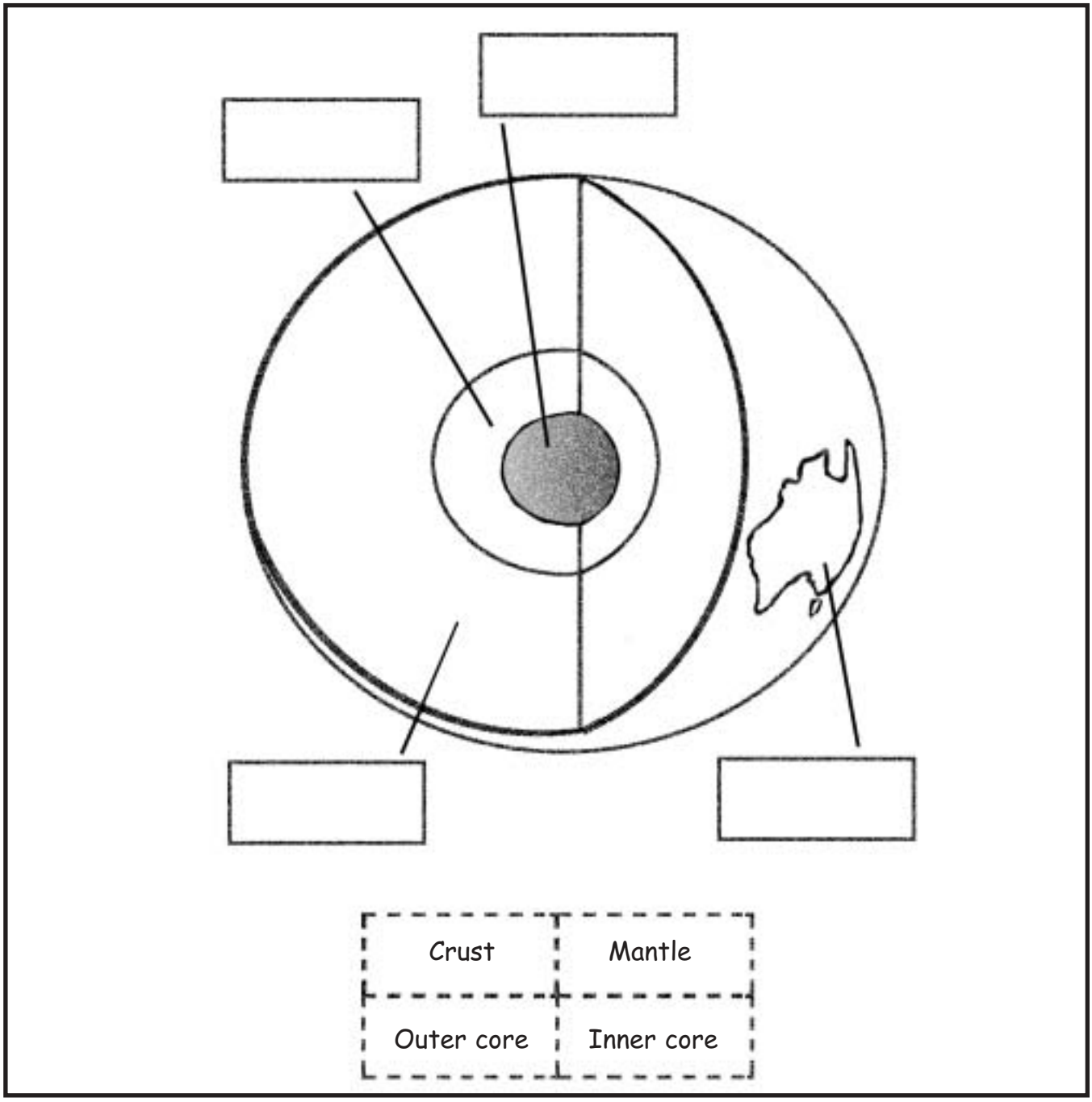


Resource 2 What do you know about the Earth?

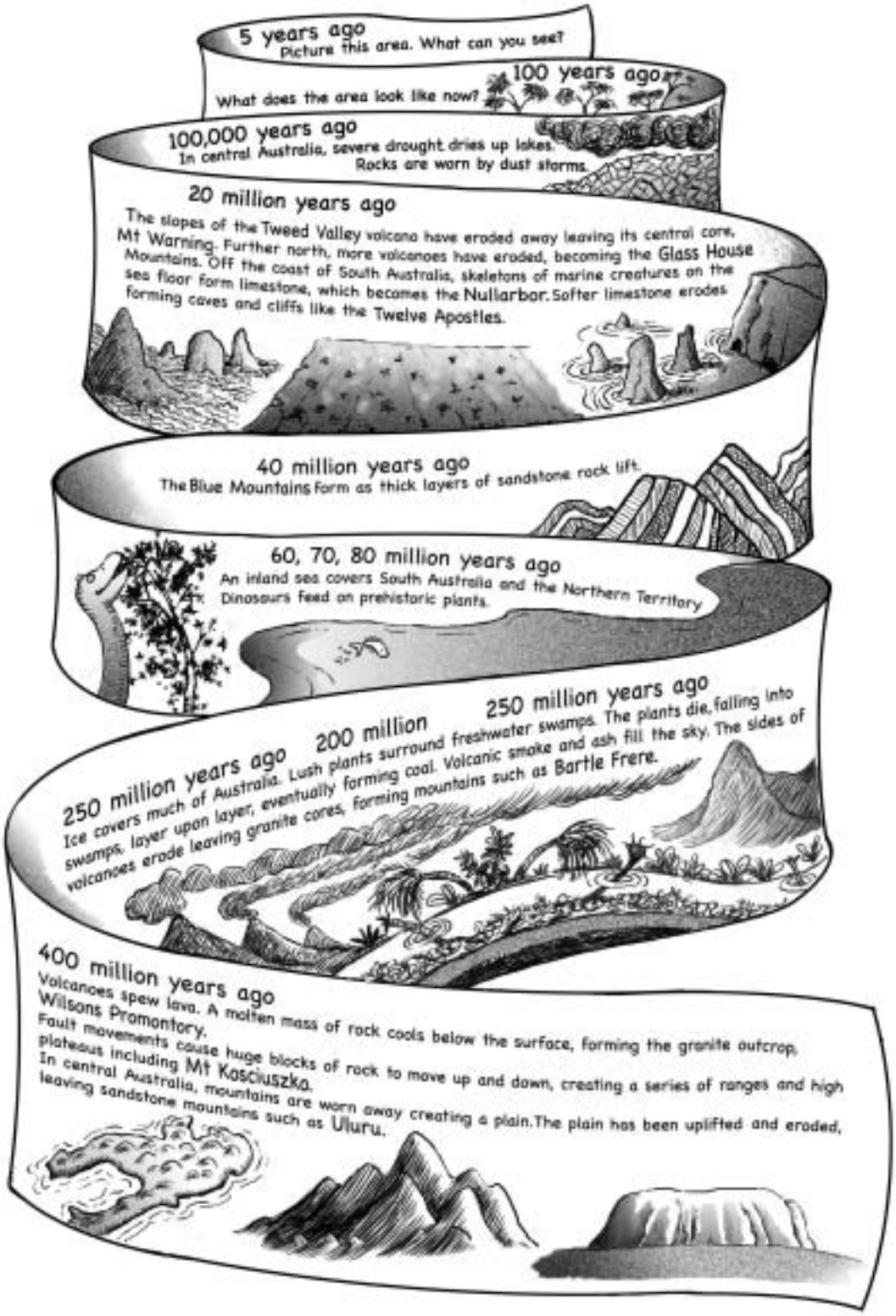
Resource 3 Cross-section of the Earth

Read the following information about the Earth. Cut out the labels below and place them in the correct parts of the diagram.

The Earth has four main layers. These are the **crust**, the **mantle**, the **outer core** and the **inner core**. The crust is the layer we live on and is made up of the lightest material. The mantle is made up of molten rock. The heat in the mantle melts the rock. The outer core is made up of very hot molten iron and nickel. The inner core is made up of solid iron and nickel. It is solid because of the extreme pressure at the centre of the Earth.



Resource 4 Geological timeline



Adapted from: Minerals Council of Australia 1992, *Mineral magic*, Canberra.
Lewis, G 1995, *Australia and ancient lands*, AGSO, Canberra.

Resource 5 Volcano demonstration

Purpose

To enable students to understand how volcanoes change the landscape

Materials

- modelling clay
- small plastic cup
- large tray or biscuit sheet
- 1 tablespoon flour
- 2 tablespoons baking soda
- 10cm square tissue paper
- 1/3 cup vinegar
- 1 drop of food colouring
- safety glasses

Procedure

1. Using the tray as a base, build the volcano with the modelling clay. Make sure that the opening in the top is large enough to hold the small plastic cup.
2. Put the flour and baking soda in the centre of the tissue paper and wrap it up, making sure the ends are tightly twisted.
3. Put the package in the cup.
4. Add a drop of food colouring to the vinegar. Wearing safety glasses, pour half the vinegar into the cup. When the foaming stops, add the remaining vinegar.

Observations

Record your observations in your journal.

Resource 6 Birth of a volcano

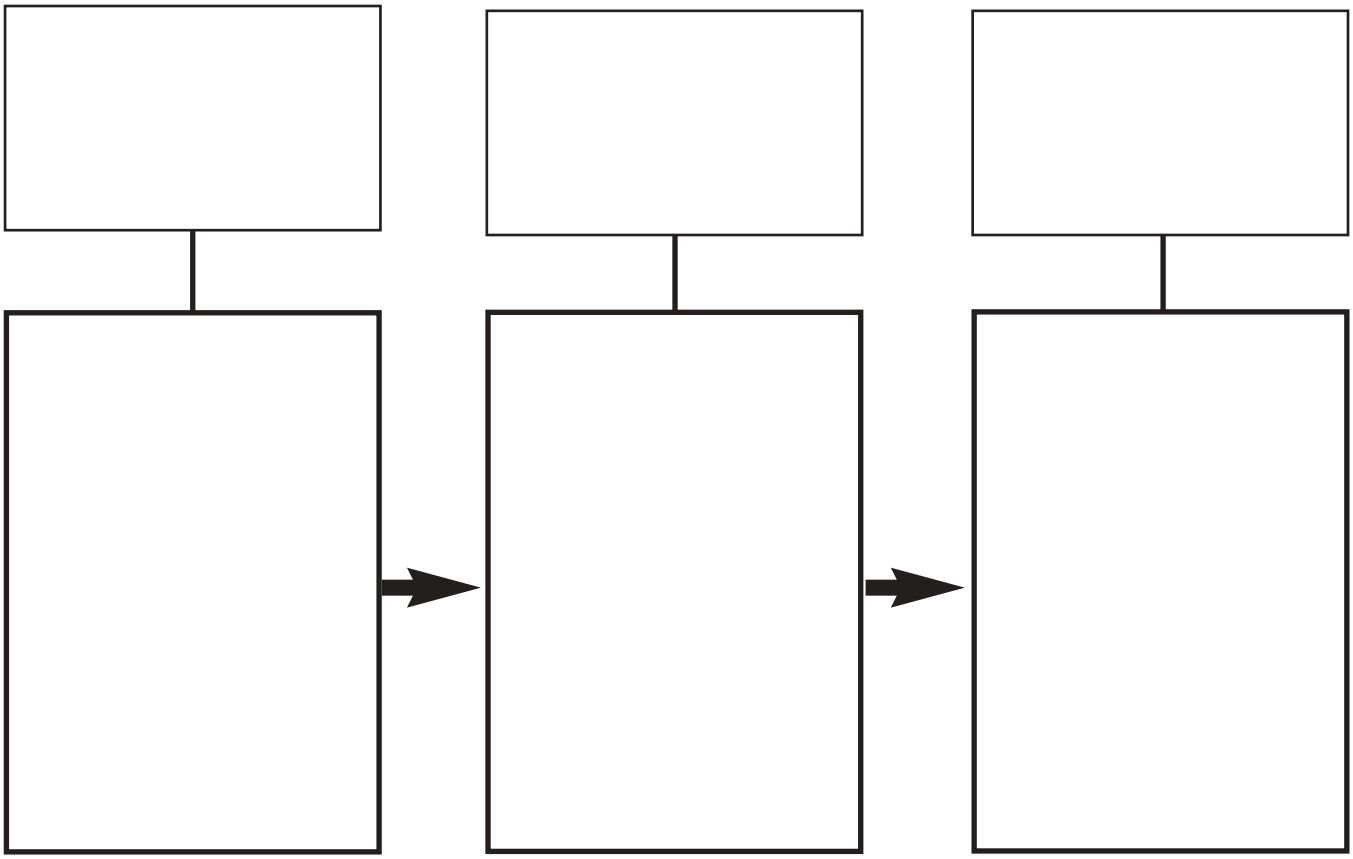
Demonstrating outcome EB 2.1

Purpose

To encourage students to understand how volcanoes change the landscape.

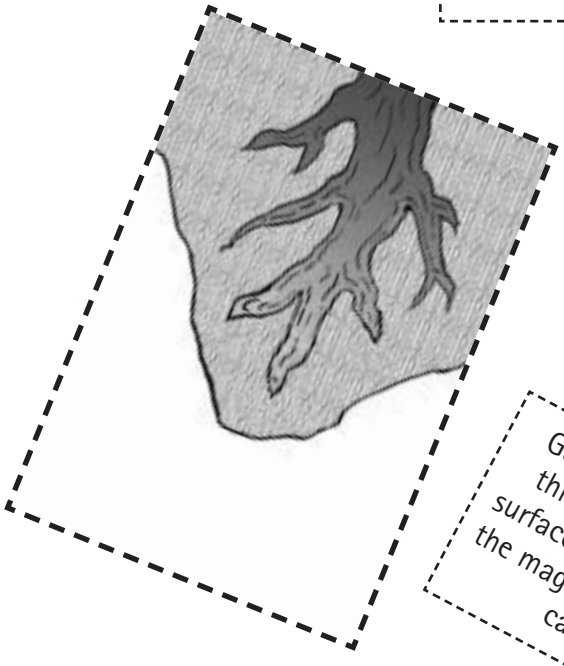
Procedure

1. The pictures opposite show the birth of a new volcano. Put them in the right order.
2. Read the sentences in the text boxes and match them with the pictures.
3. Glue them into the boxes on this page.



Gas and hot molten rock called magma pushes up from under the ground.

The lava and ash pile up to create a volcano.



Gas and magma escape through a crack in the surface of the crust. When the magma comes out it is called lava.

Resource 7 Igneous slips

Purpose

To understand how igneous rocks are formed.

Directions

Read the following slips; cut them out and place them into the correct order. Paste them into your science journal.

quickly (on the surface) the crystals are very small. If rocks cool slowly (below the surface) the crystals are larger. So there are two main types of igneous rock—those that form below the surface and those that form above the surface. Basalt, obsidian and	in water. Granite and gabbro form below the surface. Granite is a coarse-grained, light-coloured rock with a speckled appearance. These speckles are crystals of the minerals quartz, feldspar and mica. Gabbro is a, coarse-grained, dark-coloured rock. Gabbro is very similar to basalt in its mineral make up.
Igneous rocks are formed by the solidification of magma or lava. Molten rock is called magma when it is below the Earth's surface. When it is above the surface, after a volcanic eruption, it is called lava. As molten rock cools, it forms crystals. If rocks cool	pumice form above the surface. Basalt is the most common form of lava. It is smooth and velvety-black in appearance and very hard. Obsidian is nature's glass. It forms when lava cools quickly on the surface. It is glassy and smooth. Pumice is full of air pockets that were trapped when the lava cooled as it frothed out onto the surface. Pumice will float

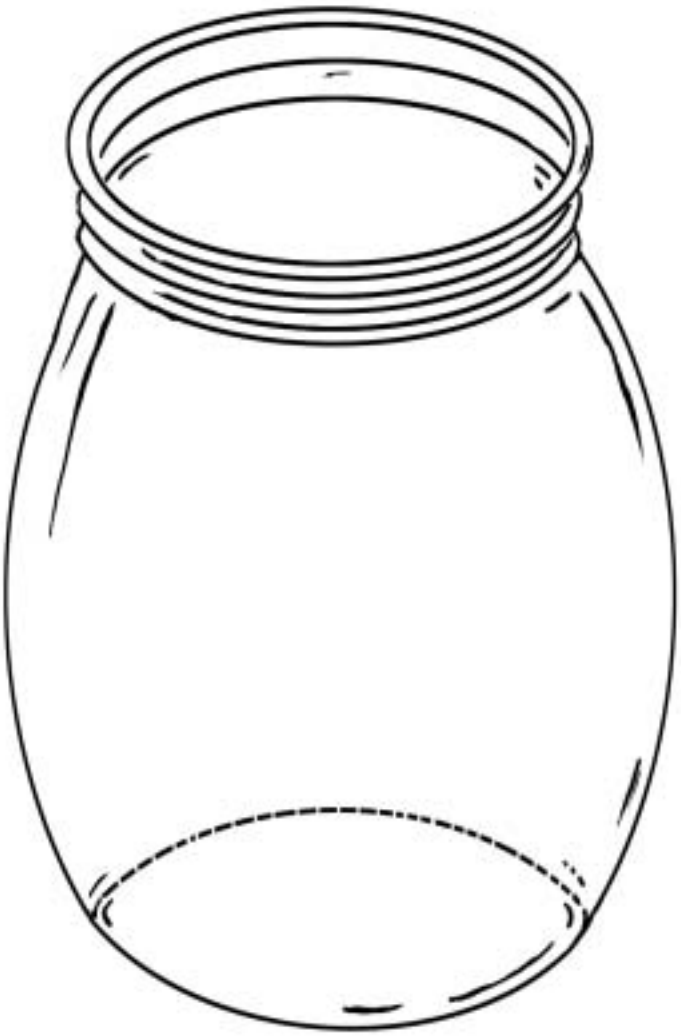
Resource 8 Sedimentary experiment

Purpose

To discover how sedimentary rocks are made.

Materials

- a handful of soil
- a handful of sand
- a handful of fine gravel
- a glass jar



Procedure

1. Put your name on your jar.
2. Put a handful of soil, sand and fine gravel into a glass jar.
3. Fill the jar with water, put the lid on tightly and shake very well.
4. Allow the contents to settle overnight.
5. The next day look at the contents of the jar and finish these sentences.

Observations

a) Describe what you saw. Draw what you saw in the jar below.

_____

_____

In the morning,

b) Describe what you think happened.

I think that

_____

_____

_____

_____

_____

_____

Resource 9 Rocky recipes

Igneous rock lollies

Purpose

To demonstrate how igneous rocks are formed.

Ingredients

- 1 cup sugar
- 1/2 cup liquid glucose
- 1/2 cup water
- 1 tablespoon butter
- 1 teaspoon bicarbonate of soda

Procedure

1. Put sugar, liquid glucose, water and butter in a heavy pan.
2. Heat gently until dissolved and then boil for about 6 minutes, until it all turns light golden brown.
3. Pour half into a cold oiled baking tray and watch it flow and set like lava.
4. Into the remaining half, add a teaspoonful of bicarbonate of soda. This releases carbon dioxide into the mixture in lots of little bubbles—you will need to pour it in a tin quickly before it sets. This is like pumice.
5. Both can be broken with a hammer when set, forming the similar patterns of cracks you find in rocks after earthquakes.

Source: http://www.bbc.co.uk/education/rocks/ primer.shtml

Sedimentary slice

Purpose

To understand how sedimentary rocks are formed.

Ingredients

- 125 g butter
- 1 1/2 cups wafer crumbs
- 400 ml tin of condensed milk
- 1 cup choc chips
- 1 1/4 cups coconut
- 1 cup chopped nuts

Procedure

1. Melt the butter and pour into a greased clear rectangular cake/loaf pan.
2. Crush wafer biscuits and sprinkle the crumbs over the butter.
3. Pour the condensed milk evenly over the crumbs.
4. Layer the nuts then the choc chips evenly and press down gently.
5. Bake at 180° for 20–25 minutes.
6. Cool, cut into bars and serve.

Source: Moore, J E 1998, *Geology*, Science Works for Kids, Evan-Moor Corp., Monterey CA USA.

Metamorphic munchies

Purpose

To demonstrate how metamorphic rocks are formed

Ingredients

- 4 cups flour
- 2 teaspoons baking powder
- 1/2 teaspoon salt
- 2 cups sugar
- 4 eggs
- 3/4 cup oil
- 1 teaspoon vanilla

Procedure

1. Mix flour, baking powder and salt together in a mixing bowl.
2. Beat the eggs in a large bowl and add sugar, oil and vanilla.
3. Add the flour mixture, a little at a time, to the egg mixture. It will get very stiff.
4. Empty the mixture onto a floured surface. Shape the dough into six balls.
5. Grease two baking trays or line with oven paper.
6. Roll each ball into a 'snake' as long as the baking trays and lay three snakes on each tray. Flatten them with your fingers.
7. Bake at 180°C for 25 minutes. Remove from oven and let them cool.
8. Cut the long biscuits in diagonal slices so that there is one for everyone. Cut each of these in half and give one to each person.
9. Place the remaining halves back on the baking tray and bake for an additional 10 minutes.
10. Let these biscuits cool before giving one to each person.

Source: http://www.bbc.co.uk/education/rocks/ primer.shtml

Resource 10 The rock cycle

Purpose

To help students discover how rocks are continually cycled.

Rock cycle song

(Sing to the tune of 'Row, Row, Row Your Boat')

SEDIMENTARY rocks we know

In layers it has formed

Often found near water sources

With fossils of plants and spore

Then there are the IGNEOUS rocks

Here since the Earth was born

Molten Lava, cooled and hardened

That's how it is formed

These two types of rocks we've learnt

Can also be transformed

With pressure, heat and chemicals

METAMORPHIC they will form

Source: http://www.chariho.k12.ri.us/curriculum/MISmart/ocean/rocksong.htm

The rock cycle

The rock cycle describes geological processes that form rocks. Igneous rock can change into sedimentary rock or into metamorphic rock. Sedimentary rock can change into metamorphic rock or into igneous rock. Metamorphic rock can change into igneous rock or sedimentary rock.

- Let's start with magma.
- When magma cools it forms igneous rock.
- On the Earth's surface, wind and water can break the igneous rock into pieces. This process is called weathering and erosion. These pieces are called sediments.
- The sediments can be compacted to make a layer. The layer can be buried under other layers of sediments. After a long time the sediments can be cemented together to make sedimentary rock.
- Sedimentary rock can be weathered away to form sediments again.
- When sedimentary and igneous rocks are heated they change into metamorphic rock.
- Metamorphic rock can also be weathered away to make sediment.
- Metamorphic and igneous rock can also be melted back into magma.
- The rock cycle never stops.

Source: http://www.cotf.edu/ete/modules/msese/earthsysflr/rock.html

Resource 11 Rock cycle flowchart

Demonstrating outcome EB 3.1

Purpose

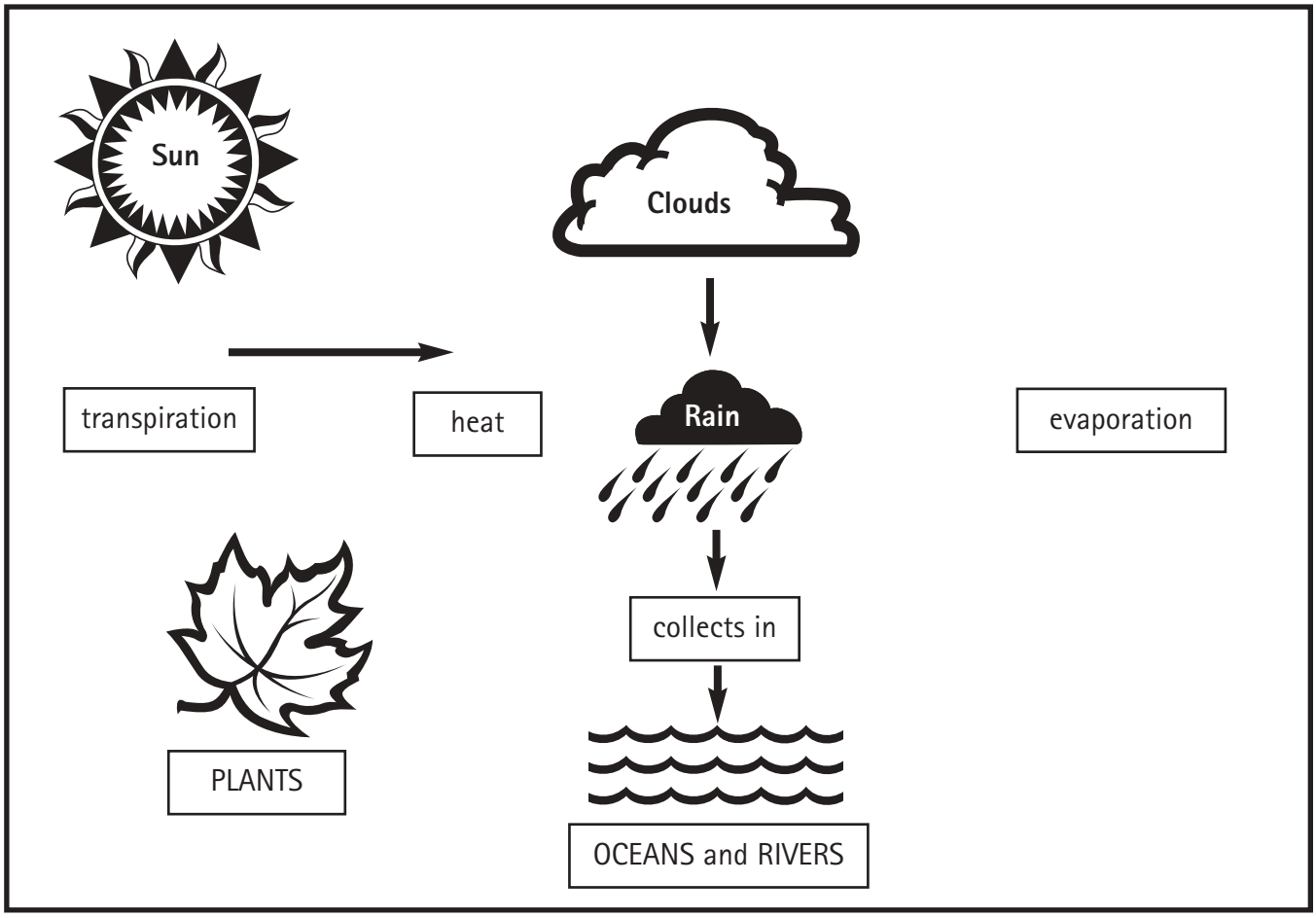
To identify and describe some interactions within a system—the rock cycle.

Procedure

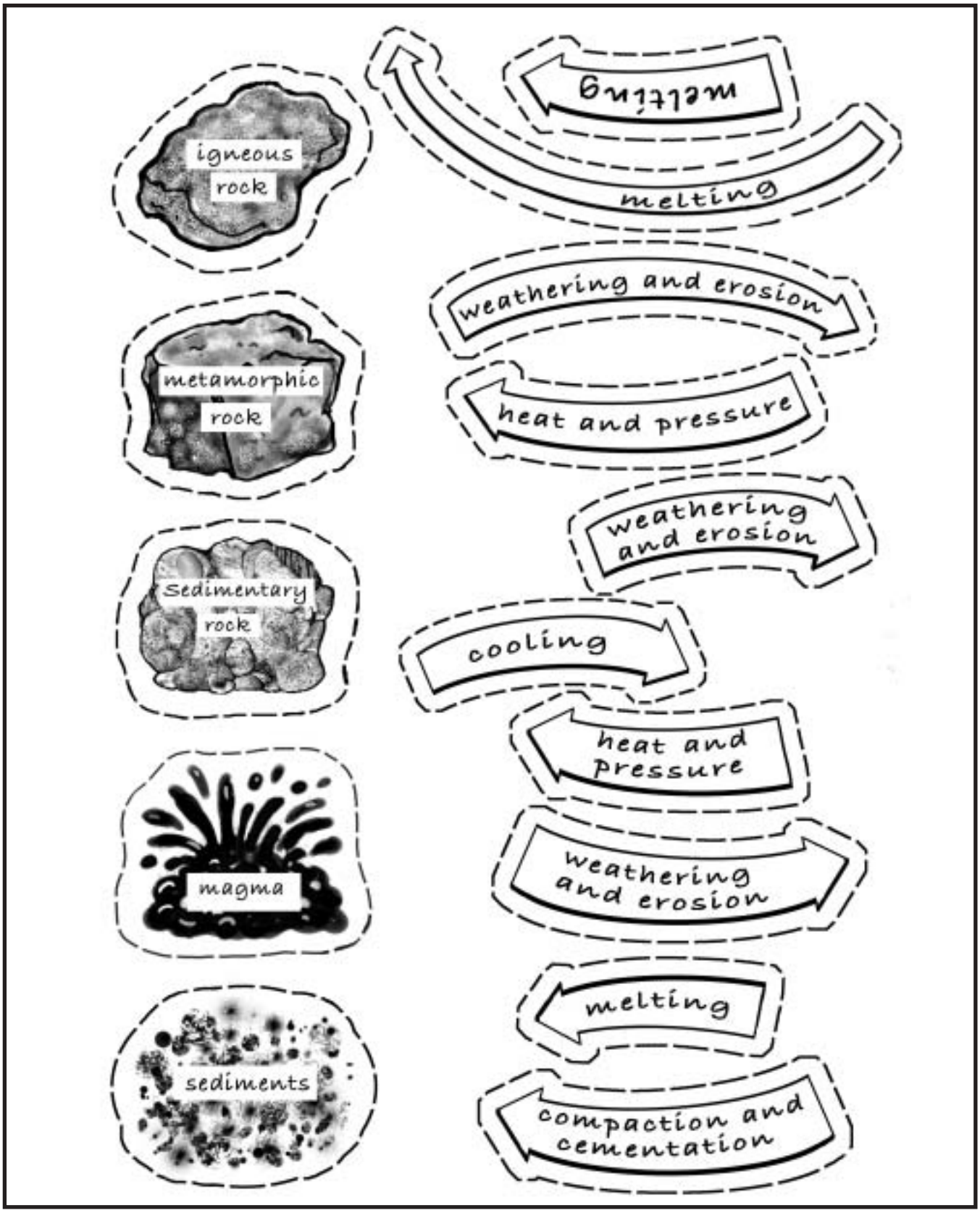
1. Read *Resource 10: The rock cycle*.
2. Using as many of the rock cycle cards as you can, make a flowchart to explain how the rock cycle works.

Here is an example of a flowchart. It shows how the elements in the water cycle interact.

3. Cut out the rock cycle cards and arrange them on an A3 sheet linking them together with the words and arrows cards.
4. Do not glue down the cards until you are sure of where you want to put them all.



Rock cycle cards



Resource 12 Rock and water experiment

Our amazing Earth

Demonstrating outcome EB 4.1

Purpose

To recognise and analyse an interaction between systems (rock and water) on Earth.

Experiment question

Which type of rock falls apart most easily after it has been frozen several times?

Materials

- a plastic container (margarine, yogurt or ice cream tub)
- smallish pieces of different sorts of rock (eg. granite, basalt, sandstone) or building material (eg. concrete, brick, cement block)
- access to a freezer.

What do you predict will happen?

Complete this sentence. I think that the _____ will fall apart the most

because: _____

_____

_____

_____

_____

Procedure

1. Put the rock pieces in a plastic container.
2. Cover them with water and put them in the freezer.
3. When the water is frozen, take container out and let water melt, then put it back in again. Do this several times.

Observations

What happened? Answer these questions:

1. Which type of rock becomes most broken up?

_____

_____

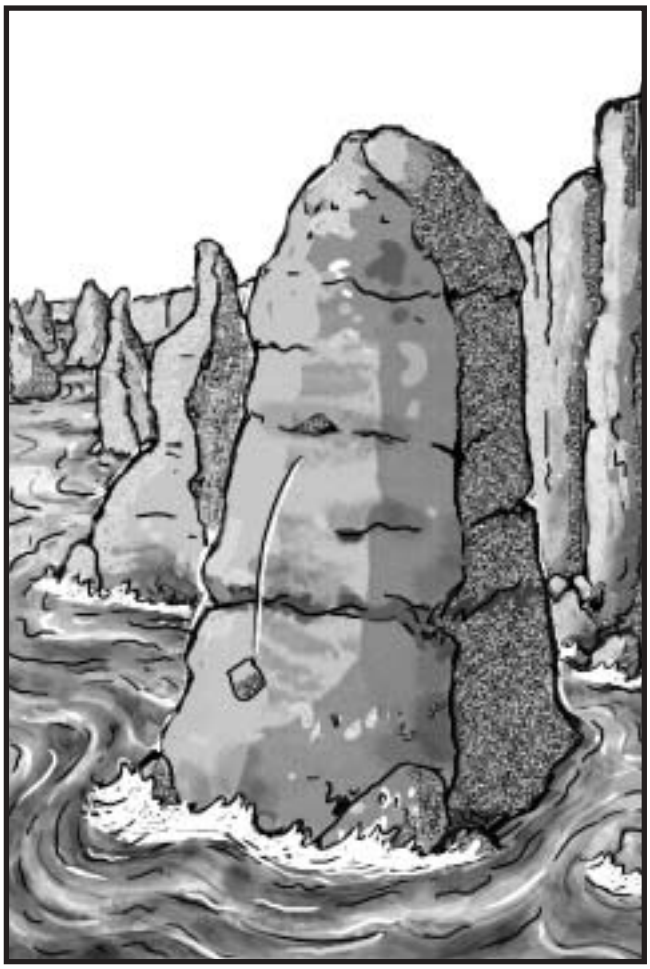
2. Why do you think this is?

_____

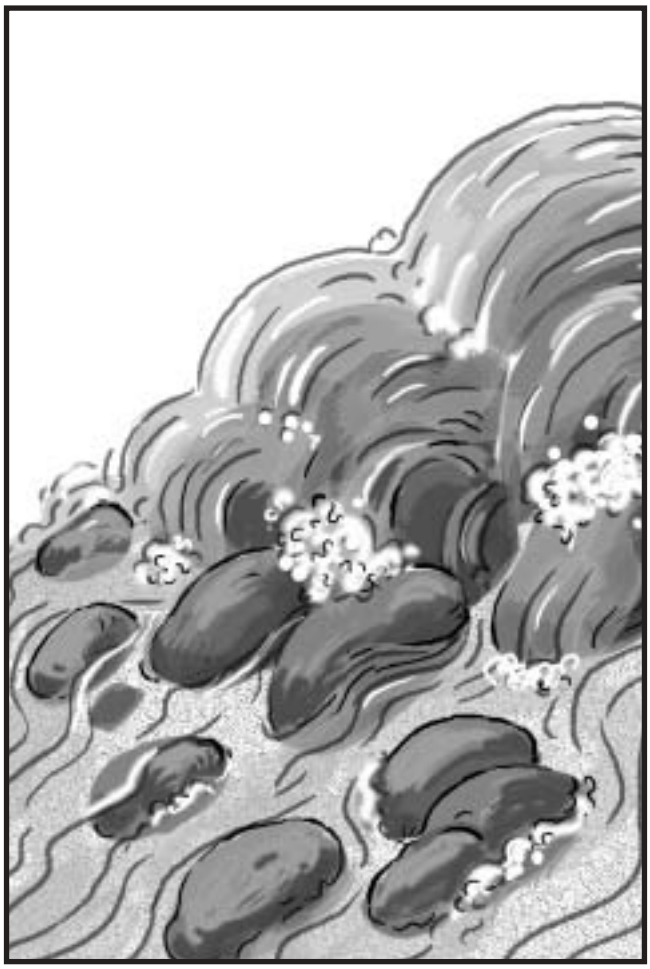
_____

Resource 13 The effect of water on rocks

Weathering and erosion



The action of waves on a beach causes erosion. The waves pound on rocks and over time, cliffs crumble. That is why you will often find sand and little pebbles on beaches. This action also creates some interesting coastal rock formations such as the Twelve Apostles in Victoria.

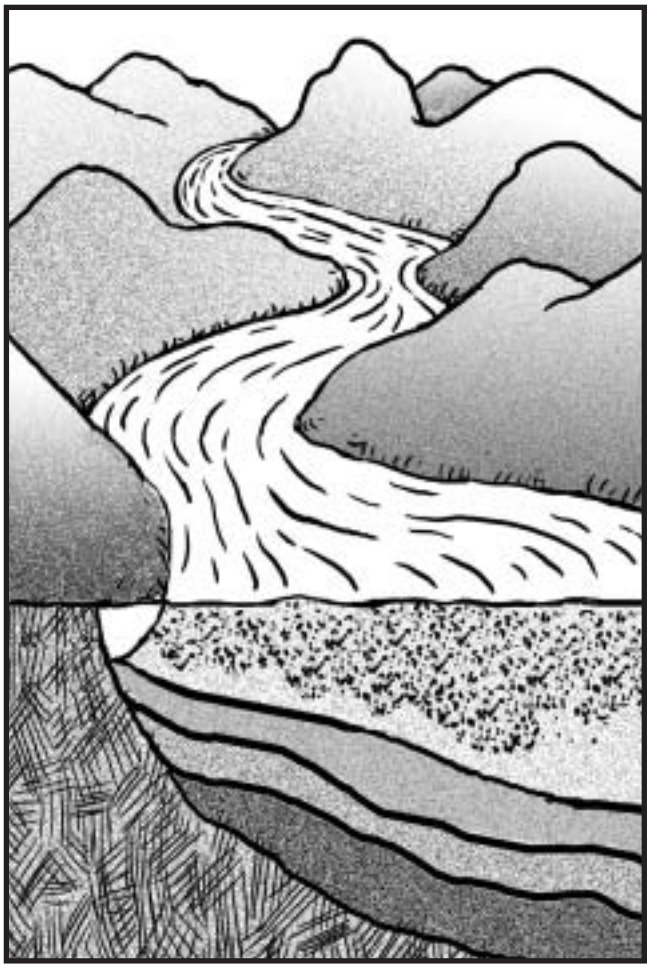


Rushing water in fast flowing rivers in the mountains or strong waves on the shore can roll rocks around. This causes the sharp edges of the rocks to break off. That is why river rocks are smooth and beach pebbles look polished.

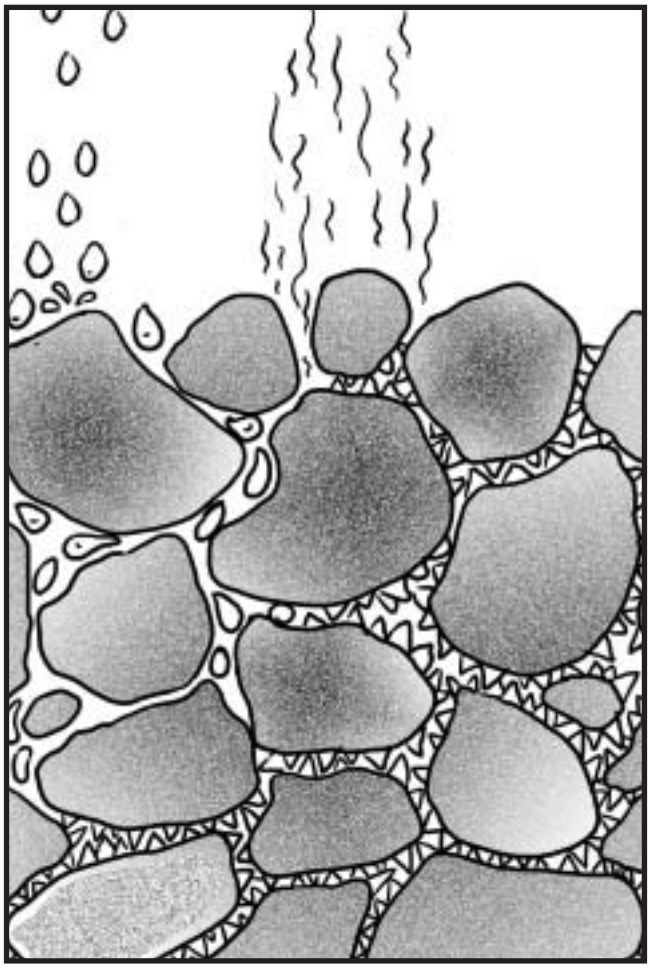
Rock formation

Sometimes water gets into cracks in rocks. If this water freezes, it expands and makes the cracks bigger. Then when the cracks fill up with water the next time, the water gets deeper into the rock because the cracks are bigger. When the water freezes again the cracks get bigger still until the rock splits apart.

Water also plays a part in the formation of some types of rocks. Obsidian or volcanic glass is formed when lava comes into contact with water. The water causes the lava to cool very quickly. The result is a hard, glassy rock.



Most sedimentary rocks, including sandstone and conglomerate, depend on water for their formation. Sediments (such as sand) are washed into lakes and oceans and settle into horizontal layers called beds. Over time they are compacted and cemented together to make rocks.



Some sedimentary rocks are formed when water (full of dissolved chemicals) seeps into the tiny spaces between the sediment grains. When the water evaporates, the chemicals are left behind as crystals around the edges of the grains. These crystals cement the grains together to form rock.

Chapter 2

Exploring rocks and minerals

Strand: **Natural and processed materials**

Key concept: **The properties and structure of materials are interrelated**

Index

Exploring rocks and minerals

Focus questions

What is the difference between a rock and a mineral?

What are these rocks and minerals called?

How can you tell them apart?

Where are they found?

Resource sheets

1. Rock hound guidelines
2. Mineral, petroleum and energy resources in Queensland
3. Queensland mines
4. Rock experiments
5. Mohs' scale of hardness
6. Rock identification key and chart
7. My rock
8. Crystal experiments
9. Salt—up close and personal

Outcomes

The following outcomes can be achieved in your classroom by following the activities and using the resource sheets provided in *Science rocks*. The overview at the beginning of this book also explains which of the activities demonstrate each outcome.

Science outcomes: Natural and processed materials	
2.1	Students group materials on the basis of properties (including solubility, texture and hardness).
3.1	Students examine and describe the smaller visible parts of common materials and relate these to the properties of the materials.
4.1	Students collect information and propose ideas to explain the properties of materials in terms of each material's underlying structure.

Background notes for teachers

Exploring rocks and minerals

Rocks and minerals

Rocks are made up of minerals. Some rocks can be made up of one mineral; others can be a combination of minerals. The way that mineral grains are arranged in rocks is a good clue to their identification.

A mineral is an inorganic (not made from living things) chemical element or compound found in the Earth. It occurs naturally and has a definite chemical composition. This means that it contains the same elements, in the same proportions and also has a crystalline structure (atoms are arranged so that they form a particular geometric shape). Geologists are interested in crystals because they tell them about the internal structure of minerals.

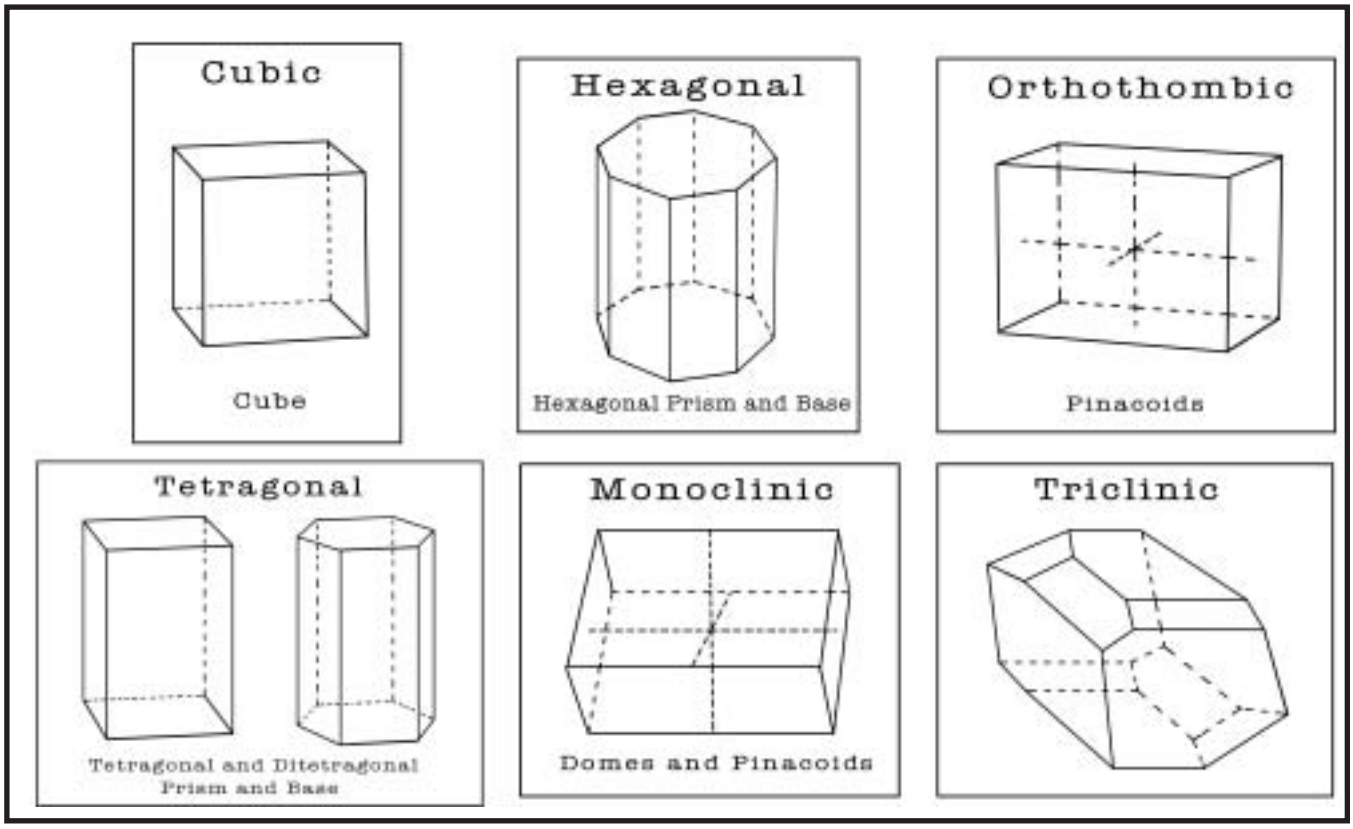
Minerals have definite physical properties, which can be tested. These include lustre, hardness, streak, colour, specific gravity (relative density), rupture (cleavage and fracture), transparency, magnetism and reaction to hydrochloric acid.

Some minerals always have the same colour while others have various colours depending on the impurities they contain. For example, quartz can be white, pink, purple or smoky.

Lustre is the degree to which light is reflected by the surface of a mineral. Minerals such as galena and gold display a metallic lustre. Transparent minerals such as quartz and calcite display a vitreous lustre similar to china.

Types of crystals

Minerals are classified into six crystal systems. Each has a mathematical geometric form. The system with the greatest symmetry (the cubic system) is first. The other systems are organised so that the one with the least symmetry is last.



- Cubic—also called isometric (salt, iron pyrite)
- Tetragonal (zircon)
- Hexagonal (beryl)
- Orthorhombic (barite)
- Monoclinic (gypsum)
- Triclinic (kyanite)

Common rocks and minerals

There are over 4 000 different minerals and hundreds of rock types. However, there are only about 10 common minerals and 20 common rock types found in the Earth's surface. Granite is a good rock to study with students as it is very common and usually contains large crystals of quartz, feldspar and mica—three of the most common minerals.

- The most common igneous rocks are rhyolite, granite, andesite, diorite, basalt, gabbro, peridotite, obsidian, pumice, tuff and scoria.
- The most common sedimentary rocks are shale, mudstone, greywacke, sandstone, conglomerate, limestone and coal.
- The most common metamorphic rocks are slate, phyllite, schist, gneiss, marble and quartzite.
- The most common minerals are quartz, feldspar, mica, olivine, pyroxene and amphibole.
- Other common minerals are calcite, clay, talc, magnetite and pyrite.

Suggestions for rocks and minerals (m) for your basic collection at school

Igneous: granite, quartz (m), basalt, obsidian, feldspar (m), pumice

Sedimentary: sandstone, shale, limestone, gypsum (m), flint, coal, conglomerate, greywacke

Metamorphic: slate, gneiss, marble, quartzite, schist

Teaching and learning activities

Exploring rocks and minerals

Activity A Becoming a rock hound

Students are introduced to rock collecting.

Purpose

To introduce students to the pleasures of rock collecting.

Teaching procedure

- Provide students with a copy of *Resource 1: Rock hound guidelines*. Explain tasks and awards. Copy the awards to show students. Put each one onto a different coloured card. Encourage students to do the chosen tasks over the course of the chapter.
- Encourage students to contact friends and family living in other places to collect and swap rocks commonly found in their local areas. Organise a swap with students in schools in other parts of Queensland, Australia or the world.
- *Resource 2: Mineral, petroleum and energy resources in Queensland* (http://nrm.qld.gov.au/mines/publications/education_awareness.html)

  and *Resource 3: Queensland mines,* which shows locations of rock types and mines in Queensland, are both useful resources for students as they look for specimens and information about rocks and minerals.
- Invite a geologist, gem club enthusiast or other person with an interest in rocks to speak to the students about rocks and their properties.

Activity B Grouping rocks

Students group rocks according to their properties.

Demonstrating outcome NPM 2.1

Purpose

To encourage students to explore the properties of rocks.

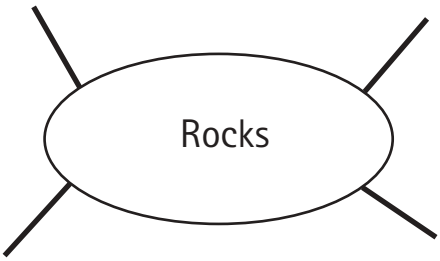
Teaching procedure

- Provide each group of students with a selection of rocks of various types, sizes, colours and textures. Ask students to examine the rocks and think of words to describe them. Record their descriptions on a class list. Vocabulary will vary according to the age and experience of students but will probably include: hard, big, small, grey, brown, white, black, lumpy, scratchy, smooth, shiny, dull, mottled, speckled, grainy, crumbly and layered.
- Invite students to group the rocks according to a property. This could be big/small, light/dark, rough/smooth, solid colour/many colours, shiny/dull. Ask students to explain the division they made.
- Using *Resource 4: Rock experiments* invite students to select a number of experiments to further explore the properties of rocks. Some things to consider when preparing for each of the experiments include:
  - **Colours and patterns:** Provide each group with a selection of rocks that look different.

– **Hardness (1):** Include at least one rock that is soft, such as talc or coal, and one that is hard, such as marble or gneiss.

– **Hardness (2):** This is an experiment for older students. Make sure it is appropriate to mark or scratch any rocks being used for this experiment. This is important if they are borrowed or expensive specimens. Include soft rocks such as pumice, sandstone and talc in the selection. When students have completed recording their results on the table, ask them to place the rocks in order of hardness. Show students *Resource 5: Mohs' hardness scale.* How does this scale compare with the order they put their rocks in? Ask students to wipe the rocks when they are finished.

- Following these experiments ask students to record some of the things they have learned about rocks in a concept map.



Activity C Identifying rocks

Students identify common rocks using a key.

Purpose

To introduce students to identification keys and assist them to identify common rocks.

Teaching procedure

- For this activity you will need one or more of each of the following specimens: granite, basalt, obsidian, pumice, conglomerate, sandstone, shale, limestone, quartzite, marble, slate and schist, coal and gneiss.
- Provide each student with a copy of *Resource 6: Rock identification key and chart.*
- Divide students into groups and place at least one type of rock in front of each group. Guide students through the key.
- When you are finished, give each group a 'mystery' rock (from the above list) and ask them to identify it.

Activity D Examining rocks and minerals more closely

Students examine rocks with hand lenses and record the properties they can see.

Demonstrating outcome NPM 3.1

Purpose

To enable students to learn more about the properties of rocks and minerals.

Teaching procedure

- Invite each student to choose a rock or mineral sample. Provide each student with a copy of *Resource 7: My rock.*
- Give students 10 minutes to look at their sample with a hand lens or magnifying glass. Then ask students to write a description of their specimen, noting the colour(s), weight, size, and shape. Ask students to draw their specimen using coloured pencils to obtain a representation that is as accurate as possible.
- Collect all the specimens and put them in a pile at the front of the room.
- Students exchange their original specimen description with another student. Using the rock or mineral descriptions, the students will then try to find the sample.
- Check to see if each student has the correct specimens.

Activity E Growing crystals

Students grow crystals in the classroom.

Purpose

To allow students to explore the structure of crystals.

Teaching procedure

- Use *Resource 8: Crystal experiments*. Choose between experiment (1) or (2) or do both. The crystals will take days to grow. The solution and temperature will affect the growth as the rate of cooling affects how the crystals grow. Solutions which cool slowly form large crystals while those which cool quickly will produce smaller crystals. Experiment (2) is a faster alternative.
- Experiments can be repeated using alum (available from chemists) or sugar for different results.
- These experiments show the relation between crystal size and the rate of cooling in the formation of rocks. For example, the large crystals in granite formed from a slower rate of cooling whereas basalt with smaller grains cooled quickly.
- These experiments are used as the basis for further exploration in Chapter 3 where students are asked to design their own investigations and test their ideas about how to grow the largest crystals.

Activity F Examining the structure of salt

Students predict, observe and explain the structure of salt as they view it under a variety of magnifications.

Demonstrating outcome NPM 4.1

Purpose

To develop students' understanding that materials may be composed of parts that are too small to be seen without magnification.

Teaching procedure

- Before you begin you will need salt, black construction paper, hand lenses or magnifying glasses and a microscope, slide and cover slip.
- Pour some salt into the palm of your hand and walk around the room allowing students to view it without saying anything. You may use table or sea salt for this activity. (Sea salt crystals are a little larger, making it easier.)
- Once all students have observed the substance, ask the following questions:
  - What do I have in my hand?
  - Does this salt look different from the salt used in your home? If so, how?
- Explain to students that salt can be processed naturally, such as sea salt, or it can be processed in a factory where chemicals are added. Continue with questioning:

– Where do you find salt? How is it used? (Most students will say on food or in cooking, but lead them to other uses, for example, the ocean/sea, curing meat, melting ice.)

– How would you describe salt? (Responses should include shape, colour, odour, taste)

- Then ask students to think about what salt crystals might look like when magnified. Encourage them to think about the shape and texture. Then tell students that they will look at salt under different magnifications and record their observations.
- There are many ways to structure this activity depending on your students' needs, class size, and available equipment. The following model is for small groups and work stations through which students can rotate. The centres can be set up as follows:

- Centre 1: The naked eye— students examine a teaspoon of salt on a piece of black construction paper.
- Centre 2: Hand lens—students examine a teaspoon of salt on a piece of black construction paper with the use of a hand lens or magnifying glass.
- Centre 3: Microscope—students examine a smaller amount of salt with a slide and cover slip under a microscope.
- Centre 4: Electron microscope—students will visit the Science Learning Network web site at <http://www.mos.org/sln/sem/ksalt.html> and look at an image of kosher salt.

• Provide students with a copy of *Resource 9: Salt—up close and personal* and explain that they are going to look at salt using different equipment and magnifications and then record their findings. Encourage students to make detailed observations, descriptions and drawings on this sheet. For example, they should use geometric shapes as they make and record observations; so, they should describe salt in the shape of a diamond, square, etc.

• Before beginning the activity, ask students to predict what salt will look like when magnified, and record their predictions in the appropriate section on the resource sheet. These should be as detailed and descriptive as possible.

• Invite students to make their observations and complete the student sheet. When all students have finished their observations, ask the following questions:

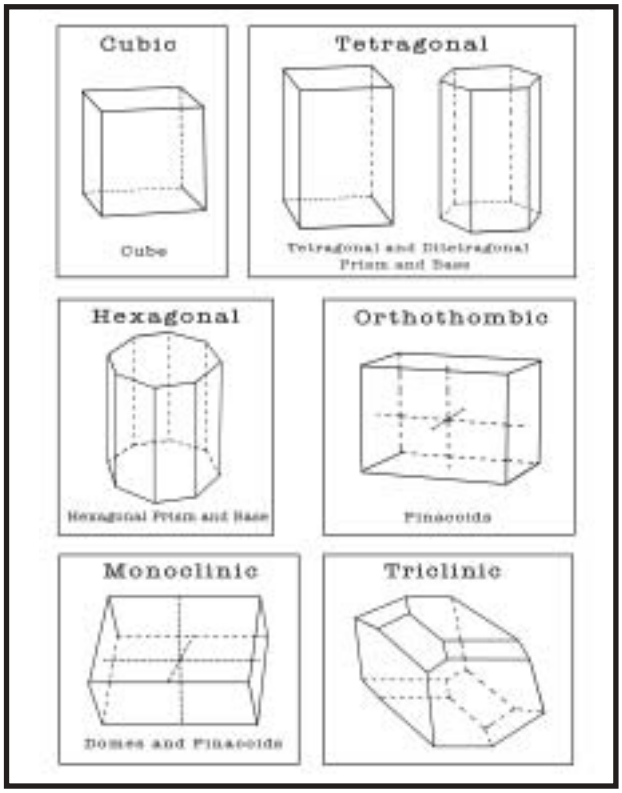
- Why was it important for you to make a prediction? (eg So I could have a record of my thoughts and be more sure of how they changed over time.)
- How did your predictions compare with what you actually observed about the structure of salt? (e.g. The salt really looked like little squares/crystals. The salt was clear rather than white.)
- How were the salt crystals the same under the magnifying glass and electron microscope? How were they different? (Students' responses should focus on the details of the shape and structure.)

• Continue the discussion but shift the focus to the record keeping. Students should recognise how recording observations made it easier to compare and analyse the physical details of salt. Ask:

- What was the most interesting difference noticed with each magnification?
- How did the data sheet help you with this activity?
- Were there any other items that we could have added to the data sheet to make recording observations easier or more complete?

• Collect resource sheets for student portfolios.

• Challange students to make one or more nets based on variations of crystals as shown here.



Source: http://www.sciencenetlinks.com/lessons.cfm?BenchmarkID=4&DocID=173

Resource 1 Rock hound guidelines

Welcome fellow rock hounds. Are you ready to learn more about rocks and minerals and earn awards along the way? Start with the opal and work your way up if you dare. Be as neat as you can. Scientists need to be careful. Good luck and good rock hunting.

Opal award

Do two of the following:

1. Explain the difference between a rock and a mineral. Write your answer in two sentences.
2. Email a geology question you would like answered to a web site with an 'ask the geologist' feature: <geological_info@nrm.qld.gov.au > (note the underscore between geological and info). Print the page as a record.
3. Make a collection of six rocks. Label them and if possible list their origin (where they came from).
4. Make a set of six rock identification cards. Each card must include a drawing or photo of the rock, the name and the type of each rock. You must include some rocks from each of the three rock types.

Sapphire award

Do three of the following:

1. What is a geologist? What does a geologist do? Write your answers in sentences.
2. Draw up a table showing the three types of rocks and list six examples of each.
3. Make a model of a fossil.
4. Photograph and label four to six local geological features (for example, mountain, hill, rock wall in road or rail cutting, headland, cliff, rocky beach, quarry, rocky ground).
5. Create a game that teaches people about rocks and minerals.

Diamond award

Do four of the following:

1. Describe the six types of crystal systems and list a mineral example of each.
2. Identify some geological features, including interesting landforms and major rock types and mineral deposits, from your local area or an area of special interest to you.
3. List five minerals and what they are used for and why they are used for this purpose.
4. Make a model of a volcano.
5. Make a chart showing the geological eras and periods. If possible indicate in what geological time the rocks in your local region were formed.
6. Prepare a six 'page' multimedia (such as PowerPoint) presentation about a Queensland mine. The presentation must include visuals and written text.

ACHIEVEMENT AWARD

ROCK HOUND OPAL LEVEL

Presented to

_____

ACHIEVEMENT AWARD

ROCK HOUND SAPPHIRE LEVEL

Presented to

_____

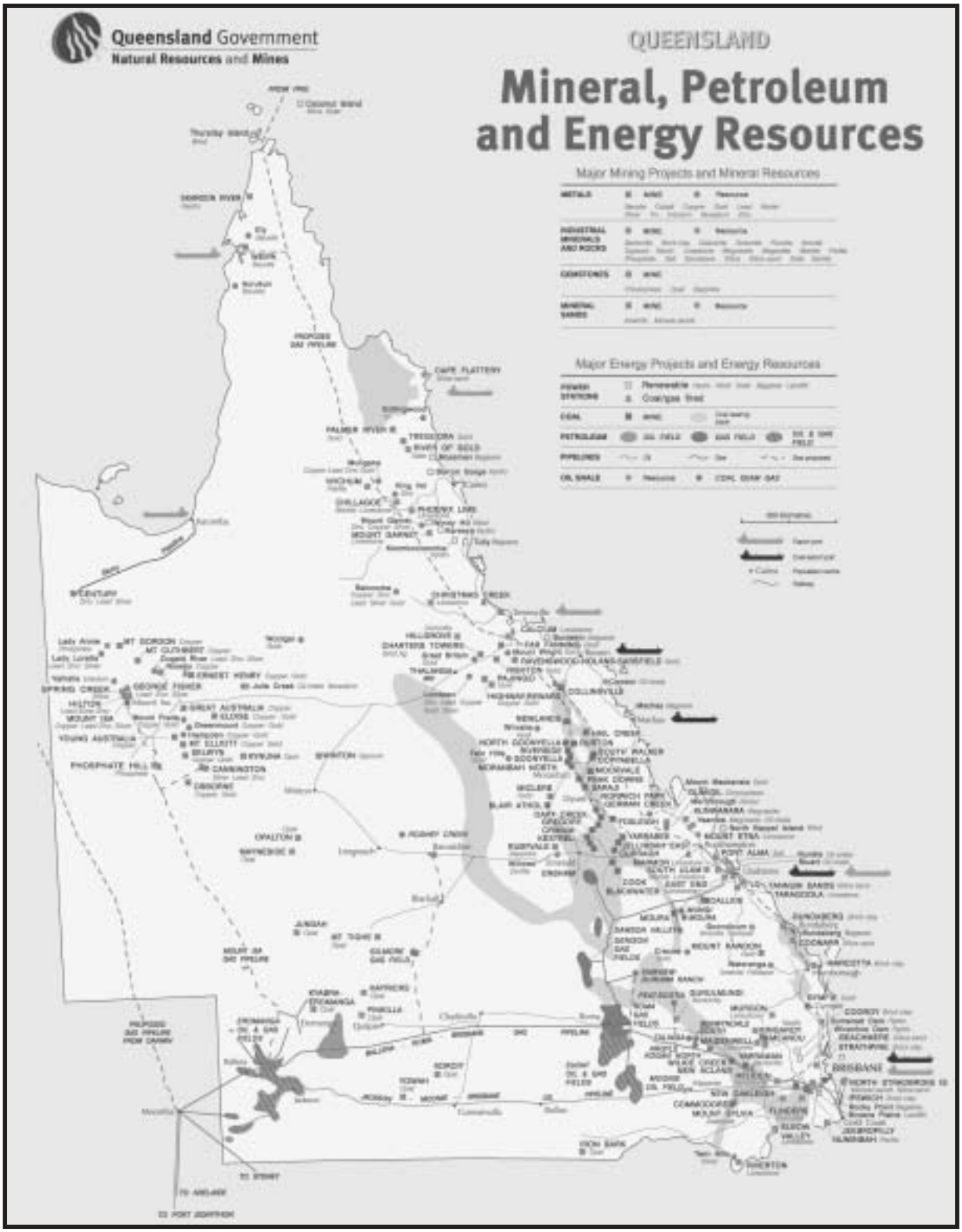
ACHIEVEMENT AWARD

ROCK HOUND DIAMOND LEVEL

Presented to

_____

Resource 2 Mineral, petroleum and energy resources in Queensland



A colour version of this map is available at:
http://www.nrm.qld.gov.au/mines/publications/education_awareness.html#re

Resource 3 Queensland mines

Significant Queensland mineral mines

Mine name	Mineral mined	Location	Mining method
Aquamarina	Marble	8 km south-south-east of Chillagoe	Open-cut
Bajool (Ulam)	Limestone	17.5 km south of Bajool	Open-cut
Boral Brisbane	Brick clay	Darra, Brisbane	Open-cut
Bowder	Brick clay	17 km south-west of Bundaberg	Open-cut
Buckland	Limestone, dolomite	12.2 km west-north-west of Mount Surprise	Open-cut
Cannington	Silver, lead, zinc	140 km south-south-east of Cloncurry	Underground
Cape Flattery	Silica sand	60 km north of Cooktown	Surface
Cathedral Quarry	Sandstone	4 km north-west of Helidon	Open-cut
Cedars	Bentonite	10 km south-west of Yarraman	Open-cut
Cement Mills	Limestone	54 km south-west of Warwick	Open-cut
Century	Zinc, lead, silver	150 km south-west of Burketown	Open-cut
Charters Towers	Gold, silver	0.9 km east-south-east of Charters Towers	Underground
Claypave	Clay/brick tile	Ipswich	Open-cut
Christmas Creek	Limestone	150 km west-north-west of Townsville	Open-cut
Comerford's Quarry	Sandstone	4 km north-west of Helidon	Open-cut
Cork (Zinaback)	Gypsum	110 km south-west of Winton	Open-cut
Cooroy	Brick clay	Cooroy	Open-cut
Coralime	Limestone	4.5 km north-east of Mount Garnet	Open-cut
Curra Limestone	Limestone	13 km north-west of Gympie	Open-cut
East End	Limestone	6 km east of Bracewell, west of Gladstone	Open-cut
Eden Valley	Gypsum	175 km south-west of Winton	Open-cut
Eidsvold	Siltstone	15 km south-east of Eidsvold	Open-cut
Elbow Valley	Limestone	20 km south-east of Warwick	Open-cut
Eloise	Copper, gold	60 km south-east Cloncurry	Underground
Ernest Henry	Copper, gold	38 km north-east of Cloncurry	Open-cut
Far Fanning	Gold	100 km south-west of Townsville	Open-cut
Flinders	Earthy lime, dolomite	45 km west of Brisbane	Open-cut
George Fisher/Hilton	Zinc, lead, silver	19.2 km north of Mount Isa	Underground
Great Australia	Copper	106 km east of Mount Isa	Open-cut
Gro-Fast	Peat	8.7 km west-south-west of Malanda, Atherton	Open-cut
Gumigil	Chrysoprase	15 km south of Marlborough	Open-cut
Gurulmundi	Bentonite	30 km north of Miles	Open-cut

Significant Queensland mineral mines

Mine name	Mineral mined	Location	Mining method
Hadleigh Castle	Gold, silver	28.9 km west of Ravenswood	Open-cut
Highway-Reward	Copper	33 km south-south-west of Charters Towers	Open-cut
Hillgrove Dolomite	Dolomite	74 km north-west of Charters Towers	Open-cut
Hivesville Dolomite	Dolomite	20 km north-west of Wondai	Open-cut
Hugenden	Gypsum	8 km west of Huganden	Open-cut
Ibis	Rutile, ilmenite, zircon	North Stradbroke Island	Dredge
IMT Bentonite Products Gurulmundi	Bentonite	32 km north of Miles	Open-cut
Ingham Lime	Limestone	24 km south-east of Ewan	Open-cut
Inkerman Lime	Limestone	24 km south of Home Hill	Open-cut
Iveragh	Silica sand	2 km south-east of Tannum Sands	Open-cut
Jeebropilly	Bentonite	South-east of Rosewood	Open-cut
Kirknie	Limestone	27km south of Home Hill	Open-cut
Kleinton	Brick clay	Toowoomba	Open-cut
Kunwarara	Magnesite	60 km north-west of Rockhampton	Open-cut
Laroona	Dolomite	95 km north-west of Charters Towers	Open-cut
Limevale Quarry	Limestone	10 km north of Texas	Open-cut
Maidenwell	Diatomite	5km west of Maidenwell	Open-cut
Marcotta	Clay tile	Maryborough	Open-cut
Marmor	Limestone	North of Marmor	Open-cut
Marule Lime	Limestone	21 km north-north-west of Childers	Open-cut
Mayne River	Gypsum	165 km south-west of Winton	Open-cut
Miles	Bentonite	5 km south-west of Miles	Open-cut
Moffatdale	Limestone	6 km south-east of Murgon	Open-cut
Montgomery's Quarry	Sandstone	6 km north-west of Helidon	Open-cut
Moreton Dolomite	Dolomite	20 km south of Ipswich	Open-cut
Mount Etna	Limestone	25 km north of Rockhampton	Open-cut
Mount Cuthbert	Copper	13 km north-west of Kajabbi	Open-cut
Mount Garnet	Zinc, lead, copper, silver, gold	Mount Garnet	Open-cut
Mount Gordon	Copper, cobalt	115 km north of Mount Isa	Open-cut
Mount Isa	Copper, silver, lead, zinc	1.3 km west of Mount Isa	Underground
Mount Norma	Copper	30 km south-west of Cloncurry	Open-cut
Mount Rawdon	Gold, silver	80 km west-south-west of Bundaberg	Open-cut

Significant Queensland mineral mines

Mine name	Mineral mined	Location	Mining method
Mount Sylvia	Diatomite	38 km south of Gatton	Open-cut
Myora	Silica sand	2 km north of Dunwich, North Stradbroke Island	Surface
New Hope Collieries	Brick clay	6 km south-east of Ipswich	Open-cut
Numinbah Perlite	Perlite	McPherson Range, south-east of Beechmont	Open-cut
Nychum	Perlite	50 km north-west of Chillagoe	Open-cut
Nyora	Kaolin	15 km south of Kingaroy	Open-cut
Osborne	Copper, gold	109 km south-east of Duchess	Underground
Oxley	Brick clay	Oxley, Brisbane	Open-cut
Pajingo Vera Nancy	Gold, silver	72 km south of Charters Towers	Underground
Partridge	Limestone	50 km south-west of Sarina	Open-cut
Phoenix Lime	Limestone	11 km south-southwest of Almaden, west of Cairns	Open-cut
Phosphate Hill	Phosphate rock	150 km south-east of Mount Isa	Open-cut
Port Alma	Salt	Port Alma	Evaporative
Ravensbourne	Kaolin	5 km north-east of Ravensbourne	Open-cut
River of Gold Slate Mine	Slate, sandstone	62 km north of Mount Carbine	Open-cut
Riverton Quarry	Limestone	19.3 km east of Bonshaw	Open-cut
Rochedale	Brick clay	Rochedale/Redland Bay	Open-cut
Sarsfield	Gold, silver	1.4 km south-east of Ravenswood	Open-cut
Schultz	Dolomite	87 km north-west of Charters Towers	Open-cut
Scotsman's Folly	Sandstone	2 km south-east of Stanwell	Open-cut
Skardon River	Kaolin	13.5 km north-east of Mapoon, Weipa	Open-cut
Southern Pacific Sands	Silica Sand	12 km east of Caboolture	Open-cut
Stevenson Gypsum	Gypsum	125 km west of Dirranbandi	Open-cut
Strathpine	Brick clay	Brendale, Brisbane	Open-cut
Stuart	Oil shale	11.2 km north-west of Gladstone Power Station	Open-cut
Sugar Lime	Limestone	95 km south-west of Cairns	Open-cut
Sunstate Sands	Silica sand	20 km south of Bundaberg	Open-cut
Taragoola	Limestone	10.5 km south-south-east of Calliope	Open-cut
Undilla	Limestone	140 km north of Mount Isa	Open-cut
Wagner's Quarry	Sandstone	5 km north-east of Helidon	Open-cut
Warbrick	Brick clay, shale	12 km south-west of Warwick	Open-cut
Weipa	Bauxite	5.7 km west-north-west of Weipa airstrip	Open-cut
Whitehill	Earthy lime, dolomite	19 km north-west of Wondai	Open-cut
Wide Bay Pits	Brick clay	Bundaberg region	Open-cut
Willows	Zeolite	2 km south of Willows, west of Emerald	Open-cut
Yarraman	Rutile, ilmenite, zircon	North Stradbroke Island	Dredge
Young Australian	Copper	117 km south-east of Mount Isa	Open-cut

Significant Queensland coal mines

The PCI coal type is pulverized coal injection, a very finely ground coal fuel.

Mine name	Coal type	Location	Mining method
Blackwater	Coking and thermal	Blackwater	Open-cut
Blair Athol	Thermal	Clermont	Open-cut
Burton	Coking and thermal	Glenden	Open-cut
Callide	Thermal	Biloela	Open-cut
Collinsville	Coking and thermal	Collinsville	Open-cut
Commodore	Thermal	Millmerran	Open-cut
Cook	Coking and thermal	Blackwater	Underground
Coppabella	PCI and thermal	Coppabella	Open-cut
Crinum	Thermal	Emerald	Underground
Curragh	Coking and thermal	Blackwater	Open-cut
Ensham	Coking and thermal	Emerald	Open-cut
Foxleigh	PCI and thermal	Middlemout	Open-cut
German Creek Central	Coking	Middlemount	Underground
German Creek Southern	Coking	Middlemount	Underground
German Creek East	Coking	Middlemount	Open-cut
Goonyella	Coking	Moranbah	Open-cut
Gregory	Coking	Emerald	Open-cut and underground
Hail Creek	Coking	Mackay	Open-cut
Jeebropilly	Thermal	Amberley	Open-cut
Jellinbah East	PCI, thermal and coking	Bluff	Open-cut
Kestrel	Coking and thermal	Emerald	Underground
Meandu (Tarong Coal)	Thermal	Nanango	Open-cut
Moorvale	PCI and thermal	Nebo	Open-cut
Moranbah North	Coking	Moranbah	Underground
Moura	Coking and thermal	Moura	Open-cut
New Acland	Thermal	Acland	Open-cut
New Oakleigh	Thermal	Rosewood	Open-cut
Newlands	Thermal	Glenden	Open-cut and underground
North Goonyella	Coking	Glenden	Underground
Norwich Park	Coking and thermal	Dysart	Open-cut
Oaky Creek	Coking	Tieri	Underground and Open-cut
Alliance Colliery	Coking	Tieri	Underground
Oaky Creek No.1	Coking	Tieri	Underground
Oaky North	Coking	Tieri	Underground
Peak Downs	Coking	Moranbah	Open-cut
Riverside	Coking	Moranbah	Open-cut
Saraji	Coking	Dysart	Open-cut
South Walker Creek	PCI and thermal	Moranbah	Open-cut
Wilkie Creek	Thermal	Dalby	Open-cut
Yarrabee	Thermal	Blackwater	Open-cut

For up-to-date maps and statistics about Queensland resources go to <http://www.nrm.qld.gov.au/mines> or <http:// www.agso.gov.au/bin>

Resource 4 Rock experiments

Demonstrating outcome NPM 2.1

Experiment 1

Purpose

Students will find out if colours and patterns of rocks change when they are wet.

Materials (per group)

- 4–6 rocks
- a clear container of water
- paper towels

Procedure

1. Look at each rock and record its colour.
2. Put one rock at a time into the water. Observe any colour or pattern changes.
3. Record your results in the table.

Rock	Colour/pattern	
	Dry	Wet
1		
2		
3		
4		
5		
6		

Experiment 2

Purpose

Students will find out how to test rocks for hardness (1)

Materials

- Five different rocks
- A cloth

Procedure

1. With a felt pen, label each rock sample either 1, 2, 3, 4 or 5.
2. Scratch one rock with each of the others in turn.
3. Rub the mark with the cloth. If you can rub the mark off it is not a scratch—it is bits of the other rock.
4. Record the results of each scratch test on the unshaded boxes in the table. Put a tick in the box if the sample tested was scratched by the second sample. Put a cross in the box if the sample tested was not scratched by the second sample.

Samples tested

Scratched by	1	2	3	4	5
1					
2					
3					
4					
5					

1. Use ticks (✔) and crosses (X) to record your results on the table.

Experiment 3

Purpose

Students will find out how to test rocks for hardness (2).

Materials

- Assorted rocks
- Coin
- Butter knife
- Large nail
- Steel file

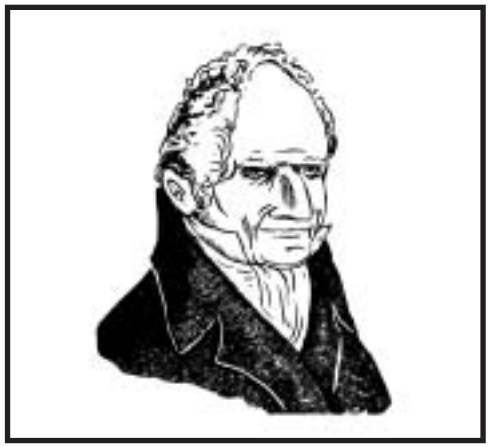
Procedure

1. Try to scratch each rock with a fingernail. Set aside any that are marked.
2. Scratch the remaining rocks with a copper coin. Set aside any that are marked.
3. Scratch the remaining rocks with a butter knife. Set aside any that are marked.
4. Scratch the remaining rocks with a nail. Set aside any that are marked.
5. Scratch the remaining rocks with a steel file. Set aside any that are marked.
6. Place any unmarked rocks in a third pile.
7. Record your results in the table.

Rock	Marked with fingernail	Marked with coin	Marked with butter knife	Marked with nail	Marked with steel file
1					
2					
3					
4					

Resource 5 Mohs' scale of hardness

In 1812 Fredrich Mohs (1773-1839), a German mineralogist invented a scale of mineral hardness. He selected the ten standard minerals and arranged them on a scale of 1 to 10. The softest mineral on the scale is talc. The hardest mineral on the scale is diamond. A harder mineral will scratch a softer one.



Mohs' scale		**Approximate hardness of common objects**
Hardness	Mineral	
1	talc	piece of chalk
2	gypsum	fingernail
3	calcite	copper coin
4	fluorite	nail
5	apatite	glass
6	orthoclase	knife
7	quartz	ceramic tile
8	topaz	steel file
9	corundum	sapphire and ruby are types of corundum
10	diamond	____

Resource 6 Rock identification key and chart

Rock identification key

1. a. You can see mineral grains—go to #2.

   b. Grains are too fine to see—go to #4.

2. a. Grains look melted together or interlocked—go to #3.

   b. Grains look glued together (not interlocked)—go to #5.

3. a. Grains are not lined up. They are randomly scattered. The rock is igneous (granite).

   b. Grains are lined up and appear to be in rows. The rock is metamorphic (gneiss or schist).

4. a. Rock is glassy or bubbly (has small holes). The rock is igneous (basalt or pumice).

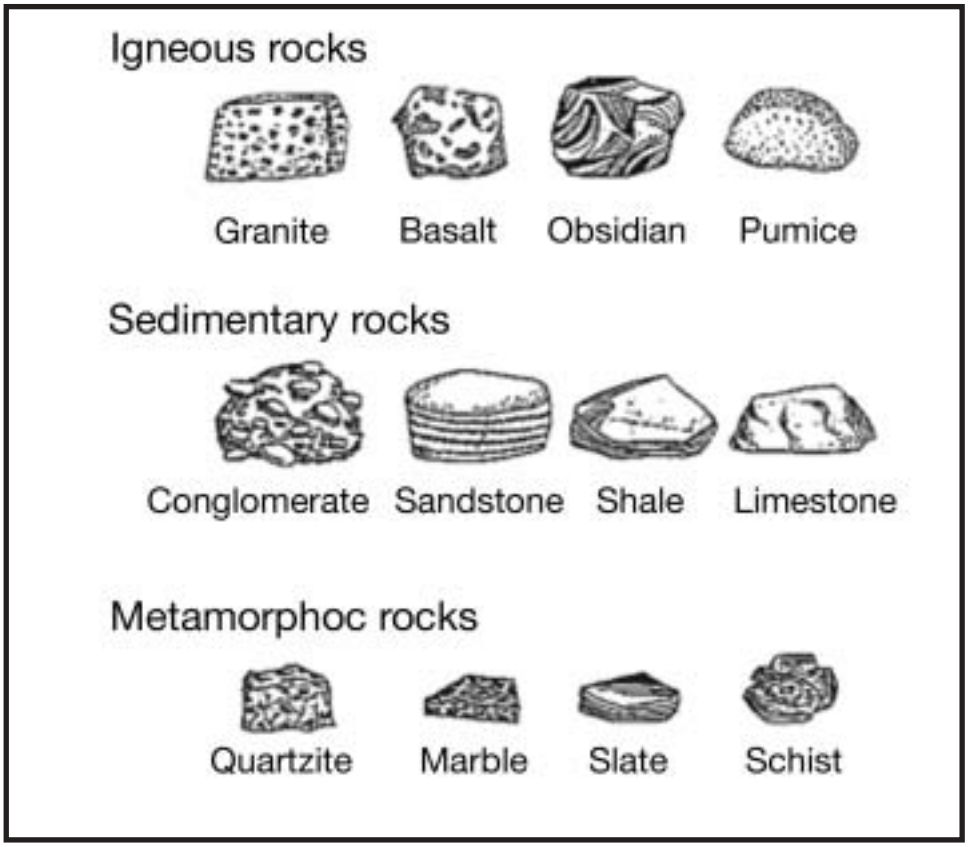
   b. Rock has hard, flat sheets that split off. The rock is metamorphic (slate).

   c. Rock is soft and may be layered. The rock is sedimentary (shale).

   d. Rock is black, soft, brittle, shiny in places. The rock is sedimentary (coal).

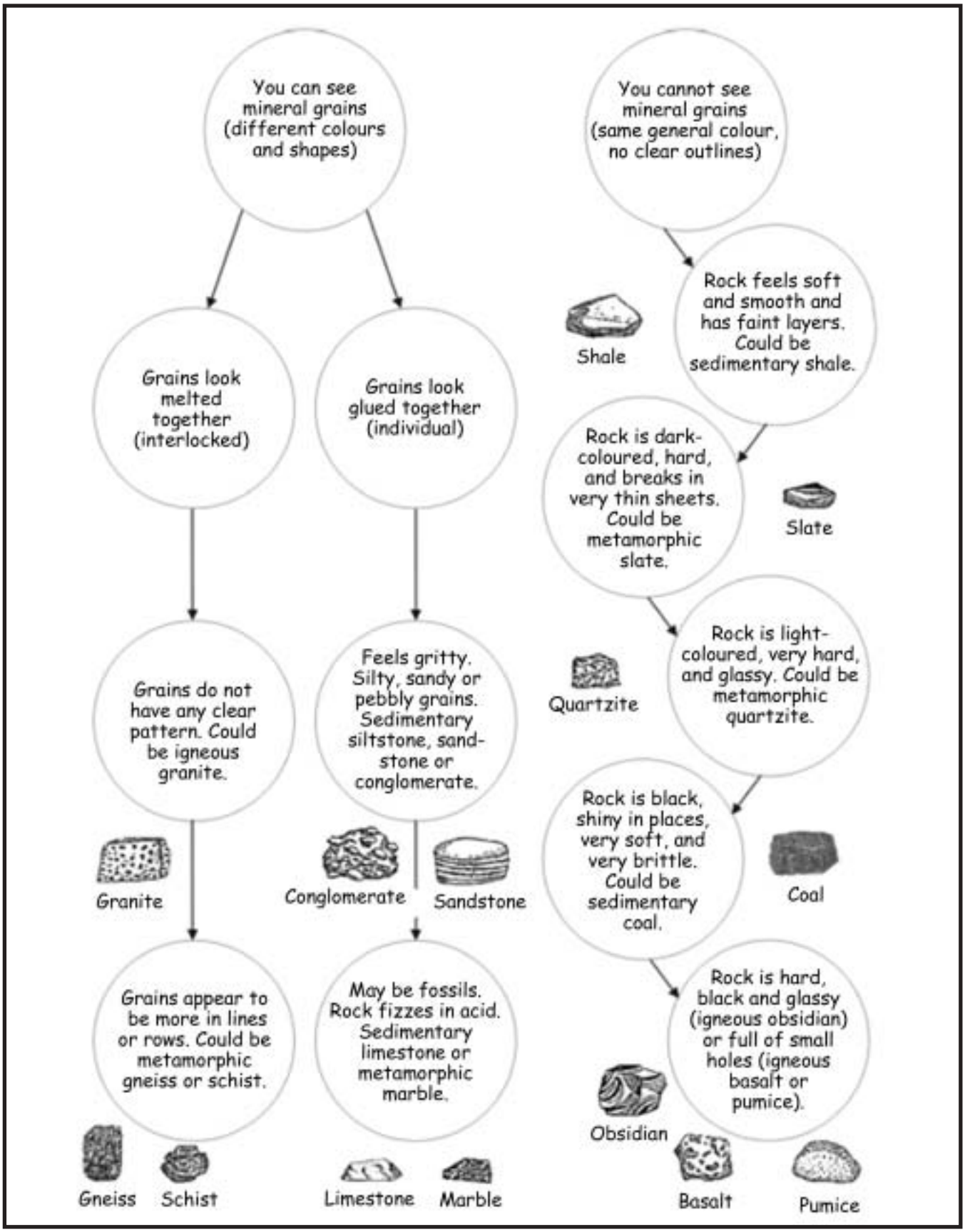
5. a. Grains feel gritty and are silt, sand, or pebble size. The rock is sedimentary (siltstone, sandstone or conglomerate).

   b. Rock fizzes when acid is poured on and may contain fossils. The rock is sedimentary (limestone) or metamorphic (marble).



Source: http://earthnet.bio.ns.ca/activities/rock_id_e.php?topic=5

Rock identification chart



Source: http://earthnet.bio.ns.ca/activities/rock_id_e.php?topic=5

Resource 7 My rock

Demonstrating outcome
NPM 3.1

When you complete this activity you will have examined and described the smaller visible parts of a rock specimen and related these to its properties.

Draw your rock here. Use coloured pencils.

• Describe what you can see using a hand lens or magnifying glass.

_____

_____

_____

_____

• What else can you find out about your specimen? (name, type, minerals present, other properties)

_____

_____

_____

_____

Resource 8 Crystal experiments

Purpose

To enable students to explore the structure of crystals.

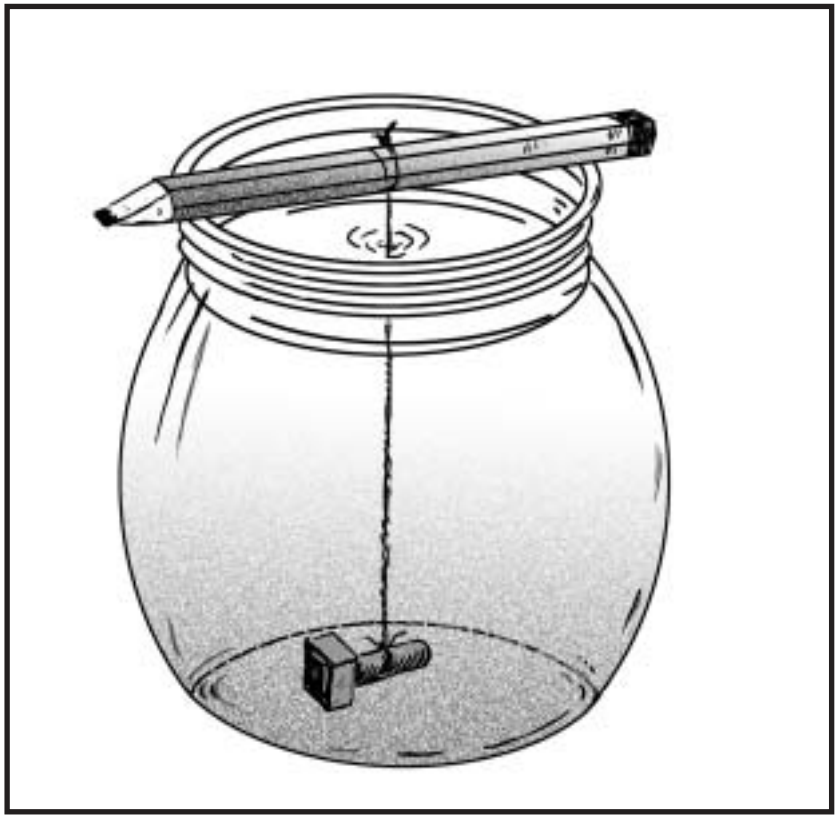
Experiment 1 Growing crystals

Materials

- Glass jar
- Hot water
- Salt
- Cardboard
- String
- Pencil or paddle pop stick
- Nail

Procedure

1. Fill a glass jar with hot water. Add salt as long as it keeps dissolving.
2. Tie string to a pencil or paddle pop stick. Make the string just long enough to reach the bottom of the jar. Weight the end of the string with a nail or a bolt. Drop the string into the solution.
3. Place the jar in a protected, warm place where it can cool.
4. Observe the salt solution each day.
5. Record your observations by drawing a small picture and writing a few short sentences in your science work book.



Experiment 2 Growing crystals

Materials

- Plastic bowl
- Base material: charcoal briquettes, porous brick, cement or sponge
- Water
- Salt
- Laundry blue
- Food colouring

Procedure

1. In a glass or plastic bowl, put some pieces of charcoal, porous brick, cement or sponge.
2. Over the base material, pour two tablespoons of water, two tablespoons of table salt and two tablespoons of laundry blue.
3. The next day add two more tablespoons of salt.
4. On the third day, pour (not directly on the base material) two tablespoons each of salt, water, and laundry blue into the bottom of the bowl and then add a few drops of vegetable colouring or ink to each piece.
5. By this time a beautiful flower-like growth should have appeared. If not, ask your teacher for two tablespoons of household ammonia to aid the growth.
6. To keep it growing, add more laundry blue, salt and water from time to time.
7. Record your observations by drawing a series of pictures and writing a few short sentences in your science work book.

Resource 9 Salt—up close and personal

Make a prediction

In your workbook, draw a detailed picture of what you think a crystal of salt would look like under magnification.

Demonstrating outcome NPM 4.1

Salt data collection table

Observing salt with...	**Written observation** Describe what you see	**Drawing** Draw a picture of what you see	**Make a comparison** Describe how your observation changed with each type of observation
The naked eye			Since this is your first observation, there is nothing to compare. You don't have to write anything this time.
A hand lens or magnifying glass			
A microscope			
An electron microscope (Use the internet)			

Source: http://www.sciencenetlinks.com/lessons.cfm?BenchmarkID=4&DocID=173

Chapter 3

Scientists at work

Strand: **Science and Society**

Key concept: **Science as a 'way of knowing' is shaped by the way humans construct their understandings**

Index

Scientists at work

Focus questions

What jobs do scientists do in the mining industry?

How do they collect information and solve problems?

What is it like to work in the mining industry?

Resource sheets

1. The story of Archimedes
2. A new metal for car engines
3. Stimulus picture of a car engine
4. The biography of Mohs
5. Biography guidelines
6. How do scientists find things out?
7. Rock hound's jumbled interview
8. Interviews with scientists
9. Graphic organisers
10. Who has the biggest crystals?
11. Sample investigation design

Science outcomes

The following outcomes can be achieved in your classroom by following the activities and using the resource sheets provided in *Science rocks*. The overview at the beginning of this book also explains which of the activities demonstrate each outcome.

Science outcomes: Science and society	
2.2	Students identify some ways scientists think and work.
3.2	Students recognise the need for quantitative data when describing natural phenomena.
4.2	Students use the elements of a fair test when considering the design of their investigations.

Note: For further information and activities about working in the mining industry refer to *Exploring mining in Queensland: Past, present and Future*; available from the Queensland Resources Council web site: <http://www.qrc.org.au> or the Department of Natural Resources and Mines web site: <http://www.nrm.qld.gov.au>.

Teaching and learning activities

Scientists at work

Activity A Looking at how scientists work

Students read narratives about scientists who made important discoveries.

Purpose

To introduce students to some of the ways in which scientists make discoveries.

Teaching procedure

- Read *Mr Archimedes bath* by Pamela Allen (Harper Collins) to the students.
- Read *Resource 1: The story of Archimedes*. This is the story that inspired Pamela Allen's book. To help students understand the science in the story, you may like to do this experiment in the classroom. In a container of water, submerge two objects of the same weight, but different volumes, and measure the amount of water displaced. If you're feeling less adventurous, simply show students two objects of similar weight that take up different amounts of space. You could use, for example, a small bathroom tile and a pile of styrofoam that weighs as much as the tile.
- Using a Venn diagram on the black/whiteboard, ask students to indicate the similarities and differences between the stories. When discussing the stories, tell students that sometimes scientists make surprising discoveries. Archimedes' discovery was surprising because he was having a bath when he thought of it.
- *Resource 2: A new metal for car engines* tells the story of an Australian scientist who invented a new alloy. Prepare visual clues for

Words from story	Clues to assist student understanding
Samurai swords	For a photo go to: http://www.dantesknife.com/V7202.jpg
Blacksmiths at forge	For general brief information about blacksmithing and a diagram go to: http://www.homepage.tinet.ie/ ~ecda/blacksmiths-intro.htm For a photo go to: http://www.browncountyblacksmith.com/images/deanatwork.jpg
Alloys	An alloy is a combination of two or more metals (or sometimes a metal and a non-metal mineral). For example, brass is an alloy made from copper and zinc.
Car engine	For a photos of car engines (not the same one as in this story) go to: http://static.redjupiter.com/gems/globalrealty/engine.jpg http://www.solve.csiro.au/1104/article1.htm
Electron microscope	For a photo of a scientist using a large electron microscope go to: http://nanoimaging.sfu.ca/equipment/img/transmission-electron-microscope.jpg For information and images from the device go to: http://www.sciencemuseum.org.uk/on-line/electron/section4/sem.asp
Engine testbeds	For a photo go to: http://www.tokyometer.co.jp/product1/gwe80th.jpg

the selected words from the story by going to the web sites listed in the table and copying the images into a file. When you read the story, you can use these images to assist students to understand the text. Use *Resource 3: Stimulus picture of a car engine* as a visual clue for 'car engine'.

- At this stage you could use *Resource 9: Graphic organisers* to assess what students understand about how scientists think and work. Alternatively, you could leave this until after students have read some of the interviews.

Activity B Writing the biography of a scientist

Students research an Australian scientist of their choice and write a brief biography.

Purpose

To introduce students to the diverse working lives of scientists.

Teaching procedure

- Invite students, working in pairs, to make three lists as described below.
  - –List the books, television programs and movies that have scientists as characters (*Frankenstein*) or actual scientists (*Quantum*) in them.
  - –List types of scientists (e.g. geologist).
  - –List the names of actual scientists (e.g. Galileo).
- Invite pairs to share their lists and construct a class list.
- Discuss the list. What are the differences between the actual and fictional scientists that students have listed? Discuss stereotypes.
- Invite students to research an Australian scientist of their choice and present the information as a biography. Discuss presentation options with students and allow them to choose an appropriate form such as booklet, flowchart or PowerPoint presentation. Discuss the biography genre with students; look at biographies from the library; provide an example and discuss its textual features. A sample is provided in *Resource 4: The biography of Mohs*. Blank proformas are provided in *Resource 5: Biography guidelines.*

Activity C Looking at how scientists observe and measure things

Students make observations and collect qualitative and quantitative data.

Demonstrating outcome SS 3.2

Purpose

To help students recognise the need to collect quantitative data.

Teaching procedure

Make an OHT of Part A of *Resource 6: How do scientists find things out?* Use it as a visual prompt, uncovering each part as you lead the discussion. The instructions and questions given here correspond to the numbered sections on the OHT. Some possible responses are shown in brackets.

1. Scientists make observations using their five senses.
   - What are the five senses? (sight, sound, smell, touch and taste)
   - How can we tell if a banana is ripe or overripe? (use sight, touch, smell and taste)
2. We can improve our senses using tools.
   - Which tools could help a person see better? (binoculars, Braille, glasses, magnifying glass, microscope, telescope, x-rays, contact lenses)

3. We can use our senses to describe objects.

- Give a lolly to a volunteer.
- Ask him/her to describe it using their senses.
- List the descriptions on the blackboard as he/she gives them.

4. There are different types of observations and all of these are valuable.

- Write the words 'qualitative data' at the top of the white/blackboard list you have recorded about the lolly.
- Write the words 'quantitative data' at the top of a new empty column.
- Collect some quantitative data about the lolly. (measure it, weigh it, count the ingredients).

5. Measurement systems are useful when making observations.

- Describe the length of the room. Now describe the length of the room without using a standardised unit of measurement (e.g. metres).
- How would you communicate this non-standard measurement to someone who was buying tiles for the room?
- Would it make things easier to use standardised measurements? Why?
- Can you think of situations where you might need accurate measurements? (carpentry, cooking, nursing, scuba diving)
- Ask Level 4 students about the different types of standardised measurement units they may know (e.g. hours/minutes, amps, Richter scale, Mohs' hardness scale).
- What measuring tools can you name? (e.g. callipers, compass, clock, fuel gauge, scales seismograph, speedometer, tape measure)
- Provide students with copies of Part B.
- Provide an interesting rock (or picture of one if necessary) and display it so all the students can see it.
- Give students time to complete their resource sheets.
- Collect completed sheets for student portfolios.

Activity D Sorting out a jumbled interview

Students read and reorder a jumbled interview.

Purpose

To introduce students to the interview genre in a fun way and to encourage them to find out what a geologist does.

Teaching procedure

1. Provide each student with a copy of *Resource 7: Rock hound's jumbled interview*.
2. Invite students to read it, match up questions and answers and cut and paste the results into their science book.

Activity E Summarising interview responses

Students read interviews with scientists and, using a graphic organiser, they record some ways in which scientists think and work.

Demonstrating outcome SS 2.2 and SS 3.2

Purpose

To introduce students to a range of experiences of scientists working in the mining industry.

Teaching procedure

1. *Resource 8: Interviews with scientists* contains interviews with a geologist, geochemist, geophysicist and a rehabilitation scientist. Invite students to form groups of four. Provide each group with one copy of each interview.

2. Invite each student in every group to choose one and read through it with a partner, acting the roles of interviewer and interviewee.
3. *Resource 9: Graphic organisers* contains three different graphic organisers. 'B' and 'C' relate directly to the interviews. ('A' is a simpler option that may be used by students who have not read the interviews but have done other activities in this chapter.) Choose an appropriate organiser and give to students.

Activity F Conducting your own interviews

Students conduct their own interviews.

Purpose

To provide students with opportunities to talk with a scientist.

Teaching procedure

- Invite students to send interview questions to scientists working locally or further afield. Students could use the same questions used in *Resource 8: Interviews with scientist* or prepare their own. If you are located in a mining community or if there is a working mine in your area, students may be able to interview a scientist working at a mine. Most communities have some scientists working locally. Medical doctors and vets are scientists, and local councils and state government departments have different types of scientists working for them, including geographical information systems (GIS) officers, hydrographers, environmental scientists and botanists.
- Accessing family and friends for interviews is easy. However, if students are contacting a mining or business organisation, or a government department, it would be wise to consider the following:
  - –Decide which organisation you will contact regarding the interview and nominate a student, or small group of students, to make a phone call or send an email. A busy organisation or department may not appreciate 30 letters, emails or phone calls from one group. For a list of Queensland mines see Resource 3 in Chapter 2.
  - –Decide on the questions that will be asked. Students can use the questions in this resource or can prepare their own. Advise students to avoid lengthy lists of questions, as they do not want to deter prospective interviewees. If students prepare their own questions, work with them to ensure that the questions are appropriate and error-free before they are sent.
  - –Make phone contact or email before sending written questions. This ensures that the questions will be welcome and that they will be directed to the right person.
  - –Work with students making the calls so that they develop and use an appropriate phone manner. If possible stay with them when they make the call so you can support them and give them feedback on their telephone skills.
- Provide students with an opportunity to share the responses they receive. Collect and collate responses and place them in your school library as a local-area resource.

Activity G Designing a fair test

Students use the elements of a fair test to design a new experiment to discover what factors could determine the size of crystals.

Demonstrating outcome SS 4.2

Purpose

To provide a model for students to design an investigation using the elements of a fair test.

Teaching procedure

- In Chapter 2 students had an opportunity to grow crystals (*Resource 8: Crystal Experiments*).

The Chapter 2 experiment can be used as a starting point and this activity is designed to take students further and lead them through the steps of designing a follow-up experiment. Refer students back to the original experiment and discuss the process and outcomes.

- Make the steps of designing an investigation known to students. These are:
  - Develop a researchable question.
  - Identify dependent, independent and controlled variables.
  - Measure the change.
  - Present the results.
- Ask students what the variables in the original experiment were. That is, what are all the things that could affect the size of the crystals grown? Make a group list of these. (These are listed as the controlled variables and independent variable in *Resource 11: Sample investigation design.*
- Make an OHT of *Resource 11: Sample investigation design*. Use it to assist students to develop their own researchable question relating to the size of crystals.
- Provide each student with a copy of *Resource 10: Who's got the biggest crystals*. Students researching the same question may work together though their hypotheses may be different.
- Talk with students about their investigation and provide guidance as they carry it out. When complete, invite students to share their outcomes and provide an opportunity for them to reflect on their learning. Keep experiment sheets for student portfolios.

Resource 1 The story of Archimedes

Archimedes was a Greek mathematician, physicist and inventor who lived between 287 and 212 BC. This is a famous story about how he made an important discovery.

Hiero II was King of the Greek city of Syracuse. One day he asked Archimedes, who was a friend of the family, to help solve a problem.

Hiero II had given a goldsmith a lump of gold and asked him to make a royal crown. The king was happy with the appearance of the crown but did not trust the craftsman. Even though the crown weighed the same as the lump of gold, the king thought that the goldsmith may have mixed some silver in with the crown and kept some of the gold for himself.

The king wanted Archimedes to help him discover the truth without melting the crown. Archimedes wondered how he could solve this difficult problem.

Later, as Archimedes was lowering himself into the public baths, he noticed that some water flowed over the sides of the bath. He became so excited that he ran out of the bathhouse without his clothes yelling, 'Eureka! Eureka!' In Greek that means, 'I found it! I found it!'

What had he found? Archimedes realised that since gold is more dense (has more weight per volume) than silver, a given weight of gold has a smaller volume than an equal weight of silver. Therefore a given weight of gold will displace less water than an equal weight of silver.

Archimedes needed to make an experiment to prove his idea. First, he weighed the crown. Then he took a lump of gold and a lump of silver each weighing the same as the crown. Even though the two lumps weighed the same amount, the silver lump was larger because silver is lighter than gold. It took much more silver to weigh as much as the lump of gold.

He put each lump in a tub of water. Because the lump of silver was larger, it caused more water to overflow than the lump of gold did. Archimedes then knew that if the crown were pure gold it would displace the same amount of water as the lump of gold.

When Archimedes submerged the crown, it made more water overflow than the lump of gold did. This experiment proved that the goldsmith had added silver to the crown. The king's suspicions were confirmed and the dishonest goldsmith was beheaded for his theft.

Resource 2 'A new metal for car engines' by Colleen Bettles

My particular scientific interest is Metallurgy. Metallurgy is a very old science. The craftsmen who made the samurai swords in Ancient Japan were metallurgists. Blacksmiths working at a forge use techniques of metallurgy to make horseshoes. Metals as we know them are usually alloys. Alloys are mixtures of several different elements carefully combined and heated to give them special properties such as strength or stiffness.

I was asked to make a new alloy that can be used to make parts of a car engine. The new alloy had to be lighter than the metals used today but strong enough to keep its shape when the engine was running.

My next step was to choose which elements to mix together to make the new alloy.

I chose the ingredients that I thought would work and mixed them together at very high temperatures so that the metals melted. Then I cooled the liquid metal quickly to solidify the mixture. At this stage we looked at the new metal with a range of microscopes to see the individual grains of material that were joined together to make up it up. We measured the size and shape of the grains and photographed them. (When you develop a new metal alloy you must carefully control the size of these grains and also try to produce very small particles inside the grains.) To see the small particles inside these grains, we used an electron microscope to magnify the metal up to 20 000 times. We observed the size and location of the very fine particles and took many photographs from several different angles to create a 3-dimensional picture of the metal.

Now we had to test the metal to see if it was strong enough. To do this, we pulled apart specially prepared samples of the metal and recorded the amount of force needed to break them.

Then, we reviewed the photographs from the microscopes and studied the particles in detail. We made changes to the composition of the new metal, melted it and tested it again. The whole process of observation, measurement and comparison was repeated several times before we found the recipe, which created an alloy with all the properties requested by the designer.

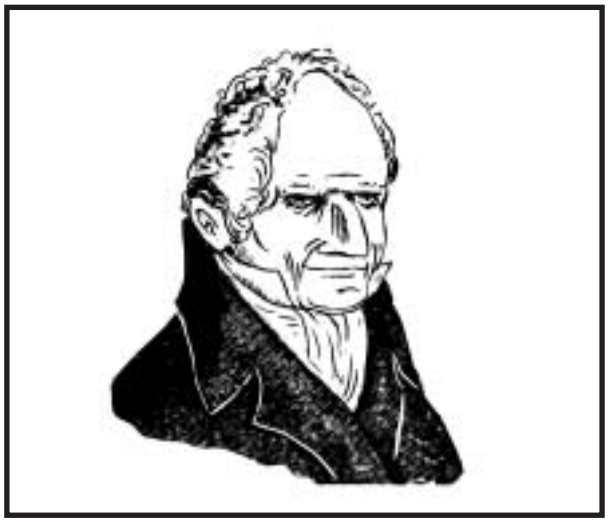
All of this work was done on small samples of about 500 grams. The next step involved making much larger batches of the metal in a factory and making sure it still had all the properties we needed. The engine components were made using the new alloy and tested on engine testbeds to make sure that the engine was running properly. After this stage was successfully completed, the engine was put into a car for a full test run. This car was driven for 65 000 km over almost three years and then its engine was removed, pulled apart and checked thoroughly to see if the metal had performed well and to check that there had been no change in the shape, particularly around the cylinder walls.

It was very exciting to see an alloy that I invented made into real parts and used in an engine. But scientific research is not for impatient people. It took our team three years to produce this new alloy. We had to do painstaking testing and recording of all results. However, the continuous pushing into the unknown and the excitement of discovering something new made it all worthwhile.

Resource 3 Stimulus picture of a car engine

For further information read the related article from the CSIRO at:
<http://www.solve.csiro.au/1104/article1.htm>

Resource 4 The biography of Mohs



Friedrich Mohs

Timeline

Date (year)	Event
1773	Born in Gernrode, Germany.
1798	Began studying maths, chemistry and physics at the University of Halle, then studied mineralogy at the Mining Academy at Freiberg.
1801	Became pit foreman/mining inspector at the Neudorf lead mines
1802	Commissioned to sort and describe the mineral collection of a banker from Vienna. There he devised a classification system of minerals, which he published two years later.
1812	Became professor of mineralogy at Johanneum University in Graz, Austria. While there, he developed and published his hardness scale.
1824	Published a book about the six types of crystals explaining them mathematically.
1839	Died in Agordo, Southern Italy while studying its volcanic areas.

Biography outline—Mohs

Biography outline	Heading
Friedrich Mohs was a talented mineralogist who devised a scale for measuring the hardness of rocks. He also developed a system for classifying rocks based on their physical properties.	Introduction What has he/she achieved?
Mohs was born in Germany in 1773. When he was twenty-five years old he went to study maths, chemistry and physics at the University of Halle. From there he studied mineralogy at the Mining Academy at Freiberg. In 1801 he began work as a pit foreman and mining inspector at a lead mine in Neudorf. The next year he moved to Vienna in Austria to catalogue the mineral collection of a wealthy banker. While he was doing this, he created a systematic way of classifying minerals. He published this system in 1804. By 1812 he was professor of mineralogy at the Johanneum University in Graz, Austria. There he developed and published his famous hardness scale. He continued to work at universities in Austria and Germany and in 1824 he published a book about the six types of crystals. He died in 1839 while studying volcanic areas in southern Italy.	Series of events List the events in the order. Use your timeline.
Today, scientists and science students still use his system of describing types of crystals and his scale for measuring the hardness of rocks.	Conclusion Why is he/she important?

Resource 5 Biography guidelines

1. Choose an Australian scientist.
2. Find out:
   - What did this person do and in which year did it happen?
   - Why is their work is important?
3. Record this information on the timeline.
4. When your research is finished use the biography outline to write the biography.

Timeline

Date (year)	Event

Biography outline

	Heading
	Introduction What has he/she achieved?
	Series of events List the events in the order. Use your timeline.
	Conclusion Why is he/she important?

Resource 6 How do scientist find things out?

Part A

1. Using our five senses to make observations

a. What are the five senses?

b. How can we tell if a banana is ripe or overripe? Which senses could we use to find the answer to our question?

2. Improving our senses using tools

a. Which tools could help a person to see better?

3. Using our senses to describe an object

a. Describe this object using your senses.

4. Making different types of observations

a. Qualitative data can be collected, without devices, by using the five senses.

b. Quantitative data always produces numbers.

5. Using measurement systems to collect data

a. Scientists can use the metric system to collect quantitative data.

b. Can you think of situations where you might need accurate measurements?

c. What measuring tools can you name?

Part B

Demonstrating outcome SS 3.2

When you complete this activity you will have recognised the need for quantitative data when describing natural phenomena.

Look at the object your teacher has displayed. Use this page to answer the questions about the object.

_____

What is the object?

What qualitative data could you collect about this object?

_____

_____

_____

_____

What quantitative data could you collect about this object?

_____

_____

_____

_____

What tools could you use to measure this object?

_____

_____

_____

_____

_____

Why could it be useful to have quantitative data about this object?

_____

_____

_____

_____

_____

Resource 7 Rock hound's jumbled interview

Our Rock hound interviewer managed to mix up the notes from her interview with geologist Linda Dobe. Read the mixed up interview then cut out and reorganise the answers. Glue them in so that they match the questions.

Rock hound:

How do you become a geologist?

Linda:

Geologists collect data by making visual observations of rock types and mineral composition, and recording them. This information is used to make a geological map. They also collect soil and rock samples, often from drill holes, and chemically analyse these to find out what they are made up of. It is important that we collect quantitative data so that a real picture can be created based on fact instead of one person's opinion.

Rock hound:

What does a geologist do?

Linda:

At a particular site we were trying to work out if there was enough gold to make it worth mining. I collected information about the rocks on the ground including quartz, which contained the gold, and did some calculations to work out where the quartz veins might be located below the ground. I then calculated where to put the drill holes so we could reach these quartz veins. The drill core samples were collected and analysed by a laboratory for concentrations of gold. In this case there was not enough gold in the quartz veins to make it worth mining.

Rock hound:

How do you collect and use information?

Linda:

A geologist examines rocks and tries to work out how the rocks have ended up the way they are. If you are a mineral, coal or petroleum exploration geologist, you also try and work out where there are enough of these resources so that they can be mined. You really are a detective looking back in time, often with very few clues to help you.

Rock hound:

Describe a place/s you have worked and what it was like working there.

Linda:

A good scientist is someone who asks questions and can work out how to find out the answers. A good scientist is also someone who can make observations, record them accurately and notices what is 'out of the ordinary'. A good scientist is interested in how the world 'works'.

Rock hound:

Can you explain a problem you had and how you solved it?

Linda:

I worked for a year as an exploration geologist in the Pilbara desert in Western Australia. We were exploring for gold in some of the oldest rocks on the planet. They were more than four billion years old! I lived in a canvas tent with work mates in the middle of absolutely nowhere. We had a caravan as an office and a tent as a kitchen. A water bore supplied water for washing up and the shower, while a generator supplied electricity. We got hot water from lighting a fire under a 44-gallon drum of water. It was an absolutely beautiful place and it was lots of fun living there. However, even though you made friends with those you worked with, you couldn't really get in touch with other friends or family very easily as it was half a day's drive to the nearest phone. Today, satellite phones make communication easy.

Rock hound:

What do you think makes a good scientist?

Linda:

I wanted to do science at university, but I didn't really know what subjects to do, so I did almost all of them! I really enjoyed first year geology, so I continued with it. I really enjoyed the fieldwork, which was getting out into remote areas looking at rocks and trying to work out how they were formed.

Rock hound:

Why did you become a geologist?

Linda:

You do a science degree majoring in geology at university.

Resource 8 Interviews with scientists

Interview 1: Meet geochemist, Chris Towsey

1. Why did you become a geochemist?

I had a really interesting science teacher at high school, who was very enthusiastic about chemistry. I was also given a chemistry set in Year 6 and had a lot of fun with that. After high school I joined the Port Kembla steel works (NSW) as a trainee chemist, but was very disappointed in that sort of work. So, I went to university not really knowing what I wanted to do and enrolled in geology. My favourite subjects were geology and chemistry. I liked geology so much that I became a geologist.

2. How do you become a geochemist?

You need a university degree in science (Bachelor of Science), specialising in chemistry or geology. Geochemists can work in the minerals industry as I do, or in coal, oil and gas, industrial minerals, sand mining or university research areas.

3. What does a geochemist do?

A geochemist studies the chemistry of the Earth, usually for a specific purpose, such as detecting trace amounts of chemicals that will lead to a material deposit (such as copper, gold, oil or coal) that can be mined or extracted. It usually involves a lot of work in the bush, collecting samples that will contain chemicals. The samples can be rock chips, sand and gravel from creeks, soil, creek or bore water, gases contained in soil, plant leaves and bark, or even animal and insect life, such as sampling termite mounds or the termites themselves. Geochemists even sample things like trout livers, which may contain heavy metal toxins such as lead, zinc, copper, uranium or mercury. This can occur when water flows over, or drains from, an ore deposit.

4. How do you collect information and how do you use it?

We collect samples in the bush. These are taken back to a laboratory to be analysed by very high-tech equipment. The results are often graphed or mapped to produce contour maps or coloured images to show the way the chemicals are distributed. We then interpret the patterns to see where the chemicals may have come from.

5. Can you explain a problem you have faced and how you solved it?

I was asked to look for a gold deposit in a part of central Queensland at minimum cost. I designed a method of sampling creek sands, sieving out the fine sand, analysing it for very low levels of gold using a special chemical process. We used a helicopter to cover the area quickly. From these

results we found small areas with high gold values and collected soil and rock chip samples, which we analysed for gold. Using this method we found seven gold deposits, which were drilled to see if they were big enough to be mined.

6. Describe a place/s where you have worked and what it was like working there.

I have worked in twenty countries including Taiwan and Fiji. The most exciting place was in the highlands of Irian Jaya (West New Guinea) where I worked with people from a mixture of cultures, including Indonesian and West Papuan at over 4500 metres altitude in very steep mountains with high rainfall. There was even a snow-covered glacier on top of the mountains in a tropical jungle.

7. What do you think makes a good scientist?

A good scientist has good attention to detail, makes careful observations, and records results carefully. Always test conclusions by designing control tests and be prepared to change your theory or hypothesis if the facts do not support it.

Interview 2: Meet geologist, Doug Young

1. Why did you become a geologist?

I became a geologist because I was interested in science and found the outdoor life of a geologist attractive.

2. How do you become a geologist?

When I left school at grade 12 level, I went to university in Adelaide to study science. I had a preference for chemistry but found geology really interesting so I ended up completing my degree in geochemistry (a combination of geology and chemistry).

3. What does a geologist do?

As an exploration geologist, I spend time searching for minerals and coal. I particularly look for gold and base metals such as copper and zinc. This involves a great variety of tasks, not only in the office and in research libraries, but also following up leads in the bush. Exploration is a bit like forensic science—you search for clues using maps and reports found in the library. You then propose

an idea about where you may find gold and copper occurrences and last of all you go out into the area and test the idea by looking for evidence, taking samples and drilling cores.

4. How do you collect information and how do you use it?

I collect information in a variety of ways—by reading and researching in the library and by studying maps of various types, such as geology maps and maps of mineral occurrences. A lot of this information I adapt to my computer to produce new maps and images from which I can develop my ideas. When I am in the bush I collect information by observation (making new geology maps) and taking measurements of rocks and structures. I also collect samples of interesting rocks for chemical tests and take readings of the magnetic properties and electrical properties of rocks.

5. Can you explain a problem you have faced and how you solved it?

Working in exploration you are always confronted by interesting problems, which you have to solve. Whether it is finding a way to get across a boggy creek or trying to work out where the indications of copper you have found have come from, there are always questions to be answered. Often, the most perplexing question involves understanding the rocks and structures and how the copper and gold fit into the picture. To solve these sorts of problems we often have to decide where the best place is to drill a hole so that we can see what rocks are under the ground. Drilling is an exciting time as we find answers to our questions. Often we see gold in the core samples and we use the results to plan the next drill holes.

6. Describe a place/s where you have worked and what it was like working there.

I have done a lot of work around Cloncurry, which is in north-west Queensland, near Mt Isa. Mt Isa is a mining town and there are several mines in the area and the whole area is interesting for copper and gold. I work from Cloncurry, which is a small town of about 500 people and I go out with a small team of 2 to 10 people to collect information. We often work several hundred kilometres from town and camp out near the area where we are working. If we are working there for a couple of weeks we set up a good camp by a waterhole and have caravans, showers, a power plant and fridges to keep our tucker cool. Sometimes we are continually moving from site to site and often we just take swags and cook over camp fires at night. It's great sleeping out and you see enormous numbers of stars in the night sky, including shooting stars.

7. What do you think makes a good scientist?

A good scientist is a person who is inquisitive—one who likes searching for evidence, has lots of ideas and likes putting together a 'theory'.

Interview 3: Meet rehabilitation scientist, Lauren Keliher

1. Why did you become a rehabilitation scientist?

I have always been interested in the environment and I love animals and plants. Being a rehabilitation scientist allows me to learn about different plants and animals and what food and shelter they need so they can adapt to a minesite.

2. How do you become a rehabilitation scientist?

To become a rehabilitation scientist you need to finish year 12 at school and go to university. At university I studied environmental science, but you could study any course related to the environment or mining. I concentrate on land issues, relating to vegetation, soils and fauna.

3. What does a rehabilitation scientist do?

A rehabilitation scientist looks at ways to help plants and animals return to areas that have been disturbed through mining. A rehabilitation scientist also helps other people to understand the environment so they can consider what they are doing and how their actions may affect the environment, especially plants and animals.

4. How do you collect information and how do you use it?

I collect information about the environment by reading lots of books and going out to the mine to make observations. I record the things I see by taking photographs and writing notes. There are many different things to study on a minesite. They include animals, plants, water, weather, soil and rocks. It is important to understand the relationships between different things. For example, a tree needs good soil and rain to survive and animals need trees for food and protection. If an animal in the area needs a special plant for food, it is important to make sure these plants are planted on the minesite so it can survive.

5. Can you explain a problem you have faced and how you solved it?

When water comes in contact with exposed rocks on the old Mount Morgan minesite, the water becomes contaminated with sulphuric acid and heavy metals, and flows to a nearby river. Sometimes fish die from the water that runs off the old minesite. To stop this happening we have covered the acid-generating rocks with clean soil and vegetation in a trial area. This makes sure that rain cannot touch the rocks and that clean water runs off the mine into the river. This is good for the health of the minesite and the river.

6. Describe a place/s where you have worked and what it was like working there.

I am currently working on a minesite that was once Australia's largest gold and copper mine. No mining takes place any more, but there are many interesting old buildings and mining areas that have heritage value. Part of my job is to look after

the buildings and keep the minesite safe. I also have to study the plants and animals on site to make sure the exposed rocks do not affect them. When the miners found dinosaur footprints in some rocks at the site, I really enjoyed learning about the dinosaurs and making this area safe and interesting for visitors.

7. What do you think makes a good scientist?

I think a good scientist should enjoy solving problems and enjoy reading and learning about the environment. It is important to ask a lot of questions and then work your way through each question until you understand the problem. Then you look at ways to fix the problem. To be a good scientist you have to be interested in what you are doing.

Interview 4: Meet geophysicist, Andrew Mutton

1. Why did you become a geophysicist?

When I was at school, I enjoyed doing subjects like science and maths, and was very interested in how things worked. I also liked to learn about the Earth, the solar system, what the Earth and planets were made of, and how the Earth formed. I liked science subjects like physics, chemistry and geology. When I left school, I decided to do a general science course at university, where I learned about geophysics and how it is used to study the inside of the Earth. I decided then to become a geophysicist, as I believed that this was a good way of combining my interest in geology and physics.

2. How do you become a geophysicist?

To become a geophysicist, you have to go to university and study science subjects including geology, physics, and maths. Once you complete your university studies, you can apply for a job as a geophysicist with a mining or oil company, or with the government.

3. What does a geophysicist do?

A geophysicist investigates what types of rocks occur below the Earth's surface. To do this, the geophysicist uses measurements of the Earth's magnetic and gravity fields, or measures how sound waves, set off by earthquakes, move through the rocks. From these measurements, a geophysicist can predict what rocks are below the surface, and if there are any deposits of minerals or oil within the rocks.

4. How do you collect information and how do you use it?

A geophysicist uses specialised scientific instruments to measure the Earth's physical properties. These are generally measured at the Earth's surface, but can also be measured in aeroplanes flying over the land or sea. A magnetometer is an example of a special instrument used by geophysicists to measure the Earth's magnetic field. A geophysicist can predict what types of rocks occur below the surface, and if there are any deposits of minerals such as copper, gold, diamonds, or coal in these rocks.

5. Can you explain a problem you have had and how you solved it?

I was asked to consider a remote area of Western Australia and predict how far beneath the earth's surface we would have to dig before finding some copper minerals. I designed a magnetometer survey to collect the magnetic field results over this area and was able to determine that the minerals were about 250 m below the surface. We tested this by drilling a narrow hole into the rock at the point that I had calculated from the survey results. The rock taken out of the drill hole showed that the copper minerals did occur at about the depth I predicted.

6. Describe a place/s where you have worked and what it was like working there.

Most of the work I have done has been in outback parts of Australia, usually where there are no towns and very few people. For example, I spent three months in charge of a magnetometer survey using an aeroplane to collect the results, over the remote western desert areas of the Northern Territory. We had to set up our own camp near a dirt airstrip to be able to do the work, because it was hundreds of kilometres from the nearest town. The camp consisted of tents to live in, a tent kitchen and office. It was a fantastic place to work, even though it was very remote.

7. What do you think makes a good scientist?

A good scientist must firstly be able to clearly understand the problem or task that you are attempting to solve, and decide what methods or techniques will help you to solve the problem. You must then be able to collect good quality data, which will help you to solve the problem. Then you must be able to analyse the data in a way that produces solutions to the problem. Finally, you must be able to present your results in a confident way to the people who asked you to solve the problem.

Resource 9 Graphic organisers

Demonstrating outcome
SS 2.2

A

When you complete this activity you will have presented information about the way some scientists think and work.

Think about the things that you have learnt about how scientists think and work. Choose one scientist and answer these questions.

_____

Name of scientist

What was the problem they had to solve?

_____

_____

_____

How did they do it? (What did they do? What tools did they use?)

_____

_____

_____

_____

_____

_____

_____

_____

B

When you complete this activity you will have presented information about the way some scientists think and work including why they use quantitative data.

1. Read one of the interviews in *Resource 8: Interviews with scientists*.
2. Use this information to complete the following diagram. In each box, record an example of how this scientist thinks and works.

Demonstrating outcomes
SS 2.2 and 3.2

What do they do?

_____

_____

_____

_____

_____

How do they collect information?

_____

_____

_____

_____

_____

Name of scientis _____

Type of scientis _____

Why do they need/use quantitative data?

_____

_____

_____

_____

_____

What are the characteristics of a good scientist according to them?

_____

_____

_____

_____

_____

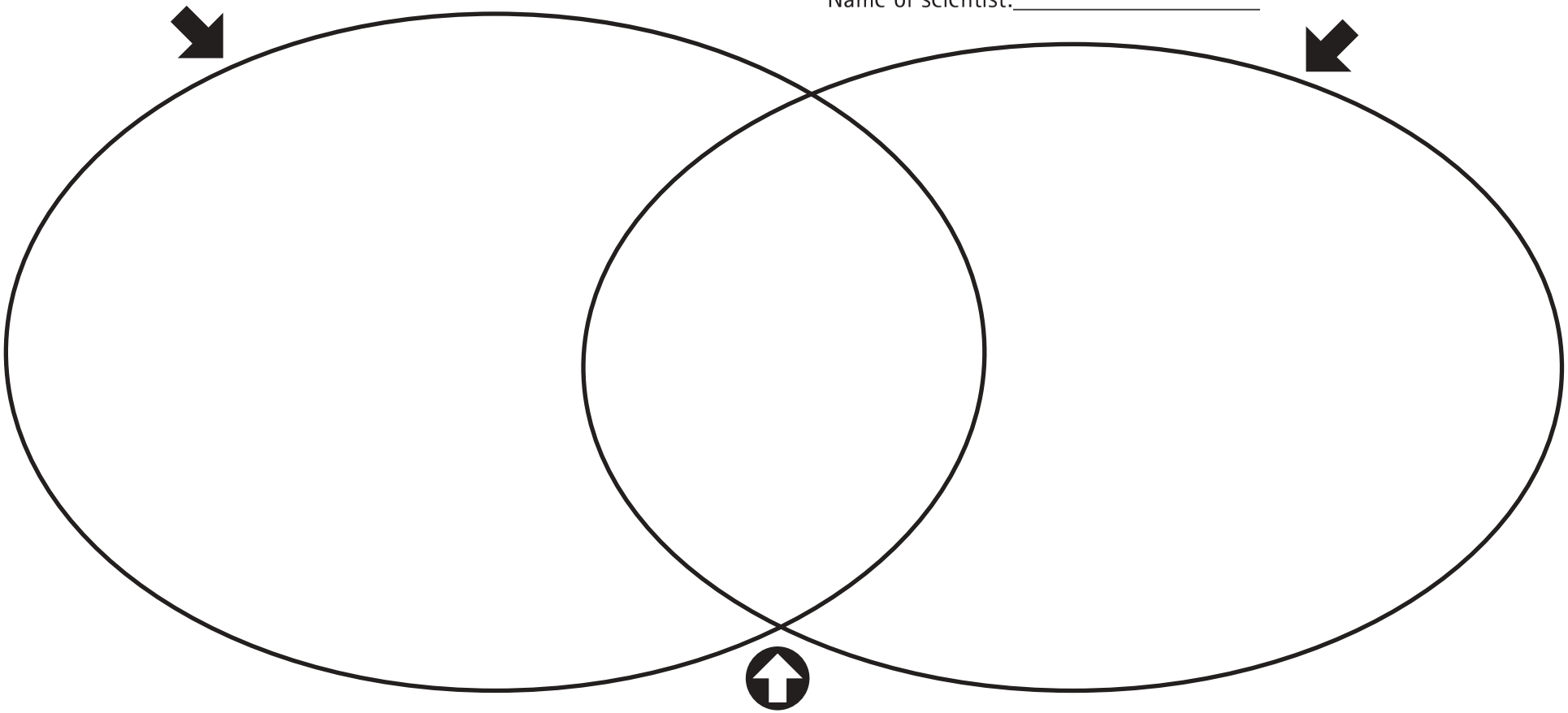
C

When you complete this activity, you will have compared information about the way some scientists think and work. You will need to work with a partner who has read a different interview from the one that you have read.

1. Write the names of the two scientists above each of the circles.
2. Talk about the scientist you read about with your partner. Is there anything that these scientists have in common? If so, record these things in the middle or overlapping sections of the two circles.
3. Record the ways in which their work experiences are different at each end of the circles.

Name of scientist:_____

Name of scientist:_____



What do they have in common

Resource 10 Who has the biggest crystals?

Demonstrating outcome
SS 4.2

Purpose

To use the elements of a fair test when designing an investigation.

My researchable question

What happens to _____ (dependent variable)

when we change _____ (independent variable)?

My hypothesis

_____

_____

_____.

Identifying variables

What will I keep the same?	What will I change?	What will I measure?
Controlled variables	Independent variable (IV)	Dependent variable (DV)

How will I measure the change?

_____

Presenting the results

_____

_____

Resource 11 Sample investigation design

Purpose

To investigate the elements of a fair test.

My researchable question

What happens to crystal size (dependent variable) when I change the length of time that they have to grow (independent variable)?

DV-dependent variable

IV-independent variable

My hypothesis

Increasing the length of time the crystals have
to grow (IV) will increase the size of the crystals (DV).

How will I measure the change?

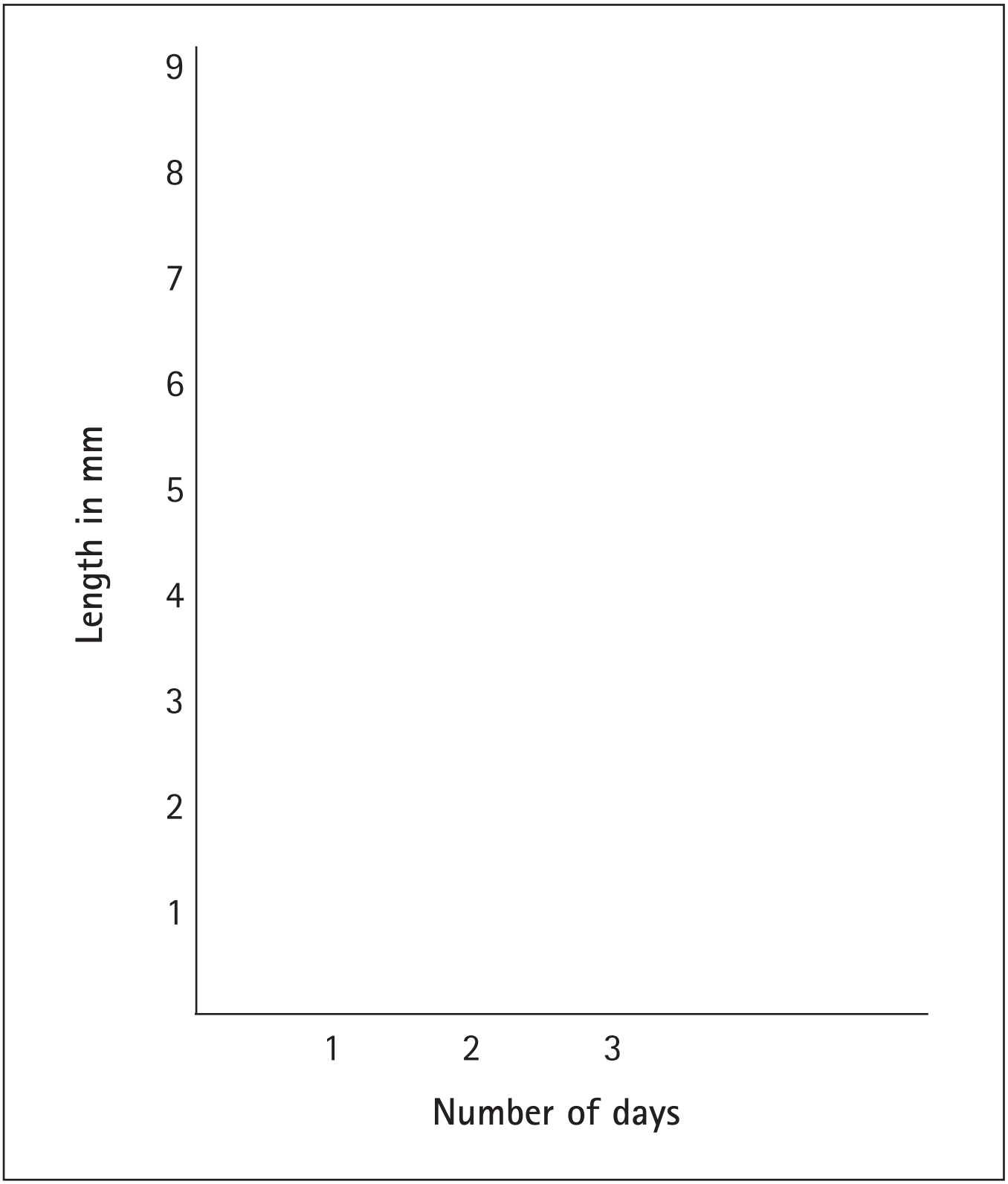
I will use a ruler to carefully measure the length (in mm) of the crystals after one, two and three days of growth.

Identifying variables

What will I keep the same?	What will I change?	What will I measure?
• type of mineral in solution (sugar, salt, alum) • amount mineral and water in solution • environment in which the solution cools (temperature, light) • size and shape of jar • string put into the solution	The length of time the crystals have to grow	The size of the crystals
Controlled variables	Independent variable (IV)	Dependent variable (DV)

Presenting the results

I will present my results in a line graph



Source: Adapted from the Queensland *Years 1-10 science syllabus*

Chapter 4

Using minerals in our lives

Strand: **Earth and beyond**

Key concept: **Living things use the resources of the Earth, solar system and universe to meet their needs**

Strand: **Natural and processed materials**

Key concept: **The uses of materials are determined by their properties, some of which can be changed**

Strand: **Science and society**

Key concept: **Decisions about the ways that science is applied have short and long-term implications for the environment, communities and individuals**

Index

Using minerals in our lives

Focus questions

What are some uses of minerals?

Can you make different things if you put minerals together?

Can these products be recycled?

How does our use of these mineral products affect our lives, the environment and the economy?

Resource sheets

Science outcomes

The following outcomes can be achieved in your classroom by following the activities and using the resource sheets provided in *Science rocks*. The overview at the beginning of this book also explains which of the activities demonstrate each outcome.

Science outcomes: Earth and beyond	
2.3	Students discuss how their community uses resources and features of the Earth and sky.
3.3	Students collect information, which describes ways in which living things use the Earth and the sun as resources.
4.3	Students summarise information to compare ways in which different communities use resources from the Earth and beyond.

Science outcomes: Science and society	
2.3	Students explain some of the ways that applications of science affect their community.
3.3	Students make predictions about the immediate impact of some applications of science on their community and environment, and consider possible pollution and public health effects.
4.3	Students present analyses of the short and long-term effects of some of the ways in which science is used.

Science outcomes: Natural and processed materials	
2.3	Students explain why common materials are used in particular situations.
3.3	Students collect information to illustrate how combining different materials influences their usefulness.
4.3	Students examine and assess ways that materials can be changed to make them more useful.

Background notes for teachers

Using minerals in our lives

Our society is dependent on resources obtained through mining. It is difficult to imagine living without metals and plastic. These materials come from minerals and fossil fuels respectively, which are finite or non-renewable resources. The challenge is how to use, reuse and substitute these materials wisely.

Fossil fuels

Fossil fuels, such as oil, coal and gas, are resources which can be burnt to produce energy. They are found in the earth where decomposed plant or animal remains have been compressed and experienced extreme pressure.

Oil and petrochemicals

Crude oil and natural gas formed millions of years ago as a result of decayed plants and animals. This matter was buried deep in the crust and put under tremendous heat and pressure. Crude oil and natural gas are extracted from the ground, by sinking an oil well. They are then transported by ship and/or by pipeline to refineries.

At refineries, crude oil and natural gas are physically and chemically changed. One of these processes of change is called distillation. This process separates the heavy crude oil into lighter groups (called fractions) of hydrocarbons. These fractions include fuel oil (used for heating and for diesel fuel in automotives), naphtha (used in gasoline and also as the primary source from which petrochemicals are derived), butane (used as a component of liquefied petroleum gas (LPG) and in cigarette lighters), ethane (used as a component of natural gas for heating and other purposes) and propane (used for bottled gas and as a component of natural gas).

At a petrochemical plant, these refined materials are made into substances such as:

- ethylene
- propylene
- xylene
- toluene
- benzene.

These substances are then processed into well-known materials such as polyethylene and nylon. Some of these processes are very complicated. It takes only one step to make polyethylene from ethylene. However it takes five steps to make nylon from benzene.

Plastic

Plastics are synthetic polymers made by joining many small molecules called monomers together. Mono means one and poly means many. The chemical reaction in which the monomers join up to form polymers is called 'polymerisation'.

Many common plastics are made from hydrocarbon monomers such as polystyrene and polypropylene, which contain only carbon and hydrogen. Other elements are found in plastics too. Polyester contains oxygen; PVC (polyvinyl chloride) contains chloride; teflon contains fluorine; and nylon contains nitrogen.

Plastics are divided into two groups:

- thermoplastics
- thermosets.

Most plastics are thermoplastics, which means that once the plastic is formed it can be heated and reformed over and over again. This property makes them easy to process and recycle. However, thermosets cannot be remelted, reformed or recycled.

Although each plastic has different characteristics most are:

- very resistant to chemicals
- thermal and electrical insulators
- usually very light in weight
- able to be processed in different ways to make thin fibres or very intricate parts.

Most plastics are blended with additives as they are processed into finished products. Some mineral additives include calcium, clay and magnesium. Additives alter the properties of plastics to make them suitable for specific purposes. Additives can:

- protect plastics from the degrading effects of light, heat or bacteria
- add colour
- increase flexibility.

There are four main methods used to process plastics:

- Extrusion—molten plastic is forced out through a small opening to shape the finished product. Plastic film and bags are made by extrusion processing.
- Injection moulding—molten plastic is forced into a cooled, closed mould. Butter and yogurt containers are made using this process.
- Blow moulding—using compressed air, a molten tube is blown into a chilled mould. Milk bottles are made this way
- Rotational moulding—plastic granules are placed inside a mould and heated. As the mould rotates, the molten plastic coats the inside of the mould evenly. This process is used to make hollow products like toys.

The very properties that make plastics so useful (strength, durability and convenience) are the same properties that have made plastics a waste problem. Only a small amount of the plastic produced each year is recycled. A large amount of plastic ends up in landfill where it may take generations to break down. A lot of plastic also ends up as litter where it is a hazard to wildlife particularly in rivers and oceans. Society can play a part in reducing this problem.

We can reduce the problem by using cloth shopping bags, reusing plastic containers after washing them and recycling plastic products whenever possible. Most local councils now operate curb-side recycling programs. Plastic containers have a resin identification code written on the side. These numbers relate to the type of recyclable plastic from which the container is made (see *Resource 6: Plastic recycling codes*).

Because plastic packages often contain products that are consumed on the go, many containers are not making it into the recycling bin. To address this, businesses, schools and local and state governments place recycling bins in work spaces and public places, because it encourages people to recycle when they are not at home.

Once collected, recyclable plastics are sorted into their different types and sent to a reclamation site. Here they are chopped into flakes, washed to remove contaminants and sold to manufacturers to make new products such as bottles, containers, clothing and carpet.

Some companies have been researching the manufacture of biodegradable and photodegradable plastics to reduce the life of plastics that end up in landfill. Some of these plastics are being made from plants so that they degrade into compost. Others are being made from hydrocarbons. The idea is that if the polymer chains are reduced in size, the plastic material should lose its strength, become brittle and eventually degrade into harmless products such as carbon dioxide and water. The development and use of more environmentally-friendly plastics is not progressing very quickly. The price of degradable plastics can be up to six times greater than the price of non-degradable plastics. The high price is due to research costs and uncertainty about demand for the product.

Coal

Like oil and natural gas, coal is formed over millions of years from the remains of once living things such as plant material. Coal is a fossil fuel found in layers or seams under the Earth's surface. It is burned to provide electricity and used in the production of steel. Coal is also an ingredient in fertilisers, pencils, paints and plastics.

Coal is Queensland's most important export commodity, earning around $8 billion annually. Australia is the world's largest exporter of coal with Queensland responsible for about two thirds of the total amount sold overseas.

Minerals

Minerals are the components of rocks and they can be divided into two groups—ore minerals and rock-forming minerals.

Metallic minerals

Metallic minerals are the ores used to make metals. They:

- are opaque
- usually make good conductors of electricity
- have a metallic lustre or sheen (are shiny).

The metals that come from metallic minerals found in the ground include copper, platinum, silver, mercury, iron, titanium, nickel, cobalt, gold, lead and zinc. Most of the metallic minerals are found in combination with other minerals. For example, lead is extracted from galena (lead sulphide), tin comes from the ore, cassiterite, zinc comes from sphalerite, and chromium comes from chromite. Bauxite is the main ore for aluminium, and uranium occurs in about 50 minerals, nearly all of which are rare.

Alloys are formed when two or more metals (or sometimes a metal and a non-metal mineral) are combined. For example, brass is made from combining copper and zinc. Bronze is made from copper, tin and zinc.

Non-metallic minerals

Non-metallic ore minerals are generally translucent and tend to form as crystals. Non-metallic ore minerals include sulphur, graphite, gypsum, halite (rock salt), borax, talc, asbestos and quartz. They are used extensively in the ceramic and chemical industries as well as in the construction of roads and buildings.

Rock-forming minerals

These are the major building materials of the earth. They are largely silicates, that is, they contain silicon and oxygen. Silicon is a non-metallic element, always found in combination with something else. It is second only to oxygen as the main element found in the Earth's crust. Other rock-forming minerals include the large families of micas, feldspars, amphiboles, pyroxenes, zeolites and garnets.

Teaching and learning activities

Using minerals in our lives

Activity A Discovering what things are made from

Students play 'Animal, Vegetable, Mineral' and identify things in their classroom that are made with minerals.

Demonstrating outcome EB 2.3

Purpose

To engage students' interest and discover their existing ideas about what things are made from.

Teaching procedure

- Introduce the game of 'Animal, vegetable, mineral' to students. After explaining the game, choose an item in the classroom that is made from a mineral. For the purpose of this exercise include coal and oil as 'minerals'. You can consult *Resource 2: What things are made from* for extra information. Many students will be intrigued when they discover that your item is made from a mineral. If students are stumped or do not guess your item after a few questions, tell them what it is and what minerals are used to make it.
- Provide students with a copy of *Resource 1: What are things made from*? After looking over the resource sheet and explaining the directions, encourage students to walk around the classroom looking for items that interest them. As directed, they should list items whose composition they know in the first column, and items whose origins they are less certain about and about which they would like to learn more in the second column. You may like to extend the exploration outside the classroom into the rest of the school.
- When students are finished exploring and filling out their resource sheets, take time to discuss and compare their findings. On the white/blackboard, list several correct examples from each of the two categories. Help students to answer questions about the composition of items, such as whiteboards, which are made from a steel or aluminium frame covered with plastic sheeting made from petrochemicals (oil). Use *Resource 2: What things are made from* to assist you.

Activity B Collecting information about the origin of things

Students collect information, in groups, about objects in our homes that are made from minerals including coal and oil.

Demonstrating outcome EB 3.3

Purpose

To encourage students to explore the origins of a wide range of items made from minerals.

Teaching procedure

- Invite students to form a group of two to four students and challenge them to create:
  - a model of a room in a house (bathroom, bedroom, kitchen, laundry, garage, lounge room) with all items made using minerals, including coal and oil, labelled

–a display of household items made from minerals (for example, sporting goods, musical instruments, electronic items, toys or toiletries) including information about the minerals used to create them.

- Discuss with students the sources of information they can use (books, including encyclopaedias in the library, and web sites). The following list of web sites could be added to the classroom computer favourites list for students to access.

  –Department of Natural Resources and Mines 'Minerals make almost everything' fact sheet at <http://www.nrm.qld.gov.au/education/minerals_make.html>

  –Minerals Information Institute at <http://www.mii.org/>

- Let students know that each group will be expected to present their display to the whole group at a negotiated time.

- To test their knowledge, introduce students to the interactive graphic quiz called 'Mining helps make your home'. Go to the Queensland Resources Council web site at <http://www.qrc.org.au>. Click on 'for schools' and follow links to 'games'.

Activity C Exploring the contents of toothpaste

Students examine the materials used to make toothpaste and toothpaste packaging.

Demonstrating outcome NPM 2.3

Purpose

To encourage students to explore the reasons particular materials are chosen to make things.

Teaching procedure

- Bring a toothpaste box and tube to school for this activity.

- Show students the toothpaste tube. Ask:

  – What are the two main parts? (tube and cap)

  – Are they different types of plastic? Why? (Each part has a different purpose. The cap needs to be hard and strong. The tube needs to be soft and flexible so it is able to bend.)

  – What about the contents? What is toothpaste for? (To clean teeth and prevent decay.) Look at the contents (these are usually written on the box). This will be a bewildering list of chemicals. However, you may be able to identify a few familiar words that relate to some of its mineral contents. To take the discussion further, compare this list of contents with those on a herbal toothpaste box bought from a health food shop. What are the differences? What did/do people use when commercially produced toothpaste was/is unavailable?

- Show students a soft washing up cloth and one with an abrasive surface. Ask:

  – Which one do you think would make it easier to clean something? (The one with an abrasive surface.) Explain that we need an abrasive (a very gentle one) in toothpaste to help clean our teeth. Some abrasives that are used in toothpastes are silica (from sand), limestone and aluminium oxide (also used in sandpaper).

- Tell students that fluoride is used in toothpaste because it can help our teeth to stay strong. Fluoride is made from a mineral called fluorite.

- Ask students:

  –Why do you think most toothpaste is white? (Probably because it is the colour of our teeth.) Titanium is used because it makes things white and does not harm us if we swallow it.

  –Why do some toothpastes have sparkles in them? (Probably because the makers think

people who use the toothpaste like how it looks.) Mica is sometimes used because it is a mineral that sparkles.

- Tell students that plastic is used to make the container because it is light, waterproof and strong. Ask:
  - –Why would paper not be used for the tube? (The toothpaste would seep through the tube, which would become soft and tear.) If working with older students, you could also say that plastics are used because they are not reactive. That is, they will not react to the chemicals in the tube or to water. For example, they do not rust.
- If students do not raise it, point out that the plastic used for the tube is different from the plastic used for the lid. Ask:
  - –How would you describe the plastic used for the tube? How would you describe the plastic used for the lid? (The plastic in the tube is soft and bendable because we need to squeeze it to access the toothpaste.)
  - –The plastic in the lid is hard and strong so we snap it shut and can open and close it repeatedly without it breaking.
- Provide students with a copy of *Resource 3: Why did they use that?* Read through the resource sheet with students and ask them to complete it. Collect this resource sheet for student portfolios.

Activity D Researching a product

Students undertake an individual research assignment.

Demonstrating outcome NPM 3.3

Purpose

To illustrate for students that combining particular minerals makes them useful in a range of applications.

Teaching procedure

- Invite students to undertake an individual research project on a single item made from two or more minerals. Students could present their research as an annotated illustration. An example is provided in *Resource 4: Toothpaste at a glance*. This task could be presented on card or electronically. In order to demonstrate the outcome, students will need to provide details about the combination of materials used to make the item and why those materials are chosen.

Activity E Exploring plastic

Students explore the properties of plastics and make a natural plastic.

Purpose

To encourage students to make a connection between the properties of plastics and what they are used for.

Teaching procedure

- Ask students to bring a range of plastic items to school. Ensure that each group has a range of different types of plastic and a tub before you do the experiment.
- Provide students with a copy of *Resource 5: Properties of plastic*. Invite students to work in groups to carry out tests one to four only. Conduct test five yourself while students observe. Use hot water from an electric jug for best effect.

SAFETY ALERT

- Assist students to draw conclusions about the properties of plastics and their uses. *Resource 6: Plastic recycling codes* will assist you to identify the plastics that are used in the experiment.
- Prepare the materials you need to make casein plastic (See *Resource 7: Making plastic*). Tell students you are going to make a natural kind of plastic called casein plastic. Ask students to watch carefully as they will have to record what you used (materials) and what you did (procedure). Provide students with a copy of *Resource 8: Recording an experiment*. A second plastic recipe (gelatine shapes) is provided on *Resource 7: Making plastic*, for students to undertake.
- By now students will know that most plastics are made from petrochemicals, which are derived from oil. However, oil is used to make much more than plastic. Provide small groups with one of the lists in *Resource 9: Made from petroleum.* Invite each group to create a rap or other song (maybe to the tune of a popular song or rhyme) about things that are made from oil and present it to the other groups.

Activity F Exploring metals

Students explore the properties of metals and discover some of their uses.

Purpose

To enable students to make a connection between the properties of metals and their uses.

Teaching procedure

- To do this experiment, you will need to provide students with samples of steel, tinplate, aluminium, copper, brass and zinc. Your local hardware store will probably have all of these things in easily available and inexpensive forms such as nails, bolts and washers. Choose flat, thin samples where possible.
- Provide students with a copy of *Resource 10: Properties of metals*. Invite students to work in groups to carry out the tests. Assist students to draw conclusions about the properties of metals and their possible uses.
- Provide students with a copy of *Resource 11: Metal makes many things* and provide students with time to access the internet to find things made from the metals listed.

Activity G Exploring talc

Students explore the properties of talc.

Purpose

To encourage students to make a connection between the properties of talcum powder and its use. The mineral talc is one of the main ingredients of talcum powder and you can discover some of the properties of this mineral by looking at talcum powder.

Teaching procedure

- Obtain one or more containers of talcum powder, a spray water bottle, a deck of cards and a glass bowl.
- Ask students what they know about talcum powder.
- Invite students to rub their hands together briskly as if they are very cold. Ask them:

  –How do your hands feel as you do this?
- Sprinkle a little talc over the palms of students' hands and ask them to rub their hands together. Ask:

  –How do your hands feel now?
- While students' hands are still covered with the powder, spray or sprinkle a few drops of water on their palms. Ask:

  –What happens to the powder?

  –What have you discovered about talcum powder?
- Now put some more powder on the inside of students' forearms and ask them to leave it there for a while.

- Fill the glass bowl with water and sprinkle the powder over the surface. Just like on your skin, the tiny sheet-like particles coat the surface to form a film of flat sheets, so fine that they are suspended on the water without sinking.
- Gently disturb the water. The talcum powder coating should appear to hold the water inside it, and yet you cannot see the individual flakes. Talcum powder is used for babies because it repels water. When a baby wets its nappy, the powder prevents the skin from getting wet. The moisture is repelled from the skin and absorbed by the nappy.
- Ask a student volunteer to hold the pack of cards and try to rub their hands together. The slippery cards in the pack will let their hands slide smoothly and yet each card retains its shape. The same thing happens with the flakes in talcum powder. Each tiny talc mineral is made up of tough sheet-like layers, stacked together like a pack of cards. Talc is slippery because each sheet slides easily over the next.
- Ask students to check the talc on their forearm. Ask:

  –Is it still there?

  –Does your skin still feel slippery?

  –Has the talcum powder held its perfume?
- Tell students that talc rock may be smooth but it can have other minerals mixed with it. These can scratch skin. Only the purest talc is selected for bathroom use. The word to describe this smooth characteristic is unctuous. Cosmetic makers have to choose talc with certain characteristics such as one that will hold a perfume and will stay on the skin for a long time.

Source: Minerals Council of Australia (1992), *Mineral magic*, Canberra.

Activity H: Examining packaging

Students undertake a number of activities about packaging and rubbish.

Demonstrating
outcome SS 2.3 and SS 3.3

Purpose

To encourage students to consider what happens to the packaging containing our food and drinks.

Teaching procedure

- Before the lesson, put a plastic milk/juice/sports drink bottle, an aluminium soft drink can and a glass juice bottle in a plastic bag, as if they are rubbish. Place the bag in a class rubbish bin at the front of the room.
- Begin the lesson by quietly walking over to the classroom trash bin. Grab students' attention and interest by rummaging around in the bin as if you are looking for something. Then pull out the plastic bag you placed there before teaching this lesson. Next, ask students: What is this? (holding up the bag).
- Once they recognise that it is rubbish, dump the contents of the bag on your desk and have the class identify the contents. Continue the investigation by asking:

  –Where do you think this rubbish came from?

  –What kinds of things do you throw away?

  –What kinds of things are in the rubbish bin in your home?

  –Where do you put your rubbish?
  Encourage students to think about different kinds of rubbish by asking about the different places they put it–(bathroom wastebasket, kitchen garbage, recycling bin, etc)

- Invite students to form groups of three. Ask each group member to choose a piece of rubbish from your desk. These three products and the natural resources from which they are made are:

  –Plastic milk bottle—petroleum oil

  –Aluminium soft drink cans—bauxite

  –Glass bottle—silica sand.

- Provide students with a copy of *Resource 12: Roots of rubbish*. Read through the sheet to help students understand the task. Have brochures about recycling from your local council available in the classroom for younger students in particular. Students can easily check whether their chosen material is recycled locally or collected to be recycled elsewhere. The object in this activity is to look at personal choices and actions. We enjoy the convenience that packaging materials provide, but are we prepared to exercise responsibility about what happens when we have finished using them?

- Show a video about the problem of rubbish disposal/accumulation and show students the statistics on *Resource 13: A mountain of rubbish*.

- Take students on a rubbish hunt around the school. Students can then sort, measure (count number of bags or weigh) or estimate the amount of rubbish, record (pictograph or bar graph) and report (each group back to the whole group or whole group to the rest of the school on assembly) on the rubbish they have found. Younger students can use *Resource 14: Garbage graph* to record their findings.

- Provide older students with a copy of *Resource 15: When packaging becomes litter*. Discuss the advantages of each of these products and complete the first column. Continue to complete the first row with students. Most students will probably have had an experience of finding broken glass in a park, at the beach or by the roadside. Students may need more guidance when suggesting solutions such as the container deposit programs that exist in South Australia, the state with the lowest level of litter in Australia.

- Invite students to research some of the problems and solutions associated with littering of the other two products (plastic and aluminium). If students need some assistance with this, direct them to:

  –Australian Marine Conservation Society
  http://www.amcs.org.au/learn/fact_sheets/facts_marine_debris.html

  –Planet Ark
  http://www.planetark.com/campaignspage.cfm/newsid/7/story.htm

  –Clean up Australia
  http://www.cleanup.com.au/Main.asp?RequestType=Doc&CatID=130&docID=270

  –Zoos Victoria
  http://www.zoo.org.au/education/learningresources/mz/later/mz03-divedebris-tn.pdf

- Collect these resource sheets for student portfolios.

Activity I Looking at recycling

Students explore information and issues about recycling.

This activity can be used to demonstrate outcomes NPM 4.3 and EB 4.3

Purpose

To encourage students to examine the ways people in different communities use packaging materials and how these materials can be changed to meet a need.

Teaching procedure

- Provide students with a number of stimuli about recycling such as:
  - –inviting a speaker from your local council to speak about recycling issues in your community
  - –arranging a tour of a local recycling facility
  - –showing students a video about recycling.
- Provide students with a copy of *Resource 16: How aluminium cans are recycled*. Older students can take this activity further if they:
  - –research the process for making aluminium cans from bauxite
  - – identify the steps that are not included in *Resource 16*
  - – draw and write text for these extra steps and add them to the flowchart they've already completed using *Resource 16*.
  - –research the process for recycling glass and present the information as a flowchart.
- Make five or six copies of *Resource 17: Recycling statistics*. Invite students to form groups of five. Provide each student with one of the sources about recycling in *Resource 17*. Ask students to read their source and then share the information with the members in their group. Ask students to summarise their information and add it to a group concept map drawn on an A3 or larger sheet.
- Invite students to monitor everything that goes into their family recycling bin for a week or fortnight. Ask students to record the data on a table such as the one below.
- Invite older students to bring any samples of biodegradable plastic to school. This may be in the form of plastic bags or other packaging labelled as biodegradable or photodegradable. (The trays from Cadbury Milk Tray and Arnott's Iced Vo Vos are biodegradable. Source: http://www.plasticbagfamine.com/).
- Invite older students to do the experiment on *Resource 18: Does degradable plastic really degrade?*
- Provide students with a copy of *Resource 19: Communities in action*. Read through the article and table with students. Invite students to choose option A or B in *Resource 20: Change is possible*. Both of these options involve students undertaking some form of independent research in their community and comparing their findings with another community.

Material and Item (E.g. plastic bottle, glass jar, aluminium can, cardboard carton, newspaper)	Recycling code (for plastics only)	Tally	Total

Activity J Exploring some issues

Students decide how they can use resources more wisely.

Demonstrating outcome SS 4.3

Purpose

To provide opportunities for students to reflect on the ways in which they use resources and the impact of this resource use.

Teaching procedure

- Provide students with a copy of *Resource 21: The impact of plastic in our lives*. This research task asks students to consider much of what they have learned in this chapter. The topic could be changed to examine the impact of another material such as glass or metal. Students may find parts one and two of the resource sheets useful in organising their research. However, students could present their findings in a number of ways. Part three, the essay format, is only one option. Students could also present their findings as an oral or multimedia presentation.
- As a personal call for action, ask students to consider and complete *Resource 22: Using resources more wisely*. This statement of intent provides opportunities for students to evaluate their commitment to changing their behaviour for one and two months after their original commitment. At this stage you could facilitate a discussion about impediments to change.

Resource 1 What are things made from?

Demonstrating outcome EB 2.3

When you complete this activity, you will have thought and talked about how we use resources from the Earth to make things.

1. Search around your classroom for things that you think may be made from minerals or fossil fuel products.
2. When you find something and know what it is made from, write it in the first column as shown. When you find something and you do not know what it made from, list it in the second column.

Adapted from: *Science NetLinks* at <http://www.sciencenetlinks.com/pdfs/garbageroots1_factsheet.pdf>.

I know this is made from ...		
example		
pencil	➡	wood and graphite
	➡	
	➡	
	➡	
	➡	

I wonder what this is made from ...
example Whiteboard

Resource 2 What things are made from

Classroom item	What it is made from
Books	Titanium, kaolin or talc minerals are added to the paper to make it white and smooth.
Blackboard	The board is made from wood covered with paint containing abrasive minerals such as ground pumice.
Carpets	Wool carpets are cleaned with clays, soda ash, zeolite or petrochemicals. Synthetic fibres and dyes come from petrochemicals.
Cement	Cement is made from clays, shale, limestone, bauxite, haematite and gypsum.
Ceramic tiles	Ceramic tiles are made from clays, silica and titanium minerals. Colouring is done using ochre, umber (iron oxides) and metallic compounds of cobalt, manganese and antimony.
Chairs	Frames are often made using steel painted or galvanised with zinc. Coverings of vinyl and synthetic fibres are made from petrochemicals.
Chalk	Chalk is the dried and moulded paste of ground gypsum.
Coloured pencils	Clays and petrochemicals are used in coloured pencils.
Curtains	Curtains can be made from synthetic fibres made from petrochemicals.
Desks	The frames are often steel which has been painted or galvanised with zinc.
Door handles	Handles are usually made of steel or brass (copper and zinc).
Felt-tipped pens	These pens have a plastic body (made from petrochemicals) and the colouring is made from coal, metallic minerals and petrochemicals.
Lead pencils	Lead pencils do not have any lead in them. The 'lead' is made from graphite.
Light bulbs	The bulb is made from glass. The metal fittings are made using steel, copper, lead and tungsten.
Light switches	Switches are made using steel, copper, brass and plastic (from petrochemicals).
Linoleum	Lino is made from petrochemicals with clays, limestone and wollastonite.
Metallic window frames	Frames are made from steel or aluminium.

Classroom item	What it is made from
Paint	Most paints are made from petrochemicals and contain minerals such as calcium carbonate (from limestone).
Rubber	Sulphur is added to the rubber. Limestone, talc, clays and pumice abrasives are also used.
Tissues	Clay is added for absorbency. Talc is used for softness.
Whiteboard	Whiteboards have a steel or aluminium frame covered with plastic sheeting made from petrochemicals.
Windows	Glass is made using minerals from sand.

Source: Minerals Council of Australia 1992, Mineral magic, Canberra. Lewis G 1995, Australia and ancient lands AGSO, Canberra.

Resource 3 Why did they use that?

Demonstrating outcome NPM 2.3

When you complete this activity you will have shown why we use certain materials for particular purposes. Use the words at the bottom of the page to fill in the gaps in these sentences.

Silica (from sand), limestone or aluminium oxide are abrasive. They are used in toothpaste to _____ our teeth.

Fluoride (from fluorite) helps to make our teeth _____.

Titanium is used in toothpaste to colour it _____.

Mica is used to make the toothpaste _____.

The plastic in the lid is _____so we can snap it shut and open and close it over and over without breaking it.

The plastic in the tube is _____because we need to squeeze it to get the toothpaste out.

sparkle	clean	strong
white	hard and strong	soft and bendy

Resource 4 Toothpaste at a glance

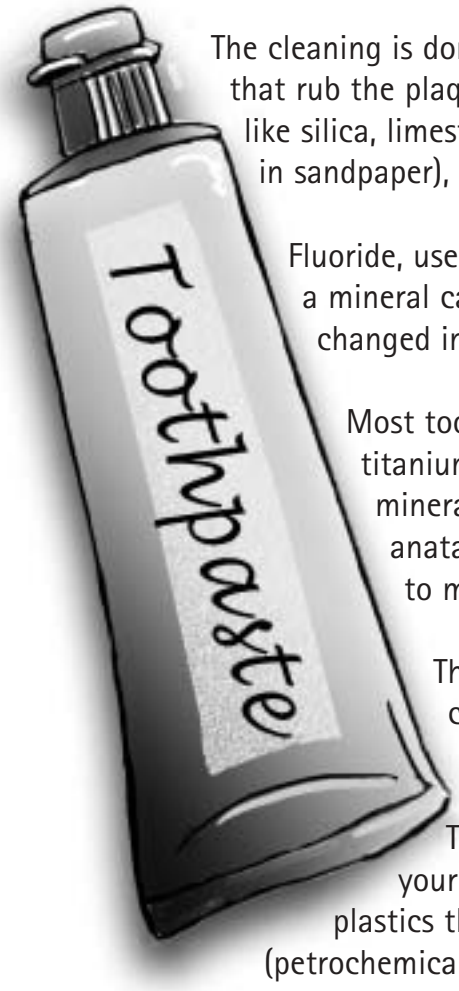
Demonstrating outcome NPM 3.3

Dig a little deeper

A bright smile

from toothpaste and minerals

Toothpaste cleans your teeth and keeps them healthy.



The cleaning is done with abrasives (from rocks) that rub the plaque away. Abrasives are minerals like silica, limestone, aluminum oxide (also used in sandpaper), and various phosphate minerals.

Fluoride, used to reduce cavities, comes from a mineral called fluorite. It is sometimes changed into stamous fluoride (tin fluoride).

Most toothpaste is made white with titanium dioxide, which comes from minerals called rutile, limenite and anatase. Titanium dioxide is also used to make white paint.

The sparkles in some toothpaste come from mica, a mineral common in many rocks.

The toothbrush and tube holding your toothpaste are both made of plastics that come from petroleum (petrochemicals) and other minerals.

Source: Mineral Information Institute, Denver, Colorado.

Resource 5 Properties of plastic

Purpose

To make a connection between the properties of plastics and what they are used for.

Materials (per group)

- A collection of plastic items including a shopping bag, polystyrene cup and soft drink bottle
- A tank or tub of water

Procedure

1. Choose two more plastic items and add them to the table. Make each piece of plastic different from the others.
2. Do tests one to four with each sample. Observe test five that will be done by your teacher.
3. Record your findings on the table.

Plastic item	TEST 1 Float?	TEST 2 Waterproof?	TEST 3 Flexible?	TEST 4 Permeable to light?	TEST 5 Heat resistant?
	Does it float when full of water?	Does water sit ON the plastic or soak IN?	Did it break when you twisted it?	Is it A. transparent, B. translucent or C. opaque?	Does hot water start melting it?
Shopping bag					
Polystyrene cup					
Soft drink bottle					

A sample conclusion:

Polystyrene would be good as a hot drinks and food container

(type of plastic) (what could you use it for?)

because it is heat resistant

(property of the plastic)

Your turn

Complete this statement.

_____ would _____

(type of plastic) (what could you use it for?)

because _____

(property of the plastic)

Resource 6 Plastic recycling codes

Resin identification code	Plastic type	Properties	Common uses
1	Polyethylene Terephthalate (PETE)	Barrier to moisture and gas Clarity Heat resistance Strength and toughness	Soft drink bottles Heatable pre-prepared food trays Fibre for clothing and carpet
2	High Density Polyethylene (HDPE)	Chemical resistance Ease of processing and forming Permeability to gas Stiffness and strength Toughness	Snack food packages Cereal box liners Milk bottles Grocery bags Detergent bottles Household chemical bottles
3	Polyvinyl Chloride (PVC)	Clarity Chemical, oil and grease resistance Ease of bending Toughness Versatility	Pipes Carpet backing Insulation Synthetic leather products Shower curtains Medical tubing and bags
4	Low Density Polyethylene (LDPE)	Barrier to moisture Ease of processing and sealing Flexible Strength and toughness	Produce bags Dry cleaning bags Flexible lids and bottles
5	Polypropylene (PP)	Barrier to moisture Heat, chemical, oil and grease resistance Strength and toughness Versatility	Large moulded auto parts Fibre for fabric and carpet Packaging Car battery casings
6	Polystyrene (PS) Expandable Polystyrene (EPS)	Clarity Easily formed Insulation	CD disk jackets Medical and food packaging Meat trays Hot food cups and containers

Resource 7 Making plastic

Purpose

To investigate the materials and process used in the making of plastic.

Casein plastic

Materials

- 1/2 cup full cream milk
- vinegar
- saucepan

Procedure

1. Slowly warm 1/2 cup milk in a saucepan.
2. When it begins to simmer, stir in a few spoonfuls of vinegar. Continue adding vinegar until mixture starts to gel.
3. Remove from heat and allow to cool.
4. Rinse the rubbery curds with water. The curds are plastic! The plastic is formed as a result of a chemical reaction between the casein in the milk and the acetic acid in the vinegar.

Gelatine shapes

Materials

- 3 envelopes plain gelatine
- 75 ml water
- 3–5 drops food colouring
- plastic lid with rim
- saucepan
- paper towels
- biscuit cutters
- a drinking straw
- scissors

Procedure

1. Mix the water and food colouring in the saucepan over low heat.
2. Stir in the three envelopes of unflavoured gelatine to dissolve it. Cook and stir for 30 seconds or until thickened.
3. Pour the mixture into a plastic lid with a rim. Push the air bubbles out with a spoon.
4. Leave to cool for 45 minutes then remove the gelatine disk from the lid. It should be flexible and pliable.
5. Use the biscuit cutters to make interesting shapes. Make jewellery, mobiles, decorations and simple toys. Scissors may be used to make spirals or other designs. Use a plastic drinking straw to make holes for hanging the pieces.
6. Shapes may be dried flat on a baking sheet. Spirals may be hung using pegs. Shapes with holes may be strung on string to dry. If shapes that you want flat begin to curl, flatten by covering. Make sure air can circulate around the shapes. The gelatine will be hard like plastic in two to three days.

Resource 8 Recording an experiment

Purpose

Materials

Procedure

Observations

Conclusions or questions

Resource 9 Made from petroleum

ink
toys
dolls
tyres
tents
shoes
glue
skis
dyes
cameras
combs
dice
mops
purses
dresses
pyjamas
pillows
candles
boats

dishwashing liquids
unbreakable dishes
car sound insulation
motorcycle helmets
refrigerator linings
electrician's tape
roller-skate wheels
permanent press clothes
soft contact lenses
food preservatives
transparent tape
disposable nappies
sports car bodies
electric blankets
car battery cases
synthetic rubber
vitamin capsules
rubbing alcohol
ice cube trays

paint brushes
insecticides
fishing lures
linoleum
paint rollers
plastic wood
rubbish bags
hand lotion
shampoo
fishing rods
anaesthetics
TV cabinets
salad bowls
awnings
safety glass
VCR tapes
movie film
loudspeakers
credit cards

telephones
antiseptics
deodorant
sweaters
floor wax
model cars
soap dishes
clothesline
panty hose
oil filters
upholstery
cassettes
house paint
ammonia
hair curlers
eyeglasses
ice chests
ice buckets
fertilisers

crayons
caulking
balloons
curtains
milk jugs
putty
tool racks
trousers
yarn
roofing
luggage
fan belts
carpeting
lipstick
aspirin
perfume
shoe polish
cortisone
CD/DVDs
vaporizers
parachutes

insect repellent
roofing shingles
shower curtains
plywood adhesive
beach umbrellas
tap washers
antihistamines
drinking cups
petroleum jelly
tennis rackets
wire insulation
ballpoint pens
artificial turf
artificial limbs
shaving cream
toothbrushes
folding doors
shower doors
heart valves
hearing aids
wading pools

water pipes
fishing boots
garden hose
umbrellas
rubber cement
cold cream
hair colouring
guitar strings
toothpaste
life jackets
golf balls
detergents
sun glasses
bandages
nail polish
false teeth
golf bags
mobile phones
toilet seats
sports shoes
backpacks

Resource 10 Properties of metals

Purpose

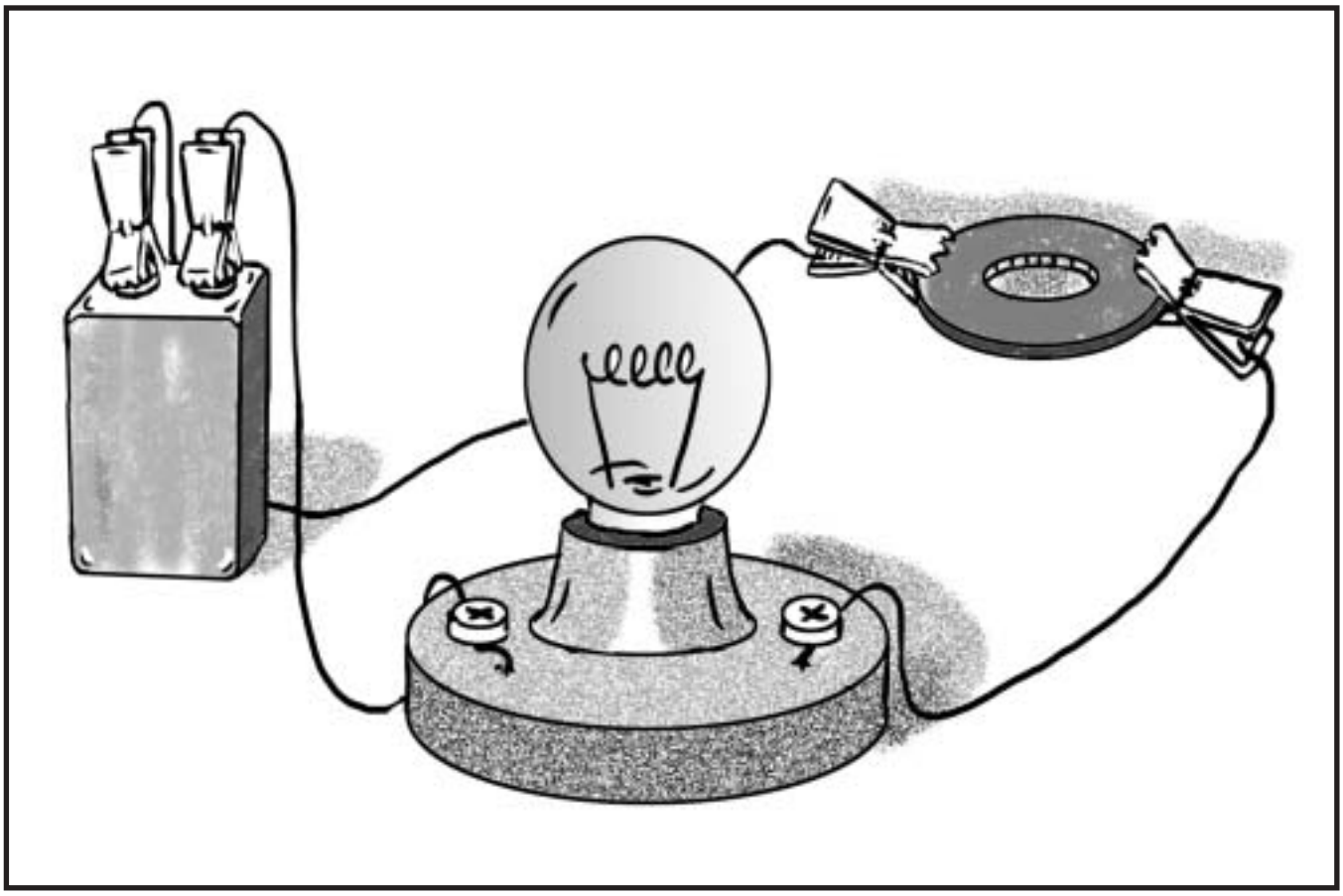
To make a connection between the properties of metals and their uses.

Materials (per group)

- Magnet
- Battery
- Three pieces of wire
- Two crocodile clips
- Small bulb in holder
- Metal polish
- Soft cloth
- Samples of aluminium, brass, copper, steel, tin and zinc.

Procedure

Test each sample and record your observations on the table.



Metal	What colour is it?	Does it shine when polished?	Is it magnetic? (use the magnet)	Does it conduct electricity? (make a circuit)
aluminium				
brass				
copper				
steel				
tin				
zinc				

Any other observations? _____

Any questions?

_____

_____

Complete this statement.

_____ would be good for _____

(type of metal) (what could you use it for?)

because _____

(property of the metal)

Resource 11 Metal makes many things

1. Go to:

http://www.nrm.qld.gov.au/education/minerals_make.html

http://www.mii.org/commonminerals.html

http://www.42explore.com/ironsteel.htm

http://www.encyclopedia.com/html/b1/brass.asp

2. Find three things made from each of these metals and record them on the table.
3. Choose one other metal and list three things made using it.

Metal	Things that are made from this metal
Aluminium	
Brass	
Copper	
Gold	
Lead	
Silver	
Steel	
Tin	
Zinc	

Resource 12 Roots of rubbish

Purpose

To consider what happens to the packaging containing our food and drinks.

Materials

- Plastic milk bottle
- Soft drink can
- Glass bottle
- Recycling brochures from the local council

Procedure

Choose a piece of rubbish from the teacher's desk and complete the chart below.

What is it?

Draw the product here

What is it made from?

What other things are made from the same material?

Can this material be recycled? YES/NO

Can this material be recycled in your town/city? YES/NO

Resource 13 A mountain of rubbish

In 2003, 21 million tonnes of solid waste was put in landfills. That is equal to about 1.146 tonnes per person each year or 3.14 kilograms per person each day.

Source: Australian Bureau of Statistics, 2003.

http://www.abs.gov.au/Ausstats/abs@.nsf/0/5c659730e0a80e01ca256b35007ace02?OpenDocument

In 2003, the amount of waste generated in Queensland was equal to about 1.181 tonnes per person.

Source:

http://www.epa.qld.gov.au/publications/p01301aa.pdf/The_state_of_waste_and_recycling_in_Queensland_2003.pdf

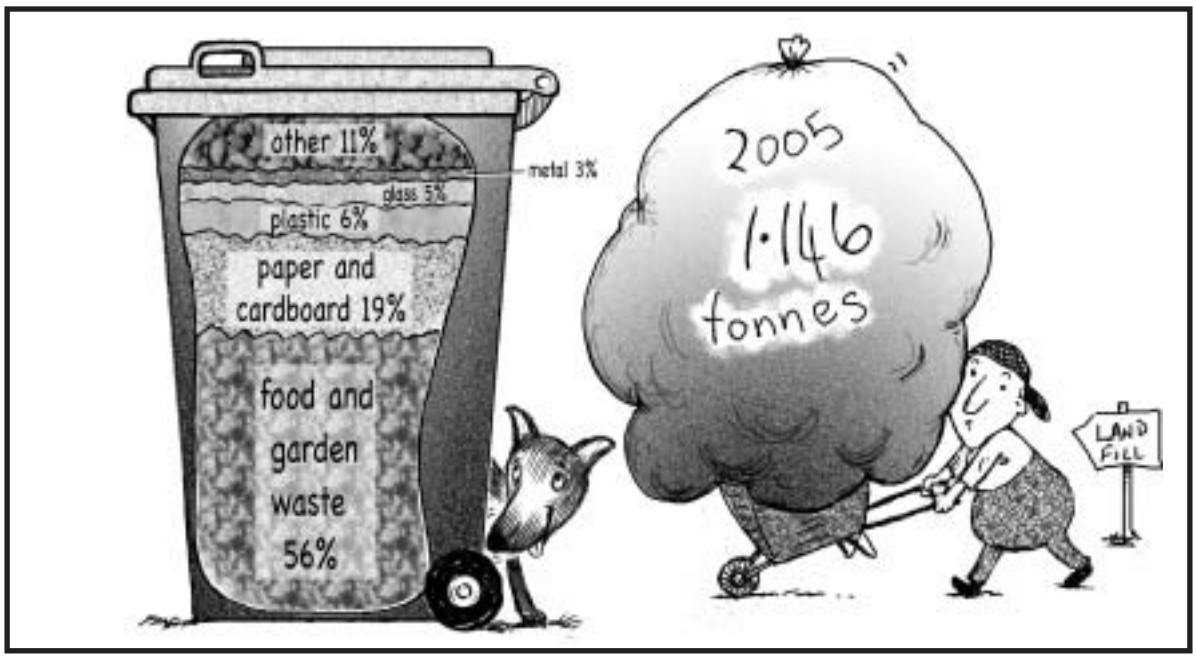
Household waste makes up almost half of the solid waste created in this country each year. The typical makeup of household waste is:

- 56% food scraps and garden waste
- 19% paper and cardboard
- 6% plastics
- 5% glass
- 3% metal
- 11% other.

Industrial waste comes from offices, factories, shops and hospitals. Every year we generate over 350 kgs of industrial waste for every person in Australia.

The building, construction and demolition industry creates well over a quarter of all solid waste. This includes concrete, timber, metals and other assorted building materials.

Source: http://www.epa.nsw.gov.au/publications/html/downtoearth/allaboutwaste.htm



Resource 14 Garbage graph

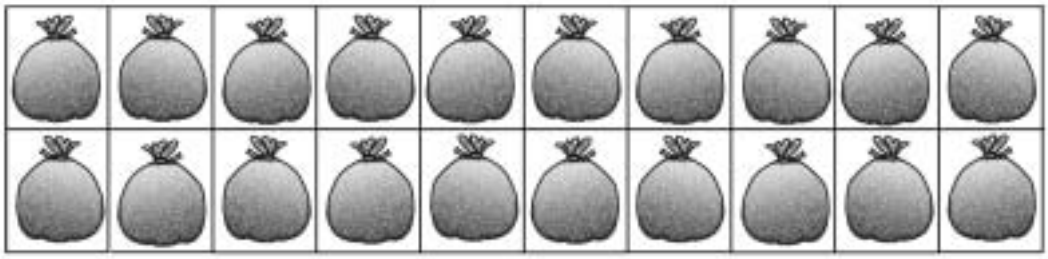
When you complete this activity you will have illustrated that rubbish is an issue in our communities.

Demonstrating outcome SS 2.3

Garbage Graph

Other							
Aluminium							
Glass							
Paper/ cardboard							
Plastic							

Number of bags



Resource 15 When packaging becomes litter

Demonstrating outcome SS 3.3

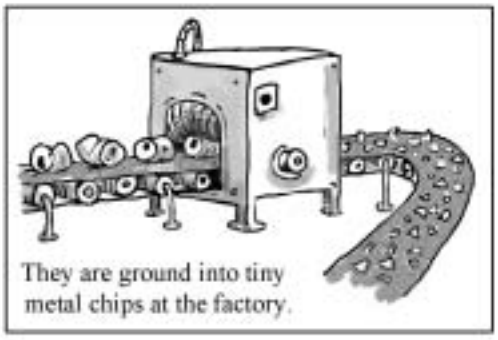
When you complete this activity you will have made predictions about the impact of some discarded packaging on the environment.

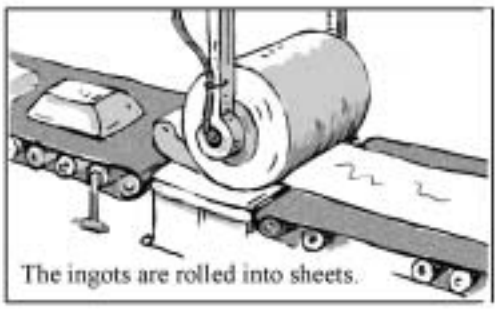
Sources of information:

Product	Advantages (Positive impacts of its use)	Disadvantages (Negative impacts of its use)	What can be done to address the negative impacts?
Glass beer bottles			
Plastic shopping bags			
Plastic six pack rings			

Resource 16 How aluminium cans are recycled

These eight boxes show the life cycle of a recycled aluminium can. However, the boxes are in the wrong order. Cut the boxes out, arrange them in the right order and glue them onto an A3 sheet. Draw arrows between the boxes to show the order and create your flowchart.





Resource 17 Recycling statistics

Source 1
Household recycling has increased in Australia during the 1990s. In 1992, around 85% of people recycled some items of waste. By 2000 this had risen to about 97%. Paper, old clothing, plastic bags and glass were the items most commonly recycled.
Only a small proportion of Australian households (just under 7% in March 2000) recycle all the waste items that can be recycled. While recycling rates have improved, more household waste still goes to landfill than is recycled. Only a small proportion of households (around 3%) in Australia recycled no waste items at all in 2000. This proportion has fallen in every state and territory since 1992.
Source:
http://www.abs.gov.au/Ausstats/abs@.nsf/0/5c659730e0a80e01ca256b35007ace02?OpenDocument

Source 2
Aluminium
Aluminium recycling saves a lot of energy. Used aluminium products are easily recycled by melting them in large furnaces. Recycled aluminium only requires 5% of the energy required to make aluminium from bauxite. Recycling one tonne of aluminium saves five tonnes of bauxite.
Glass
Recycling glass saves energy and the resources used to make glass. Glass can be recycled over and over by adding crushed glass to the furnace with sand, soda and lime. In Australia, about 40% of glass containers are collected for recycling.
Plastic
About 1 million tonnes of plastic is used in Australia each year. About half of this ends up as waste. Householders throw away 320 000 tonnes of waste plastic each year, most of which is short-life packaging materials.
Source: http://www.reln.com.au/html/body_wasteminimisation.html

Source 3
Australians currently recycle over 2 billion aluminium cans each year. This is a great effort; however, 900 million aluminium cans are still thrown away in Australia annually.
Source: http://www.planetark.com/campaignspage.cfm/newsid/119/story.htm
Cans are being made lighter every year. An aluminium beverage can weighed 16.55 g in 1992 and 15.5 g in 1997. This amounts to nearly 6% reduction in the raw material being used. Recycling aluminium is a closed-loop process. This means aluminium beverage cans are turned back into new aluminium beverage cans. Recycling saves energy. The energy required to produce (from bauxite) the metal for one aluminium beverage can is equivalent to the energy required to recycle that can 20 times.
Source: http://www.aluminium-cans.com.au/RecycleCentre.html

Source 4
It takes less energy to recycle than to manufacture plastic bags. To recycle plastic from supermarket or checkout bags, the bags are shredded and are then heated and re-extruded to make plastic pellets. These pellets are used in the manufacture of pipes, bags, film, bins, ducts, bottles, building, marine and automotive parts and more bags (including biodegradable bags).
In 2001—2002, 1000 tonnes of HDPE plastic (the plastic used for supermarket bags) was recycled with most exported for reprocessing. Fifty tonnes were recycled in Australia into plastic pipes.
Source: http://www.plasticbagfamine.com/aboutbags.aspx?id=22

Source 5
20 million Australians are currently using 6.4 billion plastic check-out bags every year. That's nearly 1 plastic bag per person per day or 345 bags per person every year. Plastic bags take between 15 and 1000 years to break down in the environment. The Federal Government and the Australian Retailers Association (ARA) have agreed to cut plastic check-out bag usage by 25% by the end of 2004, rising to 50% by 2005.
The best current option is for people to use long-life reusable bags as this reduces the need for disposable bags altogether. The disposable bags we do not use do not have to be produced, disposed of or recycled.
What about biodegradable bags? Until biodegradable products actually break down they still pose the same danger as non-biodegradable plastic bags and hence have the same short-term potential to harm wildlife and create litter problems as non-biodegradable products.
Source: http://www.planetark.com/campaignspage.cfm/newsid/61/newsDate/7/story.htm

Resource 18 Does degradable plastic really degrade?

Demonstrating outcome NPM 4.3

Purpose

To examine and assess which types of plastics are bio–degradable.

Materials (per group)

- a range of plastics (biodegradable, photodegradable and non-degradable)
- two scraps of wood
- flat headed nails

Procedure

1. Cut three pieces from each type of plastic. Make each piece the same size.
2. Label each sample e.g. 1A, 1B, 1C, 2A, 2B, 2C. Draw up a table like the one below. Record the brand name and product name of each plastic on the table (e.g. Smith's biodegradable bin liners).
3. Attach each sample (A) to one piece of wood using nails. Attach each sample (B) to another piece of wood using nails.

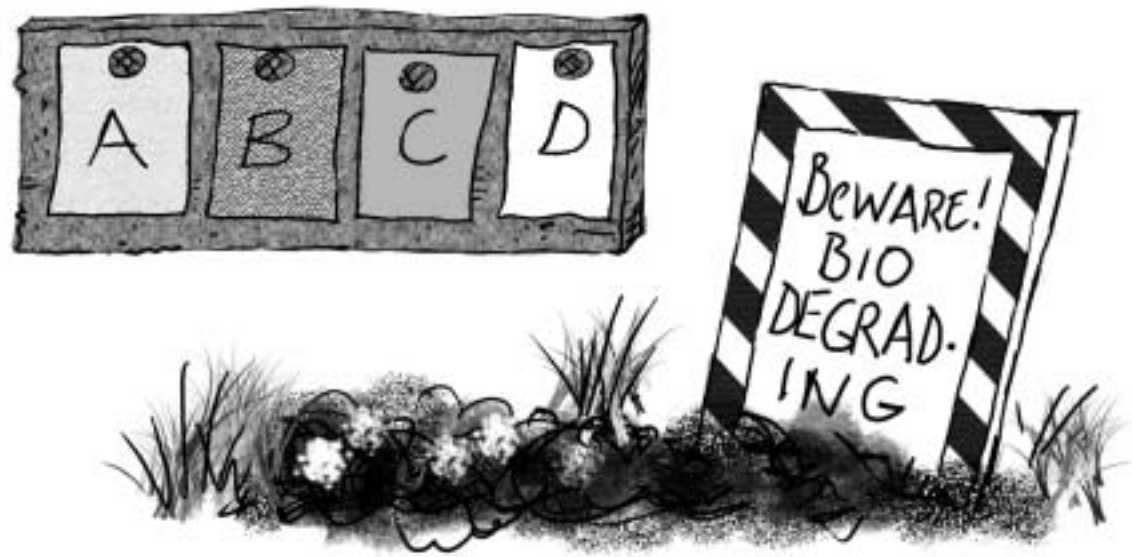
Month	(1) Biodegradable				(2) Biodegradable				(3) Photodegradable				(4) Non-degradable			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D

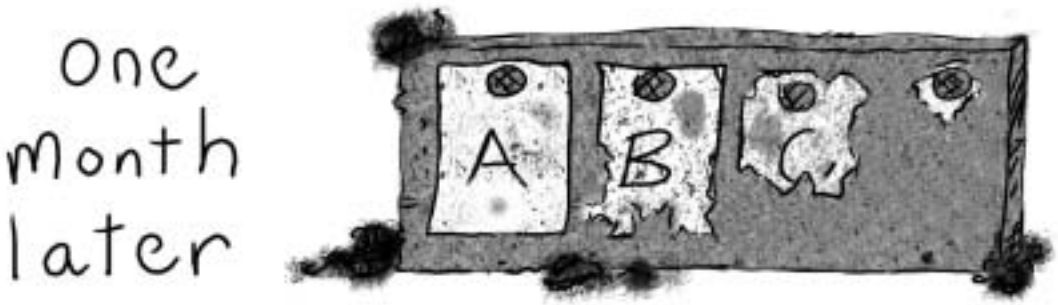
4. Place sample (A) set where they will be exposed to the sun. Bury sample (B) set just under the soil. These sites need to be safe places that will not be disturbed too much. Negotiate these places with your teacher. Place sample (C) set in some containers of water and keep sample (D) in a safe place in the classroom to use as a control.

5. Check your samples once a month and record any changes. It will probably take several months to see any change. As an additional record, you could photograph samples (A) and (B) and (C) when you first place them in location and each time you check them.

6. After several months, observe the samples for the last time and answer the following question:

   – Under what environmental conditions would each type of plastic decompose? Would they decompose in landfill, along the highway, in the ocean?





Resource 19 Communities in action

Source 1

Summary of local government household recycling programs

Key regional centre	Local government	Population	Recycling rate (kg/person)
Brisbane	Brisbane	917 216	67
	Esk	14 869	0.5
	Gatton	16 050	33
	Ipswich	128 976	43
	Population of region	1 090 221	62
Cairns	Cairns	119 256	1
	Cardwell	10 860	3
	Douglas	10 856	33
	Eacham	6 372	14
	Pormpuraaw Aboriginal Council	680	15
	Population of region	214 660	3
Gold Coast	Gold Coast	438 473	46
	Beaudesert	55 612	68
	Boonah	8 403	37
	Logan	169 433	35
	Redland	120 371	62
	Population of region	792 292	47
Mackay	Belyando	10 228	3
	Broadsound	6 483	6
	Mackay	77 157	26
	Mirani	5 309	16
	Nebo	2 095	12
	Sarina	9 862	17
	Whitsunday	15 995	9
	Population of region	127 129	20
Maroochy	Caboolture	116 992	62
	Caloundra	78 798	45
	Maroochy	131 395	61
	Noosa	45 214	42
	Pine Rivers	127 439	70
	Redcliffe	50 718	52
	Population of region	553 951	59

Maryborough	Bundaberg	45 043	16
	Burnett	24 439	54
	Cooloola	34 019	8
	Hervey Bay	44 402	56
	Isis	5 900	3
	Kingaroy	11 990	5
	Maryborough	25 260	14
	Nanango	8 540	6
	Wondai	4 261	6
	Population of region	238 497	22
Rockhampton	Calliope	15 377	17
	Duaringa	6 531	3
	Emerald	13 251	5
	Fitzroy	10 010	11
	Gladstone	27 099	11
	Livingstone	26 860	2
	Peak Downs	3 254	2
	Rockhampton	59 410	49
	Population of region	194 143	19
Toowoomba	Balonne	5 605	12
	Chinchilla	6 056	6
	Clifton	2 474	3
	Crows Nest	10 600	11
	Dalby	10 150	10
	Jondaryan	13 229	13
	Millmerran	3 457	9
	Murilla	2 743	6
	Pittsworth	4 741	18
	Roma	6 707	26
	Stanthorpe	10 515	6
	Toowoomba	91 187	31
	Warwick	21 387	7
	Population of region	240 250	16
Townsville	Bowen	12 518	3
	Charters Towers	8 790	2
	Hinchinbrook	12 326	6
	Mt Isa	20 785	2
	Thuringowa	54 465	23
	Townsville	93 911	42
	Population of region	237 489	23

Source: http://www.epa.qld.gov.au/publications/p01301aa.pdf/The_state_of_waste_and_recycling_in_Queensland_2003.pdf

Source 2

Extract from a newspaper report.

Since April 2003, all retail outlets in Coles Bay, including both supermarkets, have banned plastic check-out shopping bags. In the first twelve months, they stopped the use of 350 000 plastic check-out bags.

Planet Ark worked for some months in partnership with Coles Bay retailers who have been led in this endeavour by Ben Kearney, the owner of the local bakery.

Ben Kearney has inspired people right across Australia and around the world by coordinating Coles Bay—Australia's First Plastic Bag Free Town. As a result, Coles Bay was awarded the Environmental Excellence Award by the Tasmanian Government and more recently, Ben Kearney was named national Local Hero of 2005 at the Australia Day award ceremony.

As plastic bag alternatives in Coles Bay, they are offering a strong reusable paper bag with a handle, for 25c. The other alternative on offer is a Planet Ark reusable calico bag selling for $2.50.

Coles Bay plays host to whales on their annual migration along the eastern seaboard. One of the reasons Coles Bay has gone Plastic-Check-out Bag Free is to protect these whales and to stop the plastic bag littering of the adjoining Freycinet National Park.

Source: http://www.planetark.com/campaignspage.cfm/newsid/58/newsDate/7/story.htm

Resource 20 Change is possible (A)

Demonstrating outcome EB 4.3

When you complete this activity you will have summarised information to compare ways in which different communities use resources from the Earth and beyond.

1. Use the data on Resource 19 to graph the level of recycling in six to ten local government areas.
2. Think about what you would like to compare (areas with similar population, areas within a region, areas that share some geographical or social feature such as being coastal, urban or remote).
3. Choose the areas and plot them on a graph.
4. Write three questions that arise from the data presented on your graph.

5. Choose one of these questions to explore further.
6. How will you explore this question?

7. What did you find out?

Resource 20 Change is possible (B)

Demonstrating outcome EB 4.3

When you complete this activity you will have summarised information to compare ways in which different communities use resources from the Earth and beyond.

	Retailers who did/might participate.	What do they/could you use instead of plastic check-out shopping bags?	Which local environmental issues could this address?
Coles Bay community	Number of supermarkets: Number of bakeries: Other retailers:		
Your town/suburb/city			

Resource 21 The impact of plastic in our lives

Demonstrating outcome SS 4.3

When you complete this activity you will have presented an analysis of the short-term and long-term effects of plastic use in our society.

Planning your presentation (1): Things you need to know

How is plastic used?
Consider: range of applications

Social impacts
Consider: health, safety and convenience

Environmental impacts
Consider: pollution (land , water and air) and animal wellfare

Economic impacts
Consider: direct and indirect jobs, cost of packaging

Planning your presentation (2): Organising your ideas and information

Effects of plastic use in our society

Short-term effects		Long-term effects	
positive	negative	positive	negative

Planning your presentation (3): Drafting an essay

Title

Thesis/opinion

(How has plastic affected our lives?)

Summary of analysis to follow

Short-term effects

(positive and negative)

Long-term effects

(positive and negative)

Synthesis

(Which effects are most significant? What needs to be done to address any issues? Could you include a call for action?)

_____

_____

_____

_____

_____

_____

Restate thesis/opinion

_____

_____

_____

_____

_____

_____

Resource 22 Using resources more wisely

1. Find out things that people can do to use resources more wisely. Add them to the lists below.
2. Choose two or three things that you think you can do. Tick the boxes of the things you decide to do.
3. Rate how well you have stuck to your decisions after one and two months.

	Tick the boxes of the things you will do	Self evaluation A = all the time B = most of the time C = hardly at all	
		After 1 month	After 2 months
When shopping:			
Choose a glass container. Glass is 100% recyclable			
Choose a product in a PETE (1) or HDPE (2) container as they are the most easily recyclable plastics.			

At home			
Instead of using cling wrap, put the left overs in a re-useable plastic container with a lid.			
When you are out and about:			

PETE = (polyethylene terephthalate) and HDPE = (high density polyethylene). This is why the abbreviations are commonly used. PETE is plastic that is labelled (1) for recycling purposes and HDPE is type (2). These are listed and described (along with examples of each) in Resource 6 in chapter 4.