THEMES

Te nekeneke — Movement

Ngā toka me ngā kohuke — Rocks and minerals

Te āwhina i ngā tairongo — Helping the senses

Ngā āhuatanga aho — Light properties

Te mātakitaki me te hīkaro — Observation and inference

Te pēhanga — Pressure

SHOWS

Te whakaaturanga Matū Mīharo — Mighty Materials

Te whakaaturanga Ngaru Oro — Sounding Out Waves

UNIT PLAN

He tau kē ngā toka! — Rocks rock!

Science Roadshow 2023 RESOURCE BOOK

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

Science ROADSHOW

SCIENCE ALIVE Mātauranga

CONTENTS

This booklet

This resource contains language-based puzzles and hands-on activities that relate to the exhibit themes in the Science Roadshow's 2023 programme. Also included is a unit of work called 'Rocks Rock!', which relates to the programme's *Rocks and Minerals* theme.

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Local Curriculum

Throughout the booklet reference has been made to ways in which activities and investigations can be tailored to a Localised Curriculum, with emphases on: using the experiences students (ākonga) bring to the classroom; providing rich opportunities for learning based on students' strengths, identities and priorities; and, better connecting students with people and happenings in their communities.

Mātauranga Māori

Mātauranga Māori is a system of thought that encompasses knowledge, wisdom, philosophical and traditional understanding, and skills. Viewing science through this lens means taking a holistic approach, linking and communicating ideas to and via cultural practices, ceremonies, language and narratives. However, this system of thought has much in common with western science disciplines too. For example, they are both empirical — using observations and experience, cause and effect, trial and error, repetitive trials, pattern seeking, grouping, and comparisons, to verify ideas about the natural physical world and to build knowledge systems. The *Rocks Rock!* unit pp 16–25 lends itself well to a merged approach using the two ways of thinking.

Cross-curriculum

While the activities in this booklet are primarily science focused, many suggestions are given on how to link them across different areas of learning, as well as connecting the ideas to the community and wider world.

Foundational Science Capabilities

We have incorporated many implicit and explicit Foundational Science Capabilities components (functional interpretations of the Nature of Science strand) both within our 70 minute Science Roadshow visit experience (exhibits and shows) and within this Resource Booklet.

Science kits to support science education

We would like to draw your attention to a range of hands-on science kits for science teaching, available from the House of Science. We have referenced them in relevant places throughout this booklet. Kits are available for loan to schools on a membership basis.

House of Science website www.houseofscience.nz/science-kits/.

Sir Paul Callaghan Science Academy

The Sir Paul Callaghan Science Academy endorses the ethos and learning principles of the Science Roadshow.

More information about the Sir Paul Callaghan Science Academy is found on the back cover of this booklet.

Resource Booklet prepared by Peter E. Smith

Overview

Science puzzles (pages 4–9)

The purpose of the science puzzles is to expose students to vocabulary that will help them gain more from their visit to the Science Roadshow and from other science experiences. Like any discipline, science uses words and aspects of numeracy that are specific and purposeful, which aid students' understanding and their ability to communicate ideas.

For puzzle answers see page 27.

Hands-on activities (pages 10–15)

Two types of activities are included:

1) INVESTIGATIONS:

- emphasise the *process* of science using an array of Nature of Science concepts, with emphasis on the Science Capabilities
- involve any combination of approaches including: observations, inferences, pattern seeking, grouping and fair tests
- provide direct acts of teaching ideas
- scaffold students towards more open-ended discovery and independent scientific inquiry
- contribute to science content knowledge.

2) CHALLENGES:

- aim to solve problems or present practical challenges
- scaffold students, but are more open-ended in their outcomes
- present opportunities for more creative and critical thinking.

For guidance, possible 'answers' and outcomes, see page 27.

Abbreviations used throughout booklet

WALT = We Are Learning To (included at the start of Investigation and Challenge Sheets)

WILF = What I'm Looking For

TIB = This Is Because

For the teacher

Hands-on activity	**Engagement activities ('hooks')**	**WILFs & TIBs**	**Resources** SEARCH WORDS (Google, Journals) Specific references
Magnifying madness p 10	Show examples of magnifying glasses and how they can be used.	**WILF**: Students will discover that there are different simple ways of magnifying things. They will be able to modify these to get different results. **TIB**: Historically humans improved technologies from very simple starting points, through trial and error.	LIGHT, MAGNIFYING, MICRO **House of Science kit:** *Micro-Exploration.*
Focused light p 11	Show how a standard magnifying glass concentrates the sun's rays to a point. Compare it with a fresnel lens (which works in a similar way).	**WILF:** Students will investigate how and why a balloon can be popped using a fresnel lens. **TIB:** Students need to know how to adjust lenses to concentrate radiant energy (light and heat) to a point thereby creating a 'super hot spot' that can burn through the rubber of a balloon.	LIGHT RAYS, REFRACTION, FOCUS **Building Science Concepts:** Bk 29 *Solar Energy* L2–4. **House of Science kits:** *Enlighten me.*
The great karate chop p 12	Show a video or demonstrate how a table cloth can be pulled out from under a table setting of knives, forks and plates.	**WILF:** Students will use the science of inertia to solve a 'magic trick' challenge. **TIB:** They need to understand how inertia can be harmful and helpful in everyday life.	INERTIA, FORCES **Building Science Concepts:** Bk 42 *Marbles* L3–4. **House of Science kit:** *May the force be with you.*
How are seeds spread? p 13	Show some examples of seeds and brainstorm how some of these 'baby plants' might make their way from the parent plant.	**WILF:** Students will be able to describe several different ways by which seeds are dispersed. **TIB:** Understanding seed dispersal strategies is helpful in growing plants, creating new natural habitat, and also in preventing the spread of unwanted weeds.	SEED DISPERSAL, PLANTS **Building Science Concepts:** Bk 25 *Flowers, Fruits, and Seeds* L1–2, Bk 26 *Making New Plants* L3–4. **House of Science kit:** *Plants, petals and pollination.*
Make a barometer p 14	Demonstrate a real barometer and discuss how it measures air pressure.	**WILF:** Students will be able to build and monitor their own barometers. **TIB:** This is so they will appreciate that atmospheric pressure is constantly changing, which affects the weather.	AIR PRESSURE, WEATHER **Building Science Concepts:** Bk 31 *Water and Weather* L3–4. **House of Science kit:** *Measurement matters; Weather ready.*
Rock erosion p 15	Show a jagged and a smooth version of the same rock type. Discuss what might have changed its shape. Which shape came first?	**WILF:** Students will be able to use observations, measurements and inferences to determine which rocks are more eroded than others. **TIB:** Rock erosion is a key part of understanding the Rock Cycle.	ROCKS, EROSION

SCIENCE WORD PUZZLE

Instruments help our senses

Scientists want to know how instruments can help them to make better observations. To answer this question, use the clues hidden inside the scientific instruments to complete the paragraph below.

Complete the paragraph: *Sometimes ____________ can _____ our body's _________ by enhancing their abilities. For example, a __________ helps us see smaller _________ , and a __________e helps us see more _________ objects. Other instruments help us to _________ things that our senses __________ detect at all. For example, a _________ counter detects __________g r__________ , and a _________ points to the Earth's __________ _________ Pole.*

SCIENCE WORD PUZZLE

Light fantastic

Use the clues to help you complete the sentence about light below. The missing word will appear in the shaded area.

The colour of light is due to its ………………………

Clues

Light travels like ocean ……………. _ _ _ _ _

Past the red end of the spectrum. _ _ _ _ _ _ _ _

Past the violet end of the spectrum. _ _ _ _ _ _ _ _ _ _ _

When light bounces off surfaces. _ _ _ _ _ _ _ _ _ _

A rainbow is made up of many different ……………. _ _ _ _ _ _ _

Light is a form of …………. _ _ _ _ _ _

Light ………….. when it passes from air into water. _ _ _ _ _

Light passes through ……………. and other transparent substances. _ _ _ _ _

All the colours of the rainbow. Starts with 's'. _ _ _ _ _ _ _ _

Light that comes from the sun. _ _ _ _ _ _ _ _

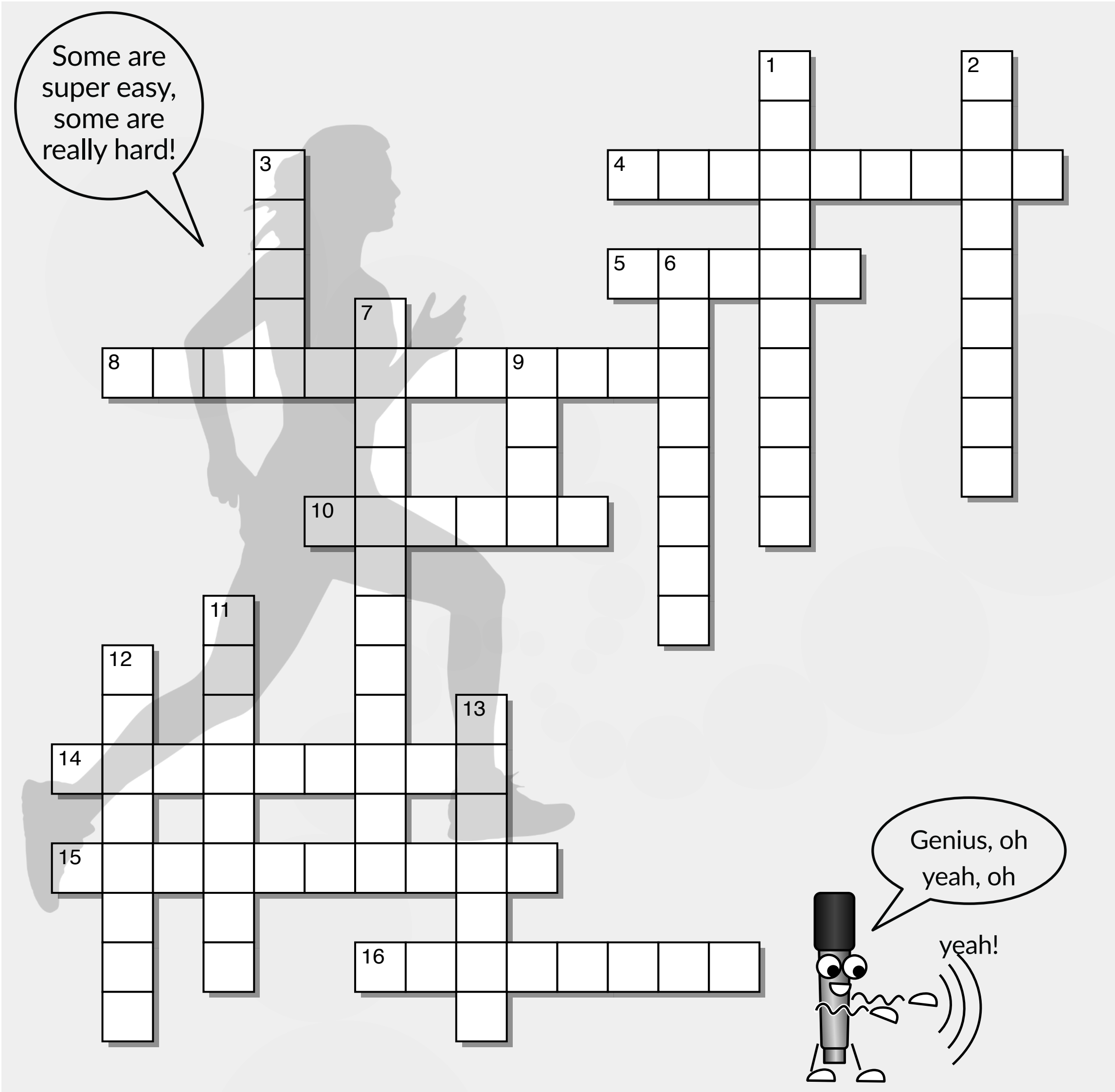
Looking locally

What interesting features of light can you fin   in your local area? Think about things like reflections the sky, traffic vehicle, shop and sign lights, colours, and refraction and spreading of light.

SCIENCE WORD PUZZLE

Movement crossword

Use the clues below to complete the crossword puzzle about movement.



Clues

Across

4) A unit for distance.
5) Like velocity.
8) Speeding up.
10) The opposite of faster.
14) Which way something goes.
15) Not moving.
16) Movement round and round.

Down

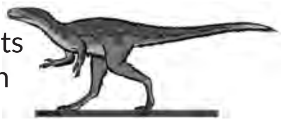
1) Something flying through the sky.
2) Running very fast.
3) A push or a pull.
6) Something that swings to and fro.
7) Slowing down.
9) How long something takes to happen.
11) How much motion something has.
12) A force that slows things down.
13) Resistance to speeding up or slowing down.

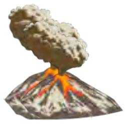
SCIENCE WORD PUZZLE

Observe and infer

Decide on which of these statements are observations and which are inferences. There will be six of each. Use a red pencil to circle the observations and blue to circle the inferences. Now draw lines between an observation and its matching inference.

Feather-shaped imprints have been observed on some dinosaur fossils.

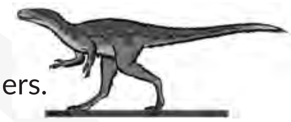




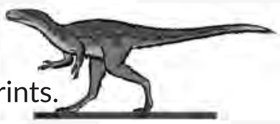
It is very hot below the Earth's crust.

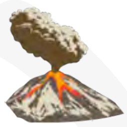
A black hole in space looks black.

Dinosaurs had feathers.



Only theropod dinosaur fossils have feather imprints.



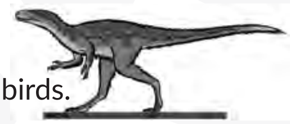


Lava oozes out of a volcano.

No light can escape from a black hole in space.

Lava is under pressure inside a volcano.

Theropod dinosaurs evolved into modern day birds.



Star matter is burnt up as it is pulled into a black hole.

There is a glowing area around a black hole in space.

Molten rock comes out of a volcano.

What are observations and inferences?

An **observation** is evidence we gain using our senses, or from the use of instruments. For example "I ***see*** an orange flame".

An **inference** is a conclusion we reach using evidence, our knowledge and reasoning. For example, "I infer that the yellow flame colour is caused by burning sodium compounds".

In groups

Discuss with your group what makes each statement either an observation or an inference.

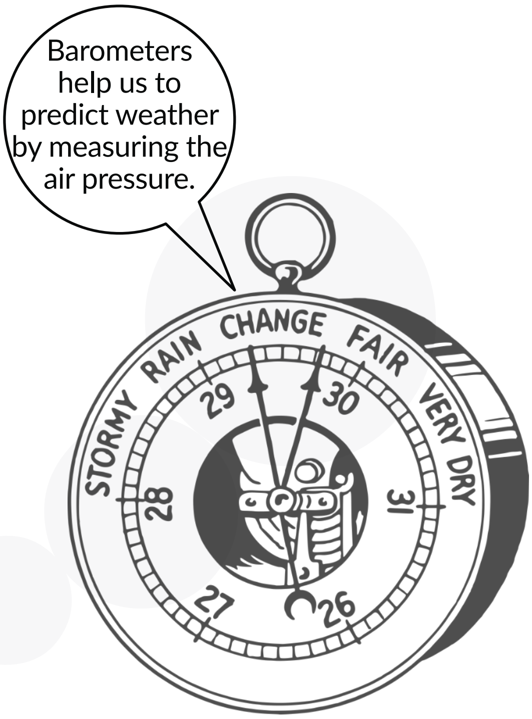
SCIENCE WORD PUZZLE

Under pressure

Complete the word search by finding 18 words that relate to pressure. The first letter of each word is circled.

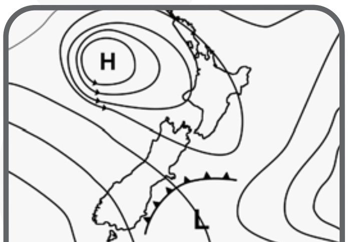
Use some of the words you have found to complete the statements about pressure below.

Y	H	K	W	V	Y	Y	T	F	K	N	B	B	W	T	G	P	H	G	I
D	X	Q	O	A	Q	M	B	I	L	G	A	Q	H	C	W	N	I	R	P
H	N	E	J	C	O	R	K	P	K	I	U	Q	I	A	G	E	G	V	V
B	Y	B	F	U	R	T	A	W	P	O	G	B	P	R	J	U	H	H	L
C	Z	D	M	U	V	E	K	S	T	C	P	H	H	B	B	M	S	K	Z
I	T	V	R	M	Z	S	C	S	J	V	A	Y	T	O	W	A	I	A	Y
D	Y	D	H	A	W	W	X	D	S	L	B	D	G	N	A	T	P	L	U
S	R	N	E	G	U	O	K	Y	L	P	X	V	E	A	T	I	C	W	X
D	S	C	L	X	C	L	B	F	L	O	E	D	F	T	M	C	M	E	P
F	O	R	C	E	P	R	I	U	E	U	H	I	B	E	O	S	Q	A	E
X	D	L	R	A	H	L	A	C	H	C	X	P	E	D	S	X	I	T	A
X	I	T	O	S	J	V	O	T	S	P	V	P	R	W	P	N	B	H	S
P	C	V	Q	W	T	W	H	S	V	R	N	V	N	A	H	T	K	E	H
J	F	V	A	E	S	X	Q	U	I	J	M	I	O	T	E	P	M	R	O
Y	M	A	O	R	L	T	E	G	M	O	T	Z	U	E	R	Q	W	F	O
N	Q	T	R	P	E	O	L	Q	S	Y	N	S	L	R	I	S	B	R	T
Q	Z	E	R	U	D	A	P	D	J	H	Q	U	L	P	C	N	Y	W	E
D	Y	S	J	S	M	O	Y	E	Y	Q	C	U	I	J	P	O	P	J	R
G	L	R	A	H	Z	N	N	B	A	R	O	M	E	T	E	R	V	K	K
E	P	B	P	G	G	A	S	P	E	C	A	O	U	H	D	E	K	W	S



Statements about pressure

Pressure is the f______ applied to a given area. For example, high heels apply a large amount of ______ on a small ______ creating HUGE p______________.



Weather h______ and ______s are caused by a______________ pressure.

A jack hammer uses air under ______________, which is an example of a p______________.

An excavator uses pressurised liquid to move its arm, which is an example of h______________.

SCIENCE WORD PUZZLE

Rock clues

Use the pictures and information clues, and do your own research, to name the rock types.
Try adding the Te Reo term too. Then, classify them as metamorphic, sedimentary or igneous. The first one is done for you.

1


Clue: I'm made of sand all stuck together.

Name: sandstone/tunaeke

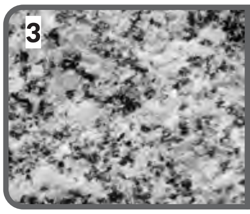
Type: sedimentary

2


Clue: I'm full of bubbles and can float on water.

Name: ____________________

Type: ____________________

3


Clue: I'm speckled, hard and used for kitchen benches.

Name: ____________________

Type: ____________________

4


Clue: I'm grey and am used in concrete and on roads.

Name: ____________________

Type: ____________________

5


Clue: I'm black, glass-like, and was used by Māori to make cutting tools.

Name: ____________________

Type: ____________________

6


Clue: I'm green and valued for my strength and beauty.

Name: ____________________

Type: ____________________

7


Clue: I'm made of tiny pieces of marine animals, like seashells, all stuck together.

Name: ____________________

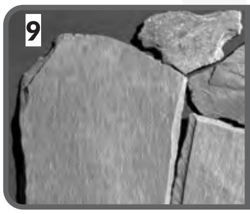
Type: ____________________

8


Clue: I'm made of layers of mud that have hardened.

Name: ____________________

Type: ____________________

9


Clue: I'm so flat I can be used on house roofs to keep the rain out.

Name: ____________________

Type: ____________________

10


Clue: I'm used to make decorative walls and fireplaces.

Name: ____________________

Type: ____________________

11


Clue: I was used to build the walls and steps of NZ's Parliament House.

Name: ____________________

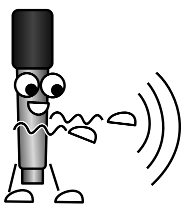
Type: ____________________

12


Clue: I'm black and am burned for heat.

Name: ____________________

Type: ____________________



Working in groups

Research and name rock type examples that are found in your local area:

____

____

CHALLENGE

Magnifying madness

WALT

We are learning to use instruments to improve observations of tiny objects. This will give us new ways to make observations that our eyes alone are not capable of.

What you will need:
(per group)

- Small objects to observe. You should include some flat items such as text and a coloured photo from a magazine.
- Plastic meat tray (cleaned).
- Miniature clothes pegs.
- Plasticine (don't use Blu tack).
- A sewing needle or similar.
- Scissors.
- Water.
- Eyedropper (optional).

Setting the scene

Instruments such as magnifying glasses and loupes are great for seeing tiny objects. In this challenge you will attempt to create three different simple magnifie s of your own out of everyday items.

Different types of magnifiers that you can buy.

Challenge 1

Make a hand magnifie

Hold your hand like this to create a tiny hole. Close one eye and with the other look through the hole at a close up object.

Study different objects up close. Does it magnify? Can you improve what you see with brighter lighting?

Challenge 2

Make a clothes peg magnifie

Squash a tiny blob of plasticine in the peg's hole. Use a sewing needle to make a tiny, round hole through the plasticine. Use it to magnify things in a similar way as you did above.

Do different hole sizes make a difference?

Challenge 3

Make a water magnifie

Use scissors to cut out a piece from a clear plastic meat tray (see below) and place a drop of water on the end of it.

Find ways to use it as a magnifie .

Discuss your methods and finding as a whole class.

Extension

1. Choose one of your magnifiers and work on ways to improve it.
2. In what sort of emergency might you need one of your magnifiers?

INVESTIGATION

Focused light

WALT

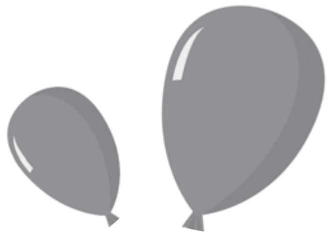
We are learning to focus light from the sun and use it to pop balloons. This helps us to understand how light can be bent and become concentrated to a point using specially-shaped clear materials such as plastic or glass.

What you will need:

(per group)

- *A fresnel lens. This one is 22 x 16 cm in size.*

- *A variety of balloon types, e.g. small water balloons, standard party balloons (cheap, thinner rubber) and helium balloons (thicker rubber).*



- *A stopwatch or timing device.*
- *A balloon pump (optional).*
- *Ruler or tape measure.*

Extension

1. Will the balloons pop in the same way if they are filled with water? Investigate and explain.

2. Can you combine two Fresnel lenses to concentrate the sun's rays even more?

What to do

Engage

Outside on a sunny day during the warm part of the year:

A. Learning how to focus

Explore

1. Use the Fresnel lens to focus the sun's rays to a point on a surface such as concrete. **Caution: Do not do this with anything that can burn.**

Explain

2. Measure and record the distance from the centre of the Fresnel lens to the brightest focal point of light. This is the 'focal length'.

Directing the sun's rays through a Fresnel lens to make a small, bright spot on the ground.

B. Popping balloons

3. Blow up a water balloon (without any water in it) and tie if off.
4. Focus the Fresnel lens onto the balloon surface and observe what happens. Explore this idea with different types of balloons.

Making it scientific

Elaborate

1. Investigate the best distance to hold the lens from the balloons to cause them to pop. Measure and record this distance. Is it the same as the focal length?
2. Time how long it takes to pop the various types of balloons.

What we found

Evaluate

1. What's the best distance to hold the Fresnel lens away from the balloons?
2. List in order the balloons that are weakest through to strongest. Why do you think some pop more easily than others?

INVESTIGATION

The great karate chop

WALT

We are learning to investigate how inertia works. This will show where inertia occurs, and how it can sometimes be helpful and at other times a problem.

What you will need:
(per group)

- *Five 20c coins.*
- *A $5 note (or piece of paper of the same size).*
- *A piece of sandpaper the same size as a five dollar note.*
- *A soft-drink bottle filled with water, with its lid on. The lid needs to be flat, not oval.*

What to do

Engage

Setting up a marvellous trick

1. Position the end of the $5 note on top of a soft drink bottle.
2. Pile five 20c coins on top as shown in the picture.

Explore

3. Now challenge a friend to pull the $5 note out without disturbing the pile of coins. Do several trials to see if it is possible.

The bottle must have a flat lid. If it is oval the coins will slip off.

This is a trick!

Explain

4. This challenge *is* possible. Instead of trying to yank the note out quickly, hang onto the loose end of the note and with your other hand do a quick one-finger karate chop down on the middle of the note. Can you make it work?

Explore further

Elaborate

5. Explore further to create the ultimate trick. Try balancing other objects on top of the bottle. Describe what you did and what happened.
6. Explore why this sometimes *doesn't* work. List why not.
7. Find a way to show and report to others what you discovered.

Evaluate

8. This trick uses a property called **inertia**. Find out what this means and where we come across it in everyday life. When can it be helpful and when can it be a nuisance?

Extension

Replace the $5 note with the piece of sandpaper, grit side facing up. Does the trick work now? Explain.

How are seeds spread?

WALT

We are learning about how plants spread their seeds. This helps us understand how to help and encourage re-seeding, for example, of wild areas with native plants.

What you will need:
(per group)

- *Access to a wild area, roadside or garden to collect seeds.*
- *Containers and paper bags for collecting and sorting seeds.*
- *A magnifying glass.*
- *Access to a digital or dissecting microscope.*
- *Secateurs and scissors.*

Setting the scene

When to collect

Seeds are dormant baby plants that are best collected in late Summer and Autumn.

How are seeds spread (dispersed)?

Seeds travel away from their parent using different means: wind, water, animals, explosive mechanisms and fi e (or extreme heat). In this challenge you are going to investigate wind, and two types of animal dispersal.

Fluffy swan plant seeds are dispersed by wind.

Challenge 1

Seeds carried by wind

Find three types of seeds you think are dispersed by wind.

To support your claims use observations and inferences to do with: the shape and parts of the seed; how well the seeds are moved by wind; where the seeds are found on the plant, how light the seeds are, and more.

Thistle seeds blown by wind.

Draw and label your seeds and explain what happens.

Challenge 2

Seeds that cling to animals

Find two types of seed you think might cling or stick to the fur, feathers or skin of animals, like mice, weka or humans.

Sticky *Pittosporum* seeds.

To support your claims use observations and inferences to do with: whether the seeds have hooks, spikes or a sticky surface, and do they stick to fur, feathers or skin?

Draw and label your seeds and explain what happens.

Challenge 3

Seeds that animals carry away or poop out

Find seeds or fruit containing seeds that you think might be carried by animals to a different place. Or, fin types that might be eaten by animals then pooped out some distance from the parent plant.

Thrush with a berry.

To support your claims use observations and inferences to do with: whether you have ever seen animals eating the berries or pooping them out, or if some animals hoard the seeds.

Draw and label your seeds and explain what happens.

INVESTIGATION

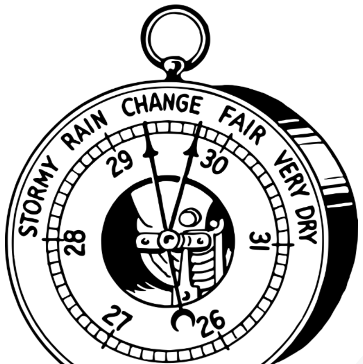
Make a barometer

WALT

We are learning how to make a simple barometer. This will allow us to take air pressure measurements which in turn tell us about changes in the weather.

What you will need:
(per group)

- *A medium sized glass jar.*
- *Some balloons.*
- *Rubber bands.*
- *A kebab stick.*
- *Sellotape.*
- *A soft drink bottle.*
- *Marker pens.*



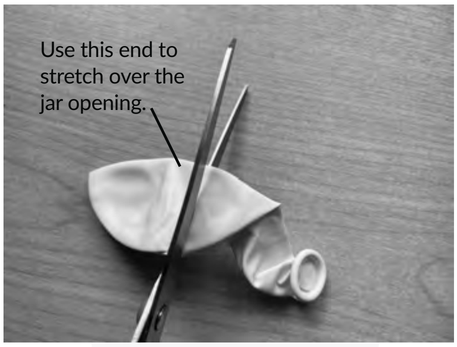
Barometer for predicting the weather.

What to do

Engage

Build your barometer

1. Cut your balloon in half as shown here.
2. Stretch it over the top of your jar and hold it in place with a rubber band. Sellotape one end of a kebab stick to the middle of the stretched balloon. Position the jar so the kebab stick point is alongside a soft drink bottle.



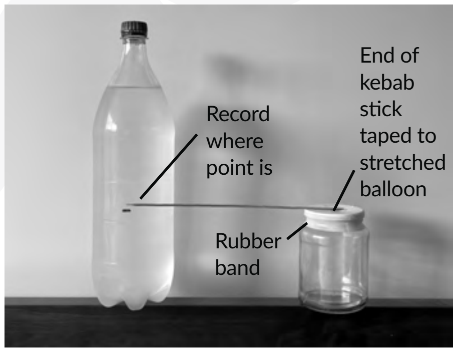
Preparing the balloon.

Explore

Taking measurements

1. Mark where the end of the straw is on the bottle. Write the date and time beside the mark. Record what the weather is like outside.
2. Repeat this each day for a whole school week. Does the straw move? Is the straw pointing higher on the scale during certain types of weather and lower during other types of weather? Carry on for a few more days and describe any patterns you observe.

Explain



Set-up for taking air pressure measurements.

Questions

Elaborate

1. When it is sunny and dry outside, where does your barometer point to?
2. When it is stormy or raining, where does the straw point?
3. From top to bottom, what order might you place these labels on your barometer scale: **change, stormy, very dry, rain, fair**?

Going local

Evaluate

For your area, make observations and talk to parents and kaumatua to find out:

- Which direction does the wind usually blow from when it rains? What signs are there that rain is coming?
- What is the most common wind direction?
- Are there any winds that sometimes make people grumpy?

Key fact

Wind direction
A wind's direction is named by the direction it ***blows from***. For example, a Northerly wind blows ***from*** the North.

CHALLENGE

Rock erosion!

WALT

We will be studying rocks to investigate how eroded they are. This will help us to understand parts of the rock cycle.

What you will need:
(per group)

- *A selection of different types of rocks like this:*

- *Rulers and protractors.*
- *Magnifying glasses.*

Setting the scene

Rocks can change over time because of ***erosion****. This means they are broken down into smaller bits due to ice expanding in cracks in the rocks, or heat extremes causing them to expand and contract and eventually shatter. Also, they might bash into other rocks as they roll down a mountain side or rumble along a riverbed during a flood or be pushed around by waves on a seashore, becoming smoother and smaller as they go. Even wind and flowin water can smooth their surfaces.*

This jagged rock has recently broken free from the side of a mountain.

In this challenge you will record observations and use these as evidence to say how eroded a selection of rocks are.

Challenge 1

List signs of erosion

Look at and carefully feel the surface of a rock. What signs can you fin indicating erosion has occurred? Look for any jagged pieces. Find a way of measuring how pointed they are. List your finding .

Investigate other rocks to find other signs of erosion.

Challenge 2

Line 'em up!

1. Sort the rocks you are supplied with into a line, with the least eroded at one end through to the most eroded at the other, like this.

2. Record data to help with your decisions.

3. Justify the order you have chosen by discussing and debating with others in your group.

Challenge 3

Tell its story

1. Choose one of the rocks and list the things that might have happened to it in the last 1000 years.

2. Draw a cartoon strip telling the story of the rock's life.

SCIENCE UNIT PLAN

Rocks rock! — He tau kē ngā toka!

Curriculum level:
Science L3 and L4

Contexts/Strands:
Planet Earth & Beyond, Material World

Science Concepts

Key concepts:

- Observing rocks — what we can see and feel; inspecting different types; makeup of sand.
- Properties of rocks and minerals — shape, colour, texture, hardness, reactivity, attraction to a magnet, density.
- Processes rocks undergo — erosion; modelling different parts of the rock cycle; igneous, sedimentary and metamorphic rocks.
- Local rocks — searching for rocks; revealing their insides.
- Uses of rocks and minerals: ironsand, white sand, pounamu, marble, limestone, greywacke, sulphur, bauxite, schist, coal; rocks used by early Māori.

Cross-curriculum studies & Mātauranga Māori

Approach:

This unit reflects how:

Cross-curriculum is the process of experiencing and understanding connections and, because of this, seeing things as a whole.

Best practice suggests drawing from only relevant Learning Areas, so for this unit, the Learning Areas of most value are: English, The arts, Learning languages, Mathematics and statistics, Science, and Social sciences.

The scope of a full cross-curriculum unit is too large for inclusion in just a few pages, so practical, hands-on science activities are emphasised here, with supporting references to cross-curriculum approaches.

Mātauranga Māori is fundamental to a holistic topic approach and may indeed be a useful focus for the unit. What traditional Māori knowledge, wisdom, understanding and traditions might contribute to understanding New Zealand's rocks and minerals?

Key aims

To investigate how rocks and minerals are key resources used in our everyday lives. This involves students:

- learning how to closely observe and investigate aspects of rocks and minerals
- discovering how rocks and minerals can be put to practical use
- discovering the importance of rocks and minerals in our lives and to our communities during the past, present and future.

ICT

Websites and YouTube demonstrations as outlined in specific activities.

Resources

School Journals and *Building Science Concepts* books as required and referred to in specific activities.

Achievement Objectives

Nature of Science (NoS)

The five Foundational Science Capabilities are the main focus within NoS and are emphasised within this unit. It is suggested that one component of a given Capability is foregrounded at any one time. However, most of the five Capabilities are inherent within most activities.

Contextual

Planet Earth & Beyond, L3–4:

Earth systems *Appreciate that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources.*

Material World, L3–4:

Properties and changes of matter *Group materials in different ways, based on the observations and measurements of the characteristic chemical and physical properties of a range of different materials.*

Localised curriculum

Use some of the following to help pursue a localised approach to your *Rocks Rock!* unit:

- visit locations of geological interest such as rock formations, a beach with varied stone/rock and sand types, or a local quarry.
- discuss, handle and make observations of rock samples from your locality (students contribute what they have seen or collected)
- discuss with adults and caregivers what they know about local rocks — what they are used for, where they are found and how they are processed
- involve the wider school community: geology experts and artists whose work involves rocks; kaumatua/elders, visiting speakers
- find out about any precious rocks and minerals that are found in your province
- visit a rock/gem shop, display or museum.

Answers and teacher guidance for pages 20–24

Bubbling rocks p20: ***Challenge 1.*** **Bubbles** form on the surface of the shell showing a chemical reaction has occurred. Water doesn't cause this reaction. Yes, a solution of citric acid and water causes bubbling too. The reaction is between acid (e.g. acetic acid in the vinegar) and calcium carbonate in the shell, to form calcium acetate, plus water, plus carbon dioxide gas bubbles. *Challenge 2.* Again, add drops of white vinegar onto the limestone, or, place the limestone into some vinegar. If bubbles form —and they do — it indicates seashells formed the limestone. Ditto for marble chips, which are metamorphosed limestone. Test by immersing a pinch of sand in white vinegar and observe using a magnifying glass. Bubbles on individual grains indicate they are fragments of seashells. Grains that don't bubble aren't from seashells. ***Challenge 3.*** **If limestone or seashells are left in vinegar, they form white-cream calcium acetate growths.**

Test rock hardness p21: Q1. Sometimes the softer rock leaves a line of powder on the harder rock, but doesn't actually scratch it. Q2. Hard rocks are good for hard-wearing surfaces like bench tops, floors and roads. Q3. Soft rocks are easy to carve into jewellery and sculptures or to use as whetstones for sharpening cutting tools.

Pumice properties p22: 1. Full of holes of varying sizes. 2. Hefting a piece of pumice shows it is very light compared to most other rocks. 3. The holes were made by gas bubbles in the larva when it cooled. Pumice is mainly silicon dioxide. 4. Pumice floats but it usually sinks deeper as water gradually seeps into the holes.

Amazing sand p23: *Challenge 1.* Colours: 1) and 2) Answers will vary, but the overall colour of the sand is determined by the combination of individual grain colours, just like the dots that make up the colours in a magazine picture. Shapes and sizes: 1) and 2) Answers will vary. The different grain sizes can be separated by picking them out individually using tweezers, but more efficiently using a number of sieves with varying hole sizes. *Challenge 2.* Is ironsand present?: Many types of sand contain some ironsand grains, especially where the sand is derived from volcanic rocks. Fair test example: Run the plastic bag covered magnet through the sand sample a set number of times, e.g. 5 times then repeat with another sample. Compare the quantities of ironsand collected. *Challenge 3.* Lightly sprinkle some sand grains in the bottom of a shallow plastic container, immerse with white vinegar, then under magnification view which sand grains form bubbles on them. The more grains that bubble, the more sand was formed from seashells. If left immersed for a few days, a coating of creamy white calcium acetate forms on the shell grains due to the reaction between acetic acid and calcium carbonate.

Rock density p24: Answers will vary depending on the rocks being measured. Extension: A common dense rock is peridotite with a density of 7.4 g/cm^3, while coal is one of the least dense at around 1.1 g/cm^3.

Specific learning intentions and activities

Endorsed by the Sir Paul Callaghan Science Academy, the following assumptions apply:

a) The 5Es instructional model is used as a general approach to lessons.

b) Student-directed learning is encouraged through teaching key techniques and approaches at the start of lessons/sections, then allowing students to build on these techniques through their own more open-ended lines of inquiry.

c) Nature of Science (NoS) components (and therefore the Five Foundational Science Capabilities) are inherent and treated in an explicit manner.

Note, you do NOT need to cover all sections, as there are many ideas presented here. The most valuable learning occurs when some areas are pursued more deeply. Tip: Print pages 16–18 to A3 size for ease of reading.

Specific Learning Intentions	Learning Activities through 5Es model
Foundational Science Capabilities/NoS Students will be able to (as examples): *Gather and interpret data* • make good *observations*, e.g. features used to identify rocks and minerals • *collect data* by grouping rocks according to their shared characteristics • *compare* and *understand* measurement *values* and *units*, e.g. rock density is measured in grams per cubic centimetre • *use* and *build* models to help understand concepts, e.g. sedimentary versus metamorphic versus igneous rocks. *Use evidence* • *use observations* along with logical thought and prior knowledge to *infer* about the make-up of rocks • *use evidence* from *different sources* such as observations versus measurements of rock properties • *use evidence* to *support claims* about, for example, a type of rock being identified. *Critique* • *critically appraise* the accuracy of a model of the rock cycle • *compare* findings with those of scientists, e.g. the density of an identified rock. *Interpret representations* • *describe* observations • *display* and *summarise* data • *interpret* or *create diagrams and maps* that summarise findings • model a process that creates simulated rock processes, e.g. heat and pressure changing sedimentary rock to metamorphic rock • *explain* findings. *Engaging in science* • *actively engage in* hands-on making, doing and testing • demonstrate *fascination* and *interest* • *become emotionally involved, e.g.* in features of a precious mineral.	***ENGAGE and EXPLORE*** **Ignite interest:** • using samples of interesting and colourful rocks/minerals • by viewing video clips of people panning for gold or hunting for precious stones • by sharing and discussing rock samples • by discussing and researching colours, uses and values of gemstones and precious minerals such as diamond, ruby, sapphire, emerald, silver, gold and platinum. **Develop descriptive word lists** Using a collection of rocks, brainstorm and record *word lists* that could be useful in describing and identifying the different types. They could be divided into: • colours, e.g. creamy, glassy black, etc. • surface patterns, e.g. speckled, swirly, etc. • rock shapes, e.g. rounded, flat, etc. • surface textures, e.g. smooth, holey, gritty, etc. • edges, e.g. sharp, rounded, etc. • heft (how heavy in the hand something feels compared to its weight) • size, e.g. fist size, pebble size, etc. • other relevant terms. **Video introduction to rocks** Though the cartoon commentary in the clip below is a little 'cringe', the information is excellent. Suggested uses: 1) students summarise ideas in their own words or in labelled picture form, 2) a teacher's quiz, 3) a starting point for investigations into different types of rocks, and 4) discuss New Zealand examples of these rocks. Duration 3:46 minutes. https://www.youtube.com/watch?v=o8heA8e9_zk **Video introductions to weathering** Suggested uses: 1) students summarise the ideas in their own words or in labelled picture form, 2) a teacher's quiz, 3) a starting point for investigations into different types of weathering, 4) replace American examples of locations, animals, etc. with NZ examples. 1. Duration 6:32 minutes. https://www.youtube.com/watch?v=mQAOe-0vxdc 2. Duration 3:23 minutes https://www.youtube.com/watch?v=-43_HBy9huc&t=63s (more advance language) **Watch how, in ancient times, a rock was shaped into a weapon or a tool** The video shows a man making an dagger from obsidian using a process called 'knapping'. It demonstrates a technique used by many early societies for making tools and weapons that need sharp edges. Obsidian is a volcanic rock that was used by early Māori. Duration 27 minutes. To save time show samples of the video at about 7 minute intervals. https://www.youtube.com/watch?v=h1DfyHyb_Hs.

Specific learning intentions and activities

Specific Learning Intentions	Learning Activities through 5Es model
Content examples Students will be able to (as examples): *Describe properties of rocks:* Colour, patterns, texture, density, hardness, etc. *Explain how rocks are different from minerals:* see over page. *Name the three main types of rocks and describe how each is formed* : igneous, sedimentary, metamorphic. *Erosion:* Explain erosion and give examples. *Rock cycle:* Explain how rocks change from one type to another over millions of years. *Local rocks:* Name some local rocks and describe how some are used. *NZ rocks:* Name some Aotearoa/NZ rocks and describe how some are used. *Traditional uses of rocks:* Describe some traditional uses of rocks by Māori and other cultures. *Other Activities and Challenges pp 20–24 list their own specific Learning Intentions.* **[Theory notes titled 'Rocks rock!', see over page.]** **Vocabulary:** basalt bauxite carbon dioxide chert clay coal density erosion flint fossil greywacke hardness hōanga/ sandstone igneous ironsand limestone marble matā/obsidian metamorphic mineral pakohe/ argillite pounamu/ greenstone precious pungapunga/ pumice rock schist sedimentary strata sulphur volcanic weathering	*EXPLAIN* **Rock cycle model/simulation** Use Starburst lollies of three different colours ripped up and massaged lightly together in your hands to form a sedimentary rock. Then massaged and heated in hands to form metamorphic rock. Then heated on a paper plate in microwave to melt and form igneous rock containing bubbles. Youtube video https://www.youtube.com/watch?v=2uQ_ZN8zWeY. **Erosion model/simulation** Build a pile of sugar cubes into the shape of a mountain, then use a syringe or eyedropper to erode and change its shape using water. Youtube video https://www.youtube.com/watch?v=2uQ_ZN8zWeY (start two thirds of the way through video at 11:12). **Reducing erosion video** How we can reduce erosion using plant cover Youtube video https://www.youtube.com/watch?v=im4HVXMGI68. **Fossil formation model/simulation** Gummy worms layered between slices of fresh white bread and put under pressure using a pile of books. Strata compress and worms leave negative impressions in bread. Youtube video https://www.youtube.com/watch?v=2uQ_ZN8zWeY. **Bubbling rocks** Detect rocks that have calcium carbonate in them, indicating they were formed from shellfish sediments **[see *Bubbling rocks* Challenge sheet, this booklet p 20].** **Test rock hardness** Compare rock hardness using a simple scratch test **[see *Test rock hardness* Investigation sheet, this booklet p 21].** **Pumice properties** Find out about the formation and properties of pumice **[see *Pumice Properties* Investigation sheet, this booklet p 22].** **Amazing sand** Find out what makes up sand **[see *Amazing sand* Challenge sheet, this booklet p23].** **Rock density** Work out the density of different rocks to assist in their identification **[see *Rock density* Investigation sheet, this booklet p 24].** *ELABORATE* **Advance their investigations** **Students ask their own questions and design experiments to:** • Investigate which soil types erode the quickest. • Find and use everyday materials to perform scratch tests to determine the hardness of unknown minerals using Mohs Hardness Scale. Typical everyday items include a drill bit, steel nail or knife, piece of glass, copper coin and your fingernail. *EVALUATE* Teachers should be able to evaluate the success of their teaching so as to make adjustments and refinements to approaches throughout a unit of work. Are students learning? How do we know? Can we measure this? Students should also be evaluating their own understanding and success throughout the unit.

Theory notes

Rocks rock!

[Adjust language and content to suit student level and ability.]

What is a rock?

A rock is a solid mixture of crystals of one or more minerals. Some rocks, such as coal and limestone, can be formed from organic materials. [Students can use own words based on the video.]

Rocks can be as small as a pebble, or formations thousands of kilometres long.

Uses of rocks

Rocks have been important to humans for over 2.6 million years.

Early humans used rocks for: [Students give/research answers and draw, e.g. hammers, arrowheads, spear points, knives, scrapers.]

Rocks used by early Māori:

[Leave some parts of the table blank for students to research the answers. They could draw pictures to illustrate these.]

Rock type	Example uses
Karā (basalt)	Adze heads for cutting and carving
Greywacke	Short handled clubs and pounders
Pounamu (greenstone)	Jewellery, weapons and adzes
Whaiapu (chert or flint)	Drilling holes, fish hooks, flake tools for cutting and scraping
Pakohe (argillite)	Adzes
Hōanga (sandstone)	Whetstones for polishing and sharpening tools
Serpentine	Reels and pendants
Tāhoata (pumice)	Floats for fishing nets
Rocks and stones	Canoe anchors, hāngī rocks, sinkers, pounding flax fibre

Some modern day uses of rocks in New Zealand (including sand):

[Leave some parts blank for students to research.]

Ironsand — making steel

Quartz sand — making glass

Marble — making floors, stairs and walls

Granite — making kitchen bench tops

Limestone — crushed for fertiliser

Greywacke — for roading, paving and in concrete

Bauxite — for making aluminium

Schist — for decorative walls, fireplaces and fences

Coal — burnt for heating, steel making, and electricity generation

Pounamu/greenstone — for ornaments and jewellery

Gemstones — agate, amethyst, citrine, diamond, emerald, garnet, obsidian, pearl, quartz, ruby, sapphire, etc. used in jewellery.

Fossils within rocks and rocks themselves — help scientists understand the history of the earth.

Types of rocks

There are three main types of rocks:

- Sedimentary — Rocks formed when sand and other sediments wash into an ocean or lake and form layers that are pressed and cemented together. Examples: [Students give answers, e.g. sandstone, mudstone, coal, limestone and greywacke.]
- Metamorphic — Rocks formed when movements of the Earth's crust force chunks of sedimentary rock downwards where heat and pressure 'cook' and squeeze it into a harder form. Examples: [Students give answers, e.g. schist, pounamu/greenstone, marble.]
- Igneous — Rocks that become so hot they form magma, the molten rock below the Earth's crust, which later cools to form solid rock. Examples: [Students give answers, e.g. granite, basalt, obsidian.]

Properties of rocks

Four easy properties to investigate include:

- **Colours and patterns —** [Students list examples of rock colours and patterns.]
- **Hardness** — [Students summarise the 'scratch test' procedure.]
- **Density** — [Students summarise how to perform rock density testing and give examples of their results.]
- **Bubbling** — [Students list what chemicals (acids like white vinegar, tartaric acid and citric acid) cause some rocks (like limestone and marble) to bubble and why.]

The rock cycle

This diagram shows how sedimentary, metamorphic and volcanic rocks are changed into one another, a process that takes millions of years.

Google image search 'simple rock cycle diagram' to display a suitable image. Students can draw their own version of this.

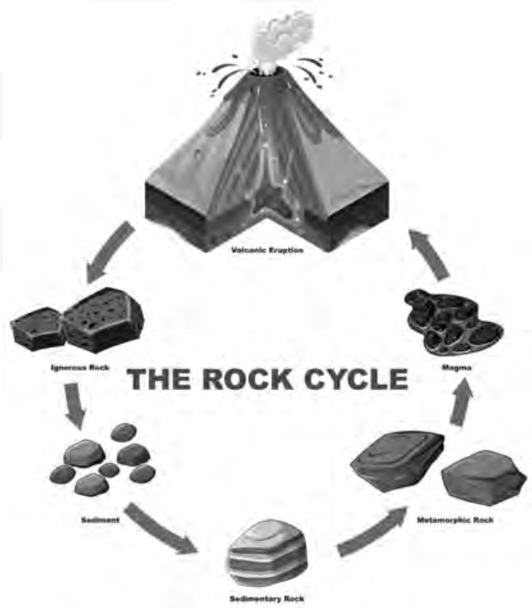


Image acknowledgement Image by brgfx on Freepik at the link https://www.freepik.com/free-vector/diagram-showing-rock-cycle_6655892.htm

CHALLENGE

Bubbling rocks

WALT

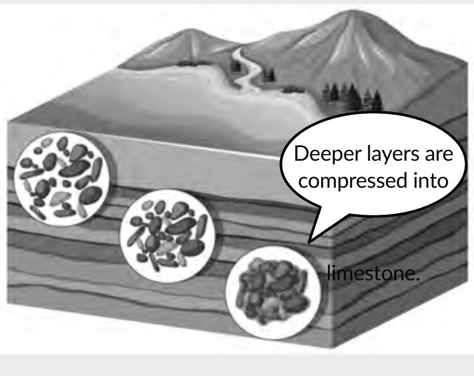
We are learning how to tell if some rocks have been formed from seashells.

What you will need:
(per person)

- *White vinegar.*
- *Citric acid and water solution.*
- *Clear plastic cups or plastic shot glasses.*
- *Seashells and selections of sea sand, some containing seashell fragments.*
- *Small chunks of limestone and some marble chips.*
- *Magnifying glass or stereo microscope.*

Setting the scene

When shellfis die, their shell fragments end up settling in layers on the bottom of the ocean. Over time, their weight squashes them together into a soft type of rock called limestone.



Over millions of years, changes in the Earth's crust can force these layers of limestone rock up into land, hills and mountains.

Can we detect the original shells within this rock, and even within the sand that they eventually form into?

Image above by brgfx on Freepik at: https://www.freepik.com/free-vector/diagram-showing-process-compaction-cementation-layers_16265436.htm#query=sediments&position=0&from_view=search&track=sph

Challenge 1

Vinegar reaction with seashell

Find a way to react a few drops of white vinegar with a seashell. You may need to scratch the shell surface fi st. View with a magnifying glass. What happens? Compare using water instead of vinegar. Does it give the same result? Dissolve some citric acid in water. Does this solution react with the shell?

The reaction

Find out about the reaction that has occurred. What is the substance in the shell that reacts with the vinegar? What makes the bubbles?

Challenge 2

Testing limestone

Find a way of testing if limestone is formed from seashells. If it is, how do you know? Repeat with some marble chips.

Testing sea sand

Find a way of testing if sea sand was formed from seashells. If it was, how do you know? Try with samples of sand from different locations. You will need to magnify things to see what is happening.

Challenge 3

Long term

What happens if a chunk of limestone is left to soak for several days in white vinegar? Does the same thing happen with a seashell? What about sand formed from seashells? Draw and label the end results.

Rising carbon dioxide levels

Rising levels of carbon dioxide in the atmosphere is making the oceans more acidic. Find out why. Then, discuss what impact this could have on shellfish.

INVESTIGATION

Test rock hardness

WALT

We are learning to fin out which rocks are harder than others. This helps us to identify the rocks and to understand why certain rocks are used for certain jobs.

What you will need:
(per group)

- *Five or more different types of rocks.*
- *A magnifying glass.*

Mohs hardness scale kit. These minerals have been ordered 1 to 10, from softest to hardest: 1) talc, 2) gypsum, 3) calcite, 4) fluorite, 5) apatite, 6) feldspar, 7) quartz, 8) topaz, 9) corundum, and 10) diamond.

Picture by Hannes Grobe CC BY 3.0.

What to do

Engage

Prediction

1. Number your rocks. Use your fingernail to feel how hard they are then predict which one is the hardest and which is the softest.

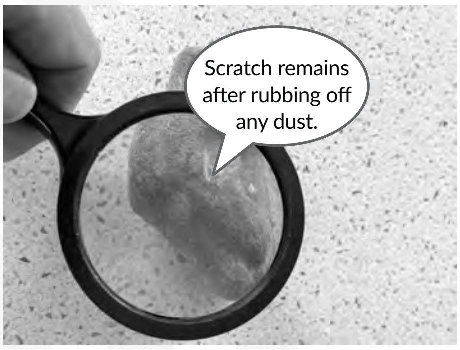
Explore

Using a scratch test to find how hard they are

2. Choose any two of your rocks. Use one rock to try and make a single scratch line on the other. It's best to use a pointy part of one to scratch a flat area on the other.

Explain

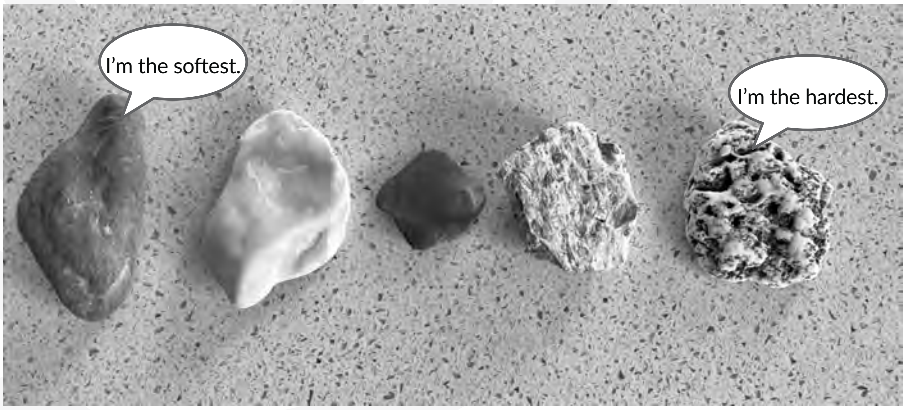
3. Rub the mark with your finger to remove any 'dust'. Now using a magnifying glass, check to see if it has left a scratch. If it has, then the rock you tried to scratch is ***softer*** than the one you scratched with. If there is no scratch on the rock, then it is the harder one.



Scratch made by a harder rock.

Elaborate

4. Repeat the process over and over until you can arrange your rocks from softest through to hardest.



Softest (left) to hardest (right) rocks found using scratch tests.

5. Once you think you know their order, get your friends to do the scratch test on the same set of rocks. Do they agree with your order? If not, perform some more tests till you do agree.

Extension

Find out about Mohs scale of mineral hardness (see picture above). What is it used for?

Questions

Evaluate

1. Why did you need to rub the scratch before deciding which rock was harder?
2. What uses might a very hard rock have?
3. What uses might a soft rock have?

INVESTIGATION

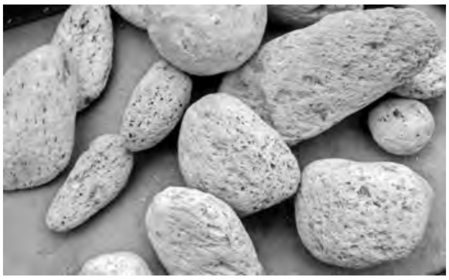
Pumice properties

WALT

We are learning to investigate some of the properties of pumice.

What you will need:
(per group)

- *A piece of pumice rock.*
- *Another rock of similar size to the pumice.*
- *Scales to weigh pumice.*
- *A bowl filled with water.*
- *A magnifying glass.*



Samples of pumice rocks found on a North Island beach.

Extension

Find out about the 2019 pumice raft produced by the Tongan underwater volcanic eruption.

Challenge

Grind up some pumice and glue it to cardboard to create a fingernail file. **Caution: wear a dust mask so you don't breathe in any fine particles.**

What to do

Engage

Describe the structure of pumice

1. Using a magnifying glass, carefully look at the structure of pumice. Describe it in your own words.

Pumice through a magnifying glass.

Explore

How heavy is pumice?
'Heft' is a term used to describe testing something's weight by giggling it up and down in your hand.

Explain

2. Compare the heft of your piece of pumice and the heft of another stone of similar size. How does the weight of the pumice compare with the other rock? Explain why they are so different in weight.
3. Research into how pumice is formed. What made the holes? What material is pumice mainly made of?

A pumice rock being jiggled up and down in the hand (called hefting) to feel how heavy it is. Feeling its weight and knowing its size gives an indication of its density.

Does pumice float?

4. Find a way to see if pumice floats. Leave it in the water for 10 seconds only, then take it out and mark the 'tideline' with a vivid pen. Now put it back in the water. Does the tideline change as time passes? What has happened by the following day?

Elaborate

Putting pumice to work

1. Make an art piece: Use a hacksaw, a drill and a nail to sculpt an ornament, a figurehead or some other art work.
2. Use a piece of pumice to make a traditional Māori fishing float.
3. Use a piece of pumice to scrape the dry skin off the soles of your feet.

Evaluate

Research

Find out what other uses pumice has. Choose one use and report back to your group about it.

CHALLENGE

Amazing sand

WALT

We are learning to investigate what makes up different types of sand. We will be using observations, and methods of testing its physical and chemical properties.

What you will need:
(per group)

- *At least three different samples of sand from different beaches.*
- *A magnet.*
- *White vinegar and a plastic pipette or eyedropper.*
- *A magnifying glass.*
- *Plastic shot glasses.*
- *Zip-top plastic bags.*
- *Kitchen sieves with different hole sizes.*
- *A plastic ruler.*

Setting the scene

When you walk along a sandy beach you may notice the sand colour and the grains sticking to your bare feet. But what is sand made off? Are all the sand grains the same size, shape and colour? What other differences do they have?

Challenge yourself to fin out more about this fascinating stuff we call sand, something we hardly ever notice!

Challenge 1

Colours

For each of your sand samples list: 1) the overall colour of the sand when dry, and 2) using a magnifying glass, all the different colours of the sand grains you can find Now explain why the sand appears this **overall** *colour.*

Shapes and sizes

In each of your sand samples, list 1) the general shapes of the sand grains, and 2) the different sizes. Can you fin a way of separating out the larger and smaller grains? (Hints: Try out sieves and also try using the 'Brazil Nut Effect', which you will need to research.)

Challenge 2

Is ironsand present?

Place a magnet inside a zip-top plastic bag and run it through a sand sample. Have any grains of ironsand been picked up by the magnet? Check each of your sand samples.

Magnet inside a plastic bag being rubbed through a sand sample and collecting ironsand.

Compare your different sand samples

Set up a fair test to find which sample contains the most ironsand (if any). How have you made sure the comparison is ***fair****?*

Challenge 3

Are tiny seashell grains in your sand?

Acids like white vinegar or citric acid will react with seashells. Find a way of testing your sand samples. Are any tiny seashell pieces in your sand? How many compared to other types of sand grains? How do you know? What does this tell you about the presence of shellfis at the beach?

Leave a sample that contains a lot of shellfis grains soaking in white vinegar for a few days. What happens? Why?

INVESTIGATION

Rock density

WALT

We are learning how to fin the density of a rock, which will help to identify it. We can then use the same method to identify other rocks.

What you will need:
(per group)

- *A 1.5 L soft drink bottle with the top tapered portion removed.*
- *Two or three rocks from the list below and small enough to fi inside the drink bottle.*
- *A measuring cylinder.*
- *Electronic scales.*
- *Kitchen tongs and craft knife.*
- *Drill and bit, and hot glue gun.*
- *A hollow plastic balloon cane.*

What is density?

Density measures how heavy something is compared to its size. Examples: 1) a steel ball is very dense compared to a rubber ball of the same size. 2) If an object is more dense than water it will sink when placed in water, and if it is less dense than water, it will float.

Densities of common NZ rocks (g/cm³)
(Approximate mean values)

Coal	1.7
Pumice (fully wet)	1.7
Tuff	2.1
Mudstone	2.2
Shale	2.3
Siltstone	2.3
Sandstone	2.4
Limestone	2.5
Scoria	2.6
Chert	2.6
Granite	2.6
Greywacke	2.6
Quartzite	2.6
Schist	2.7
Marble	2.7
Basalt	2.8
Gneiss	2.8

Extension

Out of all rock types find out which are the least and most dense.

Engage

Setting the scene

Different types of rocks have different densities (see table to left). So, if you can measure the density of a rock, you can then look up a table to find what type of rock it might be.

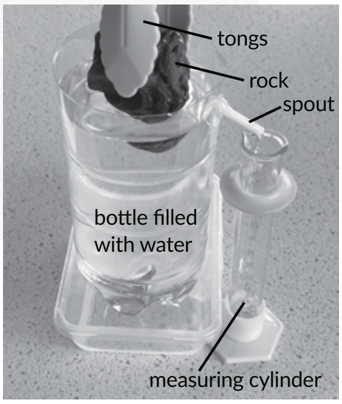
Explore

What to do

There are a number of steps in working out the density of a rock. Watch this video to see how it's done — https://www.youtube.com/watch?v=baqaLHV50cw.

Make your own 'eureka can' also known as a 'displacement can' or a 'density can'

1. Cut the top off a 1.5L soft drink bottle. Make a hole and glue a short length of hollow balloon cane into it. Test that water only runs out this spout and not where you have glued it. Once you know there are no leaks, fill the 'can' with water and wait till it stops draining out the spout.
2. Position the measuring cylinder under the spout ready to catch the water.



Eureka can set-up. The bottle is sitting on a plastic container.

Explain

Measurements

3. Weigh and record a rock's mass in grams.
4. Use tongs to carefully lower the rock into the water, releasing it before you touch the water with the tongs. If any water splashes out, refill and start again. Now, record the volume of water that collected in the measuring cylinder (measured in millilitres, which is the same as cm³). This equals the rock's volume.

Work out the density

5. Divide the rock's mass by its volume to give the density. For example, if a rock weighs 231g and has a volume of 110cm³ then,

Oh, so the density table to the left shows it could be a rock called Tuff.

The rock's density = 231g divided by 110cm³
= 2.1g/cm³

Elaborate

6. Use the method to work out the density of your rocks. Then, swap the rocks with another group to see if they find similar results.

Evaluate

Communicating your findings

Use the table to name the rocks you tested. See if others agree with your findings.

Assessment rubric

Example assessment rubric

Since the Nature of Science (NoS) strand is overarching, it is important to assess this in order to monitor learning progress in NoS skills and development of Capabilities. The following is an example of a rubric that might be used formatively and summatively, with the proviso that it is tailored to your learning situation. Change the words as you see fit.

Rubric relating to: Gather and interpret data (observations)

Observations

Name: | Year:

Blossoming tree		Level 4	I can do all of Level 3, *and* I understand the difference between an observation and an inference. COMMENTS:
Tree		Level 3	I make careful and accurate observations using appropriate senses without being prompted to do so. COMMENTS:
Sapling		Level 2	I know how to focus appropriate senses to make careful observations. COMMENTS:
Seedling		Level 1	I mainly use sight to make observations. COMMENTS:
Assessments that contribute to this overall summation			

In a nutshell

"Assessment measures learning"

Formative assessment
This is assessment ***for*** learning. It occurs ***during*** the process of learning and can inform students and teachers of progress on a day-to-day basis. Its immediacy allows for fine-tuning of direction and pace, and highlights where improvements, changes and re-working of the learning process need to occur. Both teachers and students should be actively involved in this process.

Summative assessment
This summarises what has ***been*** learnt. It occurs at the ***end*** of a block of work. Typically it is used for reporting purposes (to parents, principals, boards of trustees), or for the purpose of bench-marking progress for the broader analysis of learning over time, e.g. from one year to the next.

It is recommended that assessments should test ***both*** students' understanding of the ***process*** of science (the Nature of Science strand, including the Foundational Science Capabilities) and relevant ***content*** (i.e. relating to the *The Living World*, *The Material World*, *The Physical World* and *Planet Earth and Beyond*).

EXHIBITS AND SHOWS

Exhibit Themes

Each year we have on display six different themed collections of exhibits available during your 70 minute programme. For 2023 these themes are as follows.

Helping the senses — Te āwhina i ngā tairongo

Exhibit learning intentions relate to: magnification, metal detection, temperature, measuring radiant energy, using sonar, sound detection, merging images.

Contexts — All learning stands, Nature of Science.
House of Science Kit — Super Sense | Nongo Nui

Localised curriculum ideas — Professions using detection devices — doctors (stethoscope), building inspectors (IR cameras for thermal imaging), police (speed radar), scientists (microscopes and telescopes, alcohol and infrared thermometers, etc.)

Light properties — Ngā āhuatanga aho

Exhibit learning intentions relate to: reflection; glare, mirror images, objects and images, bilateral symmetry, focus point and focal length.

Contexts — Light and sight, Senses, Radiant Energy.
House of Science Kit — Enlighten Me | Whakamāramahia Ahau

Localised curriculum ideas — Related local professions: photographers, opticians, microscopists, astronomers and their telescopes, stained glass artists, artists working with glass, reflection and colour. Effects of glare when driving.

Movement — Te nekeneke

Exhibit learning intentions relate to: motion, speed, acceleration, inertia, momentum, gyroscopic effect, centripetal force, gearing, rotational movement, forces.

Contexts — Forces and Motion, Bicycle science.
House of Science Kit — May the Force Be With You | Kia Tau te Tōpana ki a Koe

Localised curriculum ideas — Local playground equipment, skateboards and bicycles, vehicle stopping distances, local road accident hotspots.

Observation and inference — Te mātakitaki me te hīkaro

Exhibit learning intentions relate to: careful observations using all senses; making inferences, analysing cause and effect, and making simple deductions based on observations.

Contexts — Nature of Science. Observing.
House of Science Kit — What Do You Think? | He aha ō whakaaro?

Localised curriculum ideas — Observing local wildlife such as birds and insects, observing animal behaviour and making inferences about why the behaviour occurs.

Pressure — Te pēhanga

Exhibit learning intentions relate to: pressurised projectiles, fluids under pressure, air vibrations and sound, floating and sinking, vacuums, hydraulic v's pneumatic, Venturi effect, siphoning.

Contexts — Under pressure, Forces.
House of Science Kit — Float my Boat | Te Whakamānu i Taku Poti

Localised curriculum ideas — Local aero club (how pressure helps us to fly and monitor the weather), how air pressure affects our local weather, whose vacuum cleaner has the most suction?

Rocks and minerals — Ngā toka me ngā kohuke

Exhibit learning intentions relate to: NZ rocks and minerals used by traditional Māori, and in today's world; properties of minerals.

Contexts — Earth Science, Rocks and minerals.
House of Science Kits — Earthquakes | Nga Kumekume a Ruaumoko, Volcanoes | Nga Puia

Localised curriculum ideas — Our local rocks and minerals, local quarries, local artists working with rocks, industries using rocks, e.g. roading contractors, stonemasons, kitchen bench manufacturers, decorative stones used in gardens.

Shows

While being exciting and entertaining, our shows provide a great opportunity to enhance student knowledge and understanding in two science areas each year. The shows for 2023 are shown below. To assist you in preparing for your visit, we've also developed a unit plan called *Rocks rock! He tau kē ngā toka!* — found earlier in this booklet — that complements the *Mighty Materials* show. Other past units can be found within pdf downloads of Resource Books at: www.roadshow.org/content/scienceRoadshow/resources.php.

Mighty Materials show — Te whakaaturanga Matū Mīharo

This show covers specific learning outcomes relating to the properties and behaviour of materials and substances like metals and fabrics, and how they are put to real life use, including the following:

- absorptivity of materials
- dissolving things, solvents, solutes
- heat conductors and insulators
- electroplating
- flammability of clothes, fire retardants
- strength of polycarbonates and industrial strength velcro.

House of Science kit: *Nano-chem / Nano-matū*

Sounding Out Waves show — Te whakaaturanga Ngaru Oro

This show covers specific learning outcomes relating to the science of sound, including the following:

- how sound travels and how fast it travels
- pitch and frequency, hearing range
- Doppler effect
- what substances sound travels through
- resonance, volume and amplitude
- the many effects these have on things we can or cannot hear
- good observation skills.

Shows — Learning Outcomes

After attending shows students will have increased:

- understanding of the Nature of Science and the Science Capabilities
- engagement, interest and enthusiasm for science
- understanding and knowledge of scientific ideas.

Key References for Exhibit Themes and Shows

Science kits: House of Science https://houseofscience.nz/science-kits
School Journal and Connected series: https://journalsurf.co.nz/
Building Science Concepts series: google search 'tki building science concepts'

Answers to pages 4–15

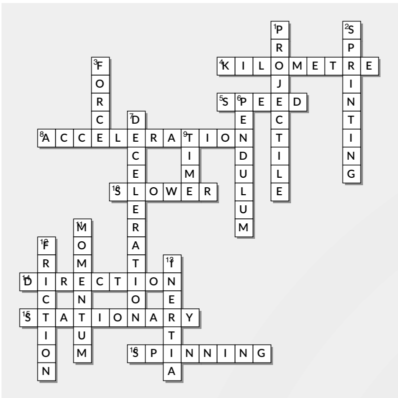
Instruments help our senses page 4

instruments, help, senses, microscope, objects, telescope, distant, detect, cannot, Geiger, ionising, radiation, compass, magnetic, North.

Light fantastic page 5

waves, infrared, ultraviolet, reflection, colours, energy, bends, glass, spectrum, sunlight. WAVELENGTH

Movement crossword page 6



Observe and infer page 7

O. A black hole in space looks black. **I.** No light can escape….

O. There is a glowing area around a black hole…. **I.** Star matter…

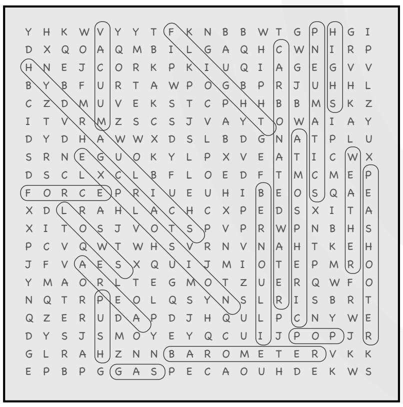
O. Molten rock comes out of a volcano. **I.** It is very hot below …

O. Larva oozes out of a volcano. **I.** Larva is under pressure …

O. Feather-shaped imprints… **I.** Dinosaurs had feathers.

O. Only sauropod dinosaur … **I.** Sauropod dinosaurs evolved…

Under pressure page 8



Statements: 1) force, force, area, pressure. 2) highs, lows, atmospheric. 3) pressure, pneumatics. 4. hydraulics.

Rock types page 9

1. sandstone/tunaeke SEDIMENTARY
2. pumice/koropungapunga IGNEOUS
3. granite/tokapata IGNEOUS
4. greywacke SEDIMENTARY
5. obsidian/tūhua IGNEOUS
6. greenstone/pounamu METAMORPHIC
7. limestone/pākeho SEDIMENTARY
8. mudstone SEDIMENTARY
9. slate/tereti METAMORPHIC
10. schist/kurupaku METAMORPHIC
11. marble/māpara METAMORPHIC
12. coal/waro koranehe SEDIMENTARY

Magnifying madness page 10

Challenge 1. Yes it does magnify. This is because it allows you to focus up closer to an object than is normal. Yes, extra light helps. **Challenge 2.** A hole that is too large or too small gives a fuzzy image. **Challenge 3.** The drop of water can be used just like a magnifying glass. The more circular the shape of the drop the clearer the image, and the more spherical it is, the higher the magnification.

Focused light page 11

Making it scientific 1. The best distance to hold the lens from the balloons for popping them is the same as the focal length. 2. Answers will vary according to the brightness of sunlight and the types of rubber. **What we found** 1. At the focal length. 2. Usually the order is: water balloon—cheap party balloon—helium balloon. Balloons that pop easier have thinner and/or poorer quality rubber. **Extension** 1. The water in a balloon keeps its rubber cooler and damp, making it more difficult to burn. 2. Two lenses do magnify more, but it is difficult to focus them.

The great karate chop page 12

Explore further 5. Answers will vary. 6. It sometimes doesn't work if: the karate chop is too slow, or, if there is too much friction between the $5 note and the object on top (due to it being too heavy or having a rough under-surface). 7. Reports will vary. 8. Inertia means an object will continue its current motion until a force causes its speed or direction to change. In this investigation, the inertia of the pile of coins on top of the $5 note means it 'wants' to stay where it is. **Examples.** It is **helpful** that a ten-pin bowling ball has a lot of inertia, so it can knock over the pins. When trying to push-start a car it is a nuisance that it has a lot of inertia, because it is difficult to move. **Extension.** It is a lot harder to make the trick work using sandpaper, because it grips onto the pile of coins and pulls it off balance.

How are seeds spread? page 13

Challenge 1. Examples of seeds spread by wind: dandelion, swan plant, thistle, Marlborough daisy, akeake, ash, sycamore, etc. Some have light fluffy seeds, others have wings, so they can float, glide or 'fly' away. The seeds usually develop high on the plant so they have a 'launch pad' to disperse from. **Challenge 2.** Examples: Hook grass, bidibid, cleaver. **Challenge 3.** Acorns and walnuts are carried to other places or scattered by rats, squirrels and pigs. Taupata, raspberry and elderberry fruit are eaten and pooped out by korimako/bellbird, pihipihi/silvereye and blackbirds.

Make a barometer page 14

Question 1. When sunny and dry it points higher up. 2. When stormy or rainy it points lower down. 3. Very dry—Fair—Change—Rain—Stormy. **Going local.** Answers will vary. Signs of rain include dark low clouds, sudden change of wind direction and damp misty air. Common winds to make people grumpy are ones that are strong, blustery, hot and/or relentless. Their direction varies with region.

Rock erosion page 15

Challenge 1. Signs include smooth or polished surfaces, rounded edges, oval or rounded form, small sized, lacking recent breaks. Measure how sharp edges and points are using a protractor. **Challenge 2.** The order will depend on the rocks chosen. Discussion around justifying the order is key. **Challenge 3.** Ideas that might be included in the cartoon strip: frost, cold and heat causing a rock to break loose from a mountain side; tumbling down the mountain; crashing into other rocks; bits breaking off; rolling along a stream bed; constant collisions against others; long boring periods when nothing is happening; being pushed into the ocean; moved by waves, etc.

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- Learn how to target all types of learners by developing practical investigations that will stimulate all the senses.
- Introduce more science to other areas of your teaching.
- Unit selection and planning.
- Investigate the cultural differences in learning styles and how teaching can be adapted to meet the needs of all learners.
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