THEMES
Earth science — Te pūtaiao ā-nuku
Inferences — Ngā hīkaro
Movement — Te nekeneke
My body — Tōku tinana
Scientific instruments — Ngā taputapu pūtaiao
Sight and illusions — Te kitenga me ngā kitenga mariko

SHOWS
Balloons and Bernoulli — Ngā puangi me Bernoulli
Kitchen Chemistry — Te pūtaiao ā-kihini

UNIT PLAN
Weather — Huarere

SCIENCE ROADSHOW
2020 RESOURCE BOOK
**Teacher's guide**

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### Introduction

We have produced this comprehensive resource of activities to better enable teachers to plan and incorporate ‘The Science Roadshow visit’ into student learning programmes. The over-riding objective is to enhance learning outcomes for students.

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  - Hints p 27
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  - Exhibits and Shows for 2020 pp 28–30

**Further support**
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- Encouragement
- Safety
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**STUDENTS**
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### 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 80 minute Science Roadshow visit experience (exhibits and shows) and within this Resource Book. And, we have exhibit themes called ‘Inferences’, and ‘Scientific instruments’.

### Science kits to support science education

We would like to draw your attention to a range of hands-on science kits for science teaching made available by the House of Science. Branches around the country service over 300 schools. They deliver, collect and re-stock a kit before sending it onto the next school, essentially acting like a science resource library. A full list of kits can be seen here: [https://houseofscience.nz/resources](https://houseofscience.nz/resources). Kits are available to Years 0–8 schools on a membership basis, which is subsidised by community sponsorship. For details of regions currently serviced, see the House of Science website: [https://houseofscience.nz](https://houseofscience.nz).

### Numeracy and literacy

Many numeracy and literacy opportunities exist within the Science Roadshow programme, both during the visit experience and within this Resource Book. In particular, shows, science experiments and investigations, challenges, interactive exhibits and the Unit of Work found in this Resource Book, are all contextual frameworks within which the teacher can present integrated programmes.

### Sir Paul Callaghan Science Academy endorsement

Research gives us very clear pointers to the components of best practice science instruction. Key aspects are incorporated within this resource book, namely: a strong emphasis on explicit teaching of the Nature of Science (through the Science Capabilities), the 5 Es Instructional Model that is based on a constructivist view of learning, good questions leading to good investigations, and, a student-directed learning approach in which students are coached towards more and more opened ended forms of scientific inquiry. These practices are endorsed by the Sir Paul Callaghan Science Academy and are fundamental to creating critical-thinking, innovative students who will become part of a science savvy public.

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

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Resource Book prepared by Peter E. Smith

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Earth science

SCIENCE VOCABULARY PUZZLE

Rock types

Use the clues to complete the crossword. The rock pictures will also help, and they are labelled I for Igneous, S for Sedimentary and M for Metamorphic. Look up books and websites to find out more.

Across
2) Has bands of colour that are often very wavy. Feels rough and glitters. M
5) Very hard, black rock. Feels rough and heavy. I
6) Dark grey. Splits apart easily. Surfaces of each layer are quite smooth. M
7) Pale coloured with air holes in it. So light that it can float on water. I
8) Shiny and black. Very smooth and glassy with sharp edges. I
11) Speckled colour, often pink and grey, or white and grey. Glittery bits in it. Very hard. I
4) May be pure white or with swirly bands of colour. Rough and grainy. M

Down
1) Rounded stones stuck together in sandy rock. S
2) Has very thin, straight or wavy layers. Splits along layers. Often glitters. M
3) Made of grains of sand. Often layered. Feels rough and sand rubs off it. S
6) Has very thin, straight or wavy layers. Splits along layers. Often glitters. M
7) Pale coloured with air holes in it. So light that it can float on water. I
8) Shiny and black. Very smooth and glassy with sharp edges. I
10) Grey, white or yellow. Can be layered and may contain fossils. S

Clues to rock names

Photo credits: gneiss, Siim Sepp, Wikipedia; pumice and chalk, Peter Smith, NSIL; marble, Luis Miguel Bugallo Sánchez, Wikimedia; obsidian, Wikimedia; conglomerate and sandstone, James St. John, Flickr; schist, Michael C. Rygel, Wikimedia.
**Inferences puzzle**

Using a ruler, draw straight lines to link each observation to its most suitable inference. Make sure you join the dots carefully. Circle the letter that each line passes through. Write these letters in their numbered space below to find the two answers. One letter clue is given.

We use our ........... to make observations. An inference is based on evidence (from our observations) and reasoning. So an inference is a bit like an intelligent ............

Your answers:


**Observations**

I hear a sharp tinkling sound. 1. O

I see that the beak is sharp and hooked. 2. S

The rock feels smooth and rounded. 3. E

I see the animal’s fur is long and thick. 4. S

It tastes sweet. 5. S

It tastes sour. 6. E

It feels hard to stop. 7. S

It smells horrible. 8. E

I hear it make a loud, deep growl. 9. S

I see the beak is flat and rounded. 10. E

**Inferences**

- It is used to tear meat.
- It contains sugar.
- It is heavy.
- It has travelled down a river.
- It lives in a cold place.
- It contains acid.
- The object is hard, perhaps metal.
- The animal is big.
- It is rotten.
- It dabbles for food in the water.

---

**Host the Science Roadshow**

Each year we need approximately 100 host schools around the country. We set up in a ‘host’ school’s hall or gym and other schools from the surrounding area are invited to our pre-booked sessions.

Our stay at a host school varies between one and three days — depending on our itinerary, the location, and how many students may visit from the host and surrounding schools.

The Roadshow makes a commitment to a set itinerary and venues well in advance, so it’s really important that our host schools can commit to hosting the Science Roadshow.

**Host Venue Criteria**

- **The use of your school hall or gym**
  - This is where we set up our exhibits and other equipment. Your hall needs to be approximately 20x30m. All our equipment is on trolleys and wheeled into the hall. As we have 60 cubic metres of equipment, the hall will need to be clear of any chairs, tables etc.

- **A group of students to be ‘Explainers’**
  - We require 13 students (Yr 7+) daily who will be trusted with assisting on specific exhibits. Our staff will conduct an extensive explainer training session that includes health and safety aspects.

- **A member of staff to act as our co-ordinator/liaison**
  - This person needs to book the hall and select student explainers. They will be our go-to person if we have any issues or questions.

- **Contact Maureen Jones for more info:**
  - maureen@roadshow.org or 04 499 7865
Cut out the scattered tiles. Lay them out in rows of three. The first should show the **diagram**, the second a phrase or term that **describes** the movement and the last, an everyday example of this type of movement. Discuss with others in your group, then once you are certain of your answers, glue the tiles onto a piece of paper. An example is given here.
Oh my poorly gut!

Use the common terms from the list to label the diagram, showing at what parts of our digestive system these things happen. The first one is done for you.

Common terms:
spew, fart, poo, gurgle, hiccup, tummy-rumble, gulp, heartburn, burp, swallow, chew, food breakdown, swollen belly, the runs.

Now choose 7 of the common terms and complete the boxes. One is done for you.

<table>
<thead>
<tr>
<th>COMMON TERM</th>
<th>SCIENTIFIC TERM</th>
<th>WHAT’S HAPPENING?</th>
</tr>
</thead>
<tbody>
<tr>
<td>spew</td>
<td>vomit or emesis</td>
<td>Food forced from the stomach and out the mouth</td>
</tr>
</tbody>
</table>

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New units, old units

When we measure something, we use 'units of measurement'. For example, we might measure a piece of paper using a ruler that uses the unit 'centimetres'. In the old days we used different units than today, so back in the 1950s we would have measured a piece of paper in inches.

Find 22 hidden units. There will be 11 old units and 11 we use today. When you have found them, put them under the correct headings at the bottom of the page. Two are done for you.

Old units

<table>
<thead>
<tr>
<th>Units used today</th>
</tr>
</thead>
<tbody>
<tr>
<td>litre</td>
</tr>
</tbody>
</table>
**Eye parts mystery**

Unscramble each of the clue words about the eye. The first is done for you. Copy the letters in the numbered cells to other cells with the same number to complete the mystery about our eyes.

<table>
<thead>
<tr>
<th>Clues</th>
<th>Unscramble</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIIS</td>
<td></td>
</tr>
<tr>
<td>TFA</td>
<td></td>
</tr>
<tr>
<td>LSEN</td>
<td></td>
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<tr>
<td>RNCOEA</td>
<td></td>
</tr>
<tr>
<td>HESLAS</td>
<td></td>
</tr>
<tr>
<td>TICOP RVNEE</td>
<td></td>
</tr>
<tr>
<td>URMOH</td>
<td></td>
</tr>
<tr>
<td>CLESMUS</td>
<td></td>
</tr>
<tr>
<td>TAIREN</td>
<td></td>
</tr>
<tr>
<td>CLSERA</td>
<td></td>
</tr>
<tr>
<td>VEOAF</td>
<td></td>
</tr>
<tr>
<td>IULPP</td>
<td></td>
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</tbody>
</table>

**Extension**

Find out what each of the parts of the eye do. How can you trick your eyes? Find out about optical illusions and test some on your friends.
Stop that erosion!

**Learning intentions** Science Capabilities: Gathering & interpreting data, Using evidence. Fair tests. Planet Earth and Beyond: Soil erosion.

### Challenge 1

**Being systematic**

Decide how to ensure these are the same for every test:
- each test ‘castle’ created is the same firmness
- the amount of water poured on top
- the strength of the water flow
- your assessment of the amount of erosion
- your recording of results.

### Challenge 2

**Compare sand and earth samples**

Make three test castles alongside each other: 1) sand, 2) soil and 3) a test castle made from soil with a small handful of grass clippings well mixed in.

### Challenge 3

**Stopping soils from eroding**

How could a farmer or landowner help soils stay on their land during heavy rain and not erode down streams and rivers? To decide:
- Test different ideas
- Gather data to support your findings.
- Decide on ways of communicating to others what you have found.

---

**What you will need:**

(Per group)
- A large plastic yoghurt container with sloping sides like this:
- Samples of sand and soil.
- A board, a jug and some water.
- A few handfuls of grass clippings.

---

**Setting the scene**

Soil erosion can be a big problem. How can we stop it, or slow it down so we don’t loose so much soil from the land during heavy rains?

Here you will do some tests on different types of soils to see if changing the soil will stop it from eroding away.

Start with a sample of sand. Make it damp using a small amount of water, then pack it firmly into the yoghurt container. Turn the container over onto a board, tap it a few times, then lift the container off. You should be left with something like a sand castle that you will build many times to perform tests on.

Using the jug, pour a steady, gentle stream of water onto the ‘sand castle’ and record how much it falls apart. Perform a few test runs before starting the Challenges.

---


Catch the money!

**Learning intentions**
Science Capabilities: Observations and inferences.
Living World: Human body and hand-eye coordination.

**What to do**

**Setting the scene**
How good are you at catching? What observations can you make and what can you infer from these observations?

You are going to attempt to catch falling objects to find out what you can infer from the observations you make and data you collect.

**Test how good you are at catching**

1. To find out, hold a flat piece of paper up high, then drop it. When it is half way down, quickly try to catch it before it hits the ground. Do lots of tests.
2. Screw the piece of paper up and repeat the tests.

**Observations and inferences**

3. Which one was easier to catch?
4. What observations did you make?
5. Attempt to write some inferences you could make based on your observations. An example is given. Add more.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>I saw the paper fall downwards.</td>
<td>It was pulled down by gravity.</td>
</tr>
</tbody>
</table>

6. Get someone else to drop objects while you try to catch. List more observations and inferences.
7. Try similar tests with the paper money and the plastic coins. Can you use science to create a ‘game of chance’ in which you mostly win?
Walking beans

Learning intentions
Science Capabilities: Experimentation, trial and error, engagement.
Physical World: Movement, forces, inertia.

What you will need:
(per group or per person)
★ Two marbles the same size.
★ A 6 x 6 cm piece of scrap paper.
★ Aluminium foil.
★ A glue stick and sellotape.
★ A plastic box with lid.
★ Optional: ball bearings.

Setting the scene
Sometimes things we see are hard to explain. In this challenge you are going to create a toy that behaves in a very odd way indeed.
Make a ‘walking bean’ using the method shown in this YouTube video:
https://www.youtube.com/watch?v=06mpikpl0_I

The result should look like this:

Make sure you always carry it like this, so it doesn’t crush.

Challenge 1

Make it walk
Carefully place your walking bean on a large flat piece of cardboard or a tray. Can you:
• find how to make it ‘walk’?
• find what way to move it so it doesn’t walk?
• discover what surfaces are best?

Challenge 2

Obstacle course
Can you make an obstacle course, or, a ‘playground’ for your walking bean. Give yourself a point for every trick you can make it perform.

Explanations
Can you explain how it works?

Challenge 3

Modifications
Can you make different versions of walking beans:
• Shorter or longer ones
• Narrower ones
• One with a ball bearing inside.
Describe and explain the differences in behaviour of your beans.

Related science kits: House of Science May the force be with you.
My reflexes

Learning intentions Science Capabilities: Observations and gathering data, communicating science. Living World: The human body and its reflexes.

Challenge 1

Knee jerk reflex
Have someone sit with their lower leg dangling. Tap them just below the kneecap with the edge of your hand or a small rubber hammer. You may have to try several spots before you are on target. What happens to the lower leg?

When will it work?
In what leg positions will the reflex work, and not work?
If the person tenses their leg muscles will the reflex work?

What’s it for?
Research into why we have this reflex and write an explanation in your own words.

Challenge 2

Other reflexes
When do these reflexes occur? Test some out, but be careful not to hurt anyone!

• blinking
• pupil becoming smaller
• ankle jerk reflex
• blushing
• coughing
• shivering
• sneezing
• startle reflex
• stretch reflex
• pain withdrawal reflex
• yawn
• tickle reflexes.

Challenge 3

Going deeper
Choose one or more of the reflexes and find out more through investigations. Report back in detail on what you have found.

Related science kit: House of Science Super Sense.
What you will need:
(per group)
- A 2 litre plastic soft drink bottle and lid (plus spares).
- Craft knife or scissors.
- Matches.
- Large sewing needle.
- Felt pen.
- Blu tack (or plasticine)
- Timing device.
- Optional: Food colouring.

What to do

Setting the scene
We use time measurements in many areas of science. Today we use digital devices, but we can also create our own time measuring device, just like the ancient Chinese did.

Making a basic water clock
1. Use a burning match to heat the sharp end of the needle, then push it through the centre of the bottle lid. Take care not to burn yourself!
2. Cut off the top part of the 2 litre bottle and put the lid on. Turn it over and rest it in the bottom part. Use blu tack to hold it in place.
3. Mark a line near the top edge and fill the top portion to the line with water. Add food colour if you wish. Immediately start timing. At 30 seconds, mark the water level in the bottom part. Continue to make marks every 30 seconds.
4. Once all the water has run through, empty it out. Now you can use your water clock as a timer. How reliable is it?
5. How could you make it accurate over shorter time periods?
6. Draw and label your water clock.

Try different designs

7. There are many ways of building water clocks. A couple of simple options are shown in this YouTube video: https://www.youtube.com/watch?v=boUI8MEaFWM
8. Try building your own design and test it for accuracy. Draw, label and explain how it works.
Sight and illusions

INVESTIGATION

Dominant eye

Learning intentions
Science Capabilities: Observations, engagement.
Living World: Human body, sight and illusions.

What to do

Setting the scene
Sometimes when we close one eye, things we are looking at appear to jump a little to the left or right. Why?

What to do

1. With both eyes open, stretch your arm out and point with one finger straight at a small object on the other side of the room.
2. Keep pointing and close one eye. Is your finger still pointing at the object?
3. Don’t move, now instead close the other eye. Is your finger still pointing at the object?
4. Which eye, your left or your right, was pointing most directly at the object? This is your ‘dominant eye’. It could be said that you are left-eyed or right-eyed.
5. Is your dominant eye on the same side of your body as the hand you write with?
6. What eye do you naturally aim with, e.g. when shooting a bow and arrow? Is this the same as your dominant eye?
7. Try other eye tests found at: https://www.wikihow.com/Determine-Your-Dominant-Eye.

Dominance in different parts of your body

8. a) Which hand do you naturally: hold a spoon in; hold a tennis racquet in; write with? b) Which foot do you naturally kick a ball with? c) Which ear do you naturally put a phone to?
9. a) Tally up your class results for which eye is dominant. b) Why do you think one side of your body is dominant to the other?

What you will need:
(per group)
* You will not need any items for this investigation.

Teacher: Ask students to throw a ball. Which hand do they naturally throw with?

Another way of testing eye dominance. Stretch your arms out and make a small hole with your hands. Look through the hole with both eyes open, towards a distant object. Now close each eye in turn. If the object stays in the centre, you are using your dominant eye. If not, you are using your non-dominant eye.

Related science kit: House of Science Super Sense.

### Topic: Weather

**L3 and L4 (but easily adapted to L1/2)**

#### Science Concepts

Key concepts relating to weather include:
- weather is the condition of the atmosphere, which can change quickly within a day
- weather depends on temperature, moisture, air pressure and movements of air or wind
- the weather can be measured and predicted by use of instruments
- weather maps and symbols help us to communicate the weather
- climate is a measure of the weather over a long period
- weather affects us in everyday life.

#### Contexts/Strand:

**Planet Earth and Beyond**

#### Key Competencies

**Thinking**

Students will use creative, critical and metacognitive processes to make sense of information and experiences gained during this unit. They will contribute to discussion with the teacher and peers and think about and reflect on their experiences in order to shift their ideas closer to scientific ideas.

**Values**

**Innovation, Inquiry & Curiosity**

These values will be promoted through both teacher and student discussion and questioning. The investigations planned give opportunity for students to make their own choices and setting concepts in a relevant context will promote students’ curiosity about science concepts in their everyday lives.

#### 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 and Beyond: *Earth systems Levels 3 & 4* 
  - Appreciate and develop an understanding that *water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth’s resources.*

**The 5 Es**

Follow good practice by presenting the science unit using the 5 Es instructional model. Use the 5Es at both the macro level (the whole unit) and at the micro level (for individual activities and investigations).

**Engage** — ignite the students’ interest and enthusiasm.

**Explore** — give students time to play, explore, make mistakes and ask questions.

**Explain** — teacher and students build an understanding of the concepts.

**Elaborate** — students expand on the concepts they have learnt, attempt to answer questions and link ideas to the real world.

**Evaluate** — an on-going diagnostic process where the teacher and students clarify what they have learnt and what needs further work.

#### Answers and teacher guidance for pages 19–23

**Air currents p19**

4) The smoke goes straight up due to the hot air rising above the candle. 5) The smoke goes down the chimney, across towards the candle, then up the other chimney. (The hot air rising above the lit candle is replaced by cooler air being sucked into the box through the other chimney.) 6) The smoke would be coming from your right and passing you like wind.

**Measuring wind p20**

Challenge 1. Paper streamers ‘stream’ away from the direction of the wind. They fly higher the stronger/faster the wind. Wind rollers move in the same direction as the wind and travel faster in stronger/faster wind. Challenge 2. Yes, you need to know where N, S, E and W are. Use a compass to find these. The flat side of the arrowhead needs to be smaller in area than the tail, so that the tail is always blown away from the wind and the arrow into the wind.

**Challenge 3**

Answers will vary.

**Cloud cover p21**

4) Answers will vary according to the day, but most groups should agree on the term to use, e.g. ‘Mostly cloudy’. (Note that consensus is an important aspect of scientific knowledge.)

**Make a thermometer: p22**

5) The water level in the straw goes up and eventually stops moving. It goes down in the fridge. 6) The level in the tube goes down and settles.

7) The water level goes down even further, and would keep falling. BUT the setup should be taken out of the freezer within 15 minutes so the vessel doesn’t break. Freezers are normally kept at –180C, while New Zealand’s coldest ever recorded temperature was –25.60C recorded in 1903 at Ranfurly, Otago.

**Make and use a rain gauge p23**

Challenge 1. The unit for rainfall measurement could be centimetres per hour, or millimetres per hour. To check if the sprinkler is watering evenly, either a) position your rain gauge in different locations under the sprinkler, or, 2) position several identical rain gauges for one hour in different locations under the sprinkler. If the readings are the same from place to place, there is even coverage.

**Weather — Huarere**

The results are likely to be

**Websites and YouTube demonstrations as outlined in specific activities.**

**House of Science kit Weather Ready (see https://houseofscience.nz/resources/).**

**School Journals and Building Science Concepts books as outlined for given activities.**

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**Specific learning intentions and activities**

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

a) The 5Es instructional model is used in all sections (see details on previous page).

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 — as they are mandatory — and here we treat them in an explicit manner. Aspects of Science Capabilities are emphasised using **bold italic** script.

A combination of these approaches encourages skill development and Nature of Science (NoS) understanding, while ‘Weather’ is the learning context. That is, the emphasis is less on traditional content coverage, and more on the process of science as emphasised by the Nature of Science and the Science Capabilities.

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 deeply. This is especially important for Years 7 & 8 and older students.

<table>
<thead>
<tr>
<th>Foundational Science Capabilities</th>
<th>Learning Activities through 5Es model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGAGE and EXPLORE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Ignition activities</strong></td>
<td></td>
</tr>
<tr>
<td>Explore some of these simple investigations relating to the weather. These types of activities will prime thinking about how the weather behaves and why.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Hot air balloon or helium balloon:</strong> Release a hot air Chinese sky lantern outside at night, or, a helium balloon within the class. <strong>Caution:</strong> ensure the lantern is made of flame-proof paper and that it is the legal fire season. <strong>Observe</strong> what happens and <strong>explore</strong> how it behaves. Discuss how the gas inside is less dense than the surrounding air, causing it to rise and that this is like warm air rising on a hot day — something that causes thermals and wind.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Temperature:</strong> Learn how to use a thermometer (digital or alcohol). <strong>Measure</strong> the air temperature inside the room, outside on a veranda, in the shade, and in a windy–shady area. <strong>Record</strong> in a chart or table. Discuss where the ‘nicest’ conditions are. Compare some daily temperatures with the weather forecast. (Remember, the Met Service measures air temperatures in a ventilated white box in an open area outside, so you could copy this idea for <strong>fair comparisons</strong>.) What effect does direct sun have on the thermometer reading? Investigate ice on puddles on a frosty morning.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Wind speed and strength:</strong> <strong>Compare</strong> the strength of the wind outside with the Beaufort scale (see <a href="http://encyclopedia.kids.net.au/page/be/Beaufort_scale">http://encyclopedia.kids.net.au/page/be/Beaufort_scale</a> and YouTube: <a href="https://www.youtube.com/watch?v=WwDNWm6IEVw">https://www.youtube.com/watch?v=WwDNWm6IEVw</a>). Throw blades of grass in the air to see how far they travel. Repeat on different days.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Wind direction:</strong> Go outside, suck the end of your finder to moisten it and hold it up high. Infer that the coldest side of your finger indicates the direction the wind is coming from. If coldest on the north side, the wind is ‘northerly’. (A compass will help to find the directions.) Throw blades of grass into the air. How does their direction of movement <strong>compare</strong> with your findings?</td>
<td></td>
</tr>
<tr>
<td>• <strong>Make wind rollers:</strong> Use to <strong>measure</strong> the speed and direction of the wind. Do the wind rollers show where there are eddies and turbulence around buildings? [See <strong>Measuring Wind Challenge</strong>, p20]</td>
<td></td>
</tr>
<tr>
<td>• <strong>Clouds:</strong> <strong>Make a cloud in a bottle:</strong> <a href="https://www.youtube.com/watch?v=E8AvfXar9zs">https://www.youtube.com/watch?v=E8AvfXar9zs</a>. This shows how the water droplets and ice crystals that make up clouds form on nuclei (tiny particles like smoke and dust) in the atmosphere when the air pressure changes. Also, find out about snow flake shapes and draw.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Rain:</strong> During a very rainy day, put an empty baked bean can out to collect the drops. As long as it has parallel sides and a flat bottom, any container will do. <strong>Measure</strong> how deep the water is in millimetres. This is ‘rainfall’, commonly measured in mm per hour or mm per day.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Air pressure:</strong> Read a barometer to see what the air pressure is. What weather change is heading your way? Lower pressures indicate rain or storm, higher pressures indicate fair or dry.</td>
<td></td>
</tr>
</tbody>
</table>
Specific Learning Intentions

Content examples relate to:

- **Hot air balloon**: Less dense air/gas rises, causing thermals and wind.
- **Temperature**: Direct sun causes higher temperatures, no sun (shade) results in lower temperatures. Ice forms on puddles when the temperature drops below 0°C.
- **Wind speed and strength**: Speed is how fast air is moving horizontally. Strength is the effect it has on objects like trees.
- **Wind direction**: A wind is named by the direction it comes from. E.g. a ‘westerly’ comes from the west.
- **Clouds**: When air pressure falls, moisture in the air forms droplets around tiny particles like dust and smoke.
- **Rain**: Rain is measured in millimetres. Sometimes we indicate how intense the rain is using ‘millimetres per hour’.
- **Air pressure**: A change in a barometer’s reading helps predict the weather to come.
- **Humidity**: Is how much moisture is in the air.
- **Condensation**: Is moisture that forms on surfaces that are cold.
- **Rainbows**: Are caused by light passing through water droplets.
- **Weather maps and reports**: These use symbols on maps to help us understand and predict the weather.
- **Importance of weather**: Weather affects our everyday lives, recreation and work.

Other Activities and Challenges pp 19–23 list their own Learning Intentions.

[Theory notes titled ‘Weather’, see over page.]

Vocabulary:
See keyword list on p 24.

Learning Activities through 5Es model

- **Humidity**: Discuss what it’s like on a dry day and on a humid day. When humid, the air is full of moisture, making it hard for us to sweat and keep cool. Auckland and Northland are often humid. If the air is dry, then we can sweat freely, helping us to cool our bodies even though the air is hot. Christchurch has low humidity on a hot northwesterly day.
- **Condensation**: On a hot day, place some cubes of ice in a drinking glass. Condensation forms on the outside. *In everyday life*: This is like the condensation we get on the inside of windows when it’s cold outside during winter. (Note the reversal compared with the drinking glass.)
- **Create a rainbow**: Spray a fine mist of water into the air from a garden hose, pointing it towards a dark background, and positioning yourself with the sun at your back. A rainbow will be visible in the droplets. Change your position to investigate when a rainbow can and cannot be seen. Students could stand in a circle around the spray and report who can see the rainbow effect and who cannot. What weather conditions cause a rainbow?
- **Weather maps and reports**: *Science communication*: Collect weather maps, learn what the symbols mean and how to read the maps. What do statements like these mean: “Heavy rain slowly easing”; “Mild NW turning colder S”; “Very cold with snow to 300 m, SW winds”? Students take weather readings using instruments, then write a report to present to the class.

*Research* into how weather information is collected by the Met Service.

- **Importance of weather**: How can weather affect our lives?” Consider what clothes to choose in the morning; farmers (crop germination and growth, lambing, etc.), fishermen (wind and waves), trampers (rain, wind, snow, hypothermia and river crossings), sports people (wind, rain, heat, ground closures).

**EXPLAIN AND ELABORATE**

Each of the above activities offers opportunities for children to seek explanations and clarify their thinking. Any one of them could be used to make teaching points (see Science Concepts on page 15 for guidance). Students should be encouraged to ask their own questions relating to activities of their choice, then investigate to find answers. They could be encouraged to find new and suitable ways of communicating their findings. In addition, the following more in-depth investigations and challenges will assist greater understanding:

**Measuring the weather**
- Measure the wind. [[Measuring wind Challenge p 20]]
- Assess cloud cover. [Cloud Cover Investigation p21]
- Measure temperature. [Make a thermometer Investigation p22]
- Measure rain. [[Make and use a rain gauge Challenge p23]]

**Understanding the weather**
- Warming and cooling of air causes wind [[Air currents model Investigation p19]]
- Study in detail a major weather event such as Cyclone Giselle that caused the Wahine disaster and integrate the science with other subject areas.
- Reading weather maps and conditions.
- Excellent NZ website: https://www.weatherwizkids.com/weather-forecasting.htm
- Forecasts: MetService phone app
- Jack Black’s forecast (humorous YouTube): https://www.youtube.com/watch?v=O7fr1XHk7g
- When tramping (YouTube): https://www.youtube.com/watch?v=t5nw-D2_H7k
- Advanced and/or for teachers (YouTube): https://www.youtube.com/watch?v=bd7DcVnrSL8&t=13s.

**EVALUATE**

Evaluation is about judging or measuring how well a teaching programme is going. 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. This ‘Evaluate’ phase occurs therefore at all stages of learning. Students should also be evaluating their understanding and success throughout the unit.

**Integration**

It is recommended that you integrate your science with other learning areas. Use science activities, investigations and challenges to engage students and where relevant, build links to English, the arts, health and physical education, languages, mathematics and statistics, social sciences and technology.
Weather

3. Pressure of air
Air pressure is the weight of air experienced at sea level. It can affect rain (see part 2.) and wind (see part 4).

Air pressure is measured using a barometer.

4. Movement of air (or wind)
When air heats up it rises and creates an area of low pressure at the Earth’s surface. Cool air rushes in from the side to replace it, creating wind. This can create huge wind patterns around the Earth.

Small scale winds
On a hot summer’s day: An onshore wind occurs when hot air above the land rises and draws air in from above the cooler sea. If we are on the beach we feel a breeze coming in from the (sea).

On a cool day: An offshore wind occurs when warmer air above the sea rises, drawing air in from above the cooler land. If we are looking out to sea we feel a breeze coming from (behind us).

Names for different wind strengths [students list and draw pictures]: Examples include (see Beaufort Scale for detail): calm, light air, gentle breeze, moderate gale, storm, hurricane, etc.

Wind speed is measured with an anemometer and wind direction with a wind vane.

Weather reports and forecasts
We see these on TV, in newspapers and online. They often use simple symbols such as [students draw and list their meanings]:

Weather maps
Weather maps have more detail. [Students draw an example.]

Climate
This is the weather condition in an area over a long period of time. It depends on: average monthly and yearly temperatures, and, average monthly and yearly rainfall and snow.

Climate affects the:
- types of food people grow and eat
- types of clothes worn
- style of house lived in
- plants and animals that live in the region.
INVESTIGATION

Air currents

What you will need:
(Per class demo)
★ Aquarium or similar.
★ Cardboard large enough to cover the aquarium top.
★ Two cardboard tubes each about 10 cm long.
★ Candle melted to a lid.
★ Matches.
★ Scissors, scrap paper.
★ Hot glue or sellotape.

What causes wind? In this investigation you will build a model of the atmosphere to see how winds are created.

1. Cut two holes in the cardboard, one positioned at each end, each slightly smaller than the cardboard tubes.
2. Glue or sellotape a tube over each of the holes so they are like chimneys.
3. Place the lit candle in one end of the aquarium and position so it is below one of the chimneys. This is what the model should look like:

4. Imagine the candle is the warmth from the sun hitting the land. Where does the heat go from here? To check, light a piece of screwed up paper, then blow it out so it is smouldering. Hold it just above the chimney on the candle side. Where does the smoke go to?
5. Now take a smouldering piece of paper and hold it above the other chimney. Where does the smoke go? Why?
6. The bottom of the aquarium represents the land. If you were standing in the middle, where would the smoke be coming from?
7. What does the smoke tell us about air (wind) movement?

Drawing a diagram

8. Draw and label the setup. Include the path of the smoke. In a different colour, label what each of the model parts represent in the real world. Here are some words to help you out: atmosphere, land, wind direction at ground level, rising hot air, sinking cool air.
Measuring wind

Learning intentions
Science Capabilities: Building devices, measurements, data collection.
Planet Earth and Beyond: Measuring wind speed and direction.

Challenge 1

Paper streamer
Make a simple paper streamer and test how it can help to show the wind direction and speed.

Wind roller
Wind rollers are made from paper. See if you can make one and test how it rolls across a tennis court on a windy day.

Challenge 2

Build a weather vane
Search Google Images using the words ‘kids weather vane’. Find ideas for creating a weather vane that will show the wind direction.

Things to consider:
• Do you need to know where North, South, East and West are? How will you do that?
• What do you need to do to make sure the arrow always points into the wind?

Challenge 3

Anemometer
Search Google Images using the words ‘kids anemometer’. Find ideas for creating an anemometer that will show the wind speed.

Things to consider:
• Will it spin freely even in light winds?
• Can you judge or measure how fast it is spinning?

What you will need:
(per group)
★ Paper, card.
★ Scissors, glue.
★ Assorted bits and pieces that you will have to find, e.g. yoghurt bottles, pins, drinking straws, etc.

Setting the scene
Wind is measured by meteorologists using special devices. An anemometer measures wind speed and a weather vane measures wind direction. Can you make your own?

Related science kit: House of Science Weather Ready.
INVESTIGATION

Cloud cover

Learning intentions
Science Capabilities: Observations and measurements.
Planet Earth and Beyond: Weather reporting and forecasting.

What to do

Setting the scene
A meteorologist describes how sunny or cloudy it is using terms we also hear on the weather forecast. To choose the right words to use, they first have to measure how much the clouds cover the sky.

The steps
1. Go outside to a wide open area like the playing fields. Look up at the sky and imagine dividing the sky into eight equal parts. Each part is called an ‘okta’.
2. Look at all the clouds, but not the clouds you can see blue sky through; they don’t count. Imagine putting all the clouds beside each other and estimate how many oktas they would cover. The number you get is used to describe the cloud cover. In this example, two out of the eight squares are filled by cloud, so a meteorologist would say it is ‘mostly sunny’ (see grids to the left for the other terms).
3. If there are no clouds in the sky a meteorologist would say it’s sunny.
4. Go outside and describe the cloud cover today using the terms ‘sunny’, ‘mostly sunny’, ‘partly cloudy’, ‘mostly cloudy’, ‘cloudy’. Compare with other groups. Repeat on other days.
5. Check out the weather forecast in the evening, then go outside the next day and see if you agree with their cloud cover prediction.
6. Try other things
7. Learn the names of the main types of clouds and what weather they are likely to bring. Can you recognise and describe these types of clouds: cirrus, cumulus, cumulonimbus, stratus and fog.
8. Over several days describe the clouds you see in the morning and record how the weather turned out.

<table>
<thead>
<tr>
<th>Date</th>
<th>Morning cloud</th>
<th>How the weather turned out</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Related science kit: House of Science Weather Ready.

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Weather

INVESTIGATION

Make a thermometer

**Learning intentions**

Science Capabilities: Making, measurements, data collection.
Planet Earth and Beyond: Temperature and weather.

**What to do**

**Setting the scene**

A basic thermometer is just a thin tube with a ‘bulb’ at the end of it. A scale alongside it helps us to take temperature measurements. In this activity you will make a thermometer and test it in some extreme conditions.

**The set-up**

1. Drill a hole the diameter of the straw in the middle of the lid. Or, if the lid is plastic you could melt a hole using a heated nail. Slip the straw through the hole.
2. Half fill the jar with water and add some food colouring to make it easy to see.
3. Screw the lid on firmly and make sure the straw goes into the water. Seal the straw into the lid with hot glue. The lid and straw must seal.
4. Blow a tiny amount of air down the straw. When you take your mouth away, the water level should rise up the tube. You want it to be a few centimetres above the lid. Try again till you get it right. Your ‘thermometer is ready to use. Mark the water level in the straw. Leave your thermometer outside for a few minutes. Does the level change much?

**Questions**

5. Sit your thermometer in a container of water at 42°C (the highest air temperature ever recorded in NZ, in Rangiora, 1973). What happens to the liquid in the straw? Mark its new level. Next, leave it in a fridge for an hour. A fridge usually sits at 4°C (like a cold morning in winter). What happens? Mark the level.
6. Finally, place it in a freezer, and check the level at 5, 10, and 15 minute intervals. Caution: Do not let it freeze, as the jar might break. What happens? Mark the level it gets to. This is like the temperature of a frosty lawn. Compare it with NZ’s lowest temperature ever recorded.

**Going further**

7. Create a scale for your thermometer. Check it against a real thermometer (a process called ‘calibration’).

**What you will need:**

(per group or as a class demo)

- A small jar such as a jam jar (glass is best) with a lid.
- Water and food colouring.
- A see-through plastic straw.
- A drill to match the straw size.
- Hot glue gun.
- Access to a fridge, freezer, a warm room and a cool place outside.
- A real thermometer.

Teacher: Engagement activity ideas

Show a video clip of extreme temperatures such as icicles, winter snow accidents, searing heat in a desert, or someone boiling an egg on a hot road.

Related science kit: House of Science Weather Ready.

Make and use a rain gauge

Learning intentions  Science Capabilities: Making, measurements and data collection. Planet Earth and Beyond: Rain and weather.

What you will need:
(yet group or as a class demo)

- A plastic soft drink bottle. Cut off the top one third of the bottle and set it up as below.
- A ruler.
- Sellotape or rubber bands.
- Permanent felt pen.
- Jelly.
- Access to a garden sprinkler.

Setting the scene
We measure rainfall with a rain gauge. It helps us to predict flooding, droughts, and soil moisture levels. It also helps us to decide what clothes to wear. Here is a basic rain gauge you can make from a soft drink bottle.

Challenge 1

Test your rain gauge
- Place it under a garden sprinkler. Does it collect water?
- Work out how much water the sprinkler ‘rains’ in one hour.
- What units of measurement should you use?
- Can you find out if the sprinkler spreads water evenly?

Challenge 2

Improving the rain gauge
- How could you improve the rain gauge? Test it out.
- Why should your gauge have a funnel leading into it?
- What is the jelly for?
- How often should you empty your gauge?

Challenge 3

Measuring the rain
Place your gauge outside on a rainy day, but position it in a different place from other groups, such as:
- under a tree
- beside a building
- out in the playground
- amongst some plants.

Were the water levels all the same? Why?

Where is it best to place your gauge for accurate measurements of rainfall? Use this location and compare your results with weather reports.
Pre- and post-unit assessment

One way of pre- and post-testing the knowledge of students on Weather, is to use ‘mind mapping’. Measure student knowledge by counting the number of words they use in their map that correspond with the list of keywords we supply to the right. Students draw a mind map on ‘Weather’ before they begin the unit. They repeat the same mind map after they have completed the unit and the scores are compared.

The students will need
An A4 sheet of paper. (The next page can be photocopied.)
Coloured pens, pencils, felts.

Drawing and assessing a mind map

**Instructions to students**
Write the word ‘Weather’ in the centre of the page, then write as many words as you can about this idea. Arrange these in related groups and use lines to connect them in meaningful ways, branching out from the centre. When you have written as many relevant words as you can, draw colourful thumbnail pictures and symbols alongside them that help to explain or add to your ideas.

**Assessing the mind map**
Give one tick for each word (or variation of the word, e.g. experiment, experiments, experimental) the student has written that is also in the keyword list. If instead of a keyword, the student has drawn a symbol or picture that clearly represents one of the keywords, also give a mark. (You could give a bonus mark for each relevant word they use that is not in the keyword list.)

**Sample mind map**
This is a student’s mind map ‘post-test’ on Weather. Ticks are given to show how marks are allocated. This student’s post-test score was 17.

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**Keyword list**

- air
- anticyclone
- atmosphere
- barometer
- Beaufort
- black ice
- classification
- cloud (and specific cloud names)
- condensation
- convection
- convergence
- cumulus (and other cloud names)
- cyclone
- depression
- dew
- drizzle
- drought
- Föhn wind
- freeze
- front
- frost
- hail
- highs
- hoar frost
- humidity
- fog
- hurricane
- ice
- inversion
- isobar
- jet stream
- lightning
- lows
- map
- northwester (and other wind directions)
- precipitation
- pressure
- rain, rainfall
- ridge
- sea breeze
- sleet
- snow, snowflake
- storm
- symbols
- temperature
- thermal
- thermometer
- thunderstorm
- tornado
- tropical cyclone
- trough
- waterspout
- wind (and specific wind directions)

Plus extra words at teacher’s discretion.
Mind map on ‘Weather’

Name ___________________________ Date ______
Year level ____ School ________________________

Weather
The Science Roadshow aims to
• Generate enjoyment and enthusiasm for science and technology that can enhance your classroom programme.
• Increase students’ knowledge and skills over a range of topics from the New Zealand curriculum.
• Provide hands-on experiences in science, technology and innovation that are not generally available in the classroom.

Research tells us that
• The benefits from an educational visit are greatest when the visit forms an integral part of the classroom programme.
• The best learning outcomes for students are achieved when they are well prepared.
• Students’ learning is enhanced by hands-on experiences.
• The quantity and quality of students’ interactions with peers and adults have a significant effect on promoting students’ learning.
• Group work that includes discussion helps students to consolidate their learning.
• Numeracy and literacy are important so we aim to incorporate these learning areas within the programme.

What happens during your visit?
• You will be met outside by a member of the Science Roadshow team. (If at all possible please leave school bags at school or on the bus.)
• Your session begins with one of the fifteen-minute shows (see details p. 30). During this time all students will be seated on the floor of the hall, possibly joining another group.
• Students will have approximately forty minutes to interact with the exhibits set up in the hall. (See exhibit details on pages 28 and 29.)
• Our Presenters will advise students when their exhibit time is over.
• Students will return to the show area for the second fifteen-minute show. Your group may be joined by students from another group for this show.
• Staff will direct your students to leave the hall at the end of the second show.

Your role as a teacher
• Move amongst your students. Interact with them and help them to engage with the exhibits and talk with others. Emphasise that they should try and understand what the exhibits are showing.
• Remind adult helpers that the exploration and discussion process is more important for students’ learning than getting the ‘right’ answer (see next page).
• Please remember that classroom teachers remain responsible for their students’ behaviour at all times.

Theme emphasis
• Prior to your visit, you may wish to organise groups who will be responsible for reporting back on specific themes or selected exhibits. Suggested ideas for reporting back:
  1) exhibit name, 2) what it looked like, 3) what it did and 4) what science idea it demonstrated.
• Additional ideas: students take pen and paper for recording their selected exhibits; use a digital camera or video device to record selected exhibits for review back in class; do a project or inquiry-based investigation on the science behind one or more of the exhibits.

Managing junior groups
• Free exploration of exhibits by children of all ages is ideal. However, it is advisable to organise adults to at first supervise small groups of children of Years 0–1 (sometimes even Year 2 children) as they move around exhibits. As soon as children gain sufficient confidence they may be encouraged to freely explore exhibits in pairs or small groups. This way they are able to choose the exhibits they are most interested in while minimising time waiting in queues.

A visit to the Science Roadshow isn’t only for your students. We hope you will also see it as a great opportunity for your own professional development.

Further science PLD opportunities are available through the Sir Paul Callaghan Science Academy — details on the back cover.

Support for the New Zealand Curriculum
The Science Roadshow experience supports the New Zealand Curriculum at four levels, with respect to Principles, Values, Key Competencies and Specific Learning Intentions. The first three are outlined below, while Learning Intentions are covered within the Unit of Work found earlier in this book.

Principles
The Science Roadshow experience embodies:
Inclusion: by recognising and affirming learning needs of all, through an array of sensory experiences
Learning to learn: by giving opportunities for students to reflect on their own learning processes by free exploration of hands-on exhibits
Community engagement: by encouraging students to connect with real life experiences and activities in science research, technology, industries, the workplace and home
Coherence: by linking science-related experiences with language and communication, technology careers and real life experiences
Future focus: by thinking and investigating through a Nature of Science / Science Capabilities lens and encouraging students to look at future-focused issues relating to science and technology, innovation, medicine and communications.

Values
The Science Roadshow embodies:
Excellence: through perseverance to find answers and to understand how things work
Innovation, inquiry and curiosity: by students thinking critically and creatively about ideas presented in shows, and reflectively about how and why exhibits work
Equity: through access for all to an interactive experience
Participation: through encouragement of students by presenters, teachers and parents and by the feedback offered by interactive exhibits
Ecological sustainability: through specific exhibit thematic(s) (depending on the year) and wherever possible, environmentally friendly administrative and operational practices
Integrity: through respect for others by listening, sharing and waiting their turn.

Key competencies
All five key competencies are well supported by the Science Roadshow experience; namely,
Thinking: by reflecting on shows and about how and why exhibits work and their relevance to everyday life
Using language, symbols and texts: by student involvement with Presenters, Explainers, peers and with self-guided interactive exhibits
Managing self: students decide who to work alongside, which exhibits to interact with and for how long
Relating to others: by students working alongside and communicating with other students, teachers, parents, Presenters and Explainers as they interact with exhibits and participate in shows
Participating and contributing: students participate and contribute to shows, and interact enthusiastically with exhibits.
Thank you for helping students to learn during their school visit to the Science Roadshow.

What is the Science Roadshow?
The Science Roadshow travels around the country teaching children about science, technology and innovation. At the Science Roadshow we like to give students opportunities and experiences that they would not usually have at school. On your visit you and the students will be able to experiment with at least 60 hands-on exhibits. You will also take part in two exciting shows.

Welcoming the science barrier

A room full of exhibits can be daunting to the non-scientist and you may feel unqualified to assist students with their understanding of an exhibit when you don’t understand it yourself. However, you don’t need to know any of the science yourself.

Instead, consider this approach.

- Stand alongside students who are experimenting with an exhibit.
- Show some interest in the exhibit and ask the student(s) what it does.
- You might like to try asking a question, then:
  - Pause (wait for an answer)...
  - Prompt (give them a hint)...
  - Praise (tell them they did well)...
- Tell them you don’t know about it yourself, but you want to know and you are relying on them to be the expert.
- Encourage them to investigate and try things. The first level of understanding may simply relate to ‘making things happen’ on the exhibit.
- Get them to tell you what they have found and show you how it works. Use questions to encourage them to investigate further. What science is it showing? How do we use this in real life?
- Ask them what the Context Board (the instructions board beside or on the exhibit) says. Assist the students to read it and repeat back to you what it means.

By these simple steps you will encourage active involvement and learning ownership by the students that will carry forward as they move onto other exhibits.

Symptoms of a kid who loves science:

- shows curiosity about the natural world
- likes experimenting and trying things out
- takes things apart and rebuilds them
- asks lots of questions about why things are the way they are.

Why does science matter? The late Professor Sir Paul Callaghan noted that the average person in the world today is better off than the richest aristocrat of 200 years ago — they will live longer, be healthier, happier, safer and more productive. Why is this? It’s largely because of science and the improvements in quality of life it has brought to millions of people around the world.

Which isn’t to say that humanity doesn’t still face a great many challenges, from climate change to food and water shortages to disease. Science will play a leading role in how society responds to and overcomes these challenges, so that life as we know it today can be sustained in the future.

Every New Zealander needs to be science savvy!

Science at home

- Spend time with your child pulling things apart to find out how they work, or building things like kit set radios. For even more fun, try engaging your child in real-life science experiments at home. You can find good ideas on the internet, and many toy shops sell relatively cheap experiment sets.
- Take advantage of what’s out there in the community. Visit your local library to find books about science. Play with interactive displays and exhibits at places like museums and planetaria.
- Develop a love of reading in your child — it builds a love of knowledge.
- Maths is the basis of all science, so make it fun, encourage it.
- If a child asks a question, don’t be afraid to say you don’t know but, importantly, show them how they can find out; do it together.
- Latch onto opportunities whenever your child displays interest, and give practical and real examples of things.
- The natural world is usually a child’s first interest; it helps if parents are a little ‘wide-eyed’ too.
**Exhibits**

### Themes

#### Earth science — Te pūtiao ā-nuku

Exhibits in this theme address specific learning intentions relating to the following: causes, effects and measurement of earthquakes; volcanism; Earth’s magnetism; plate tectonics; rock and mineral resources; and, the weather. Exhibits include:

- Canterbury’s Earthquakes
- Earth’s Magnetic Field
- Faulting
- Fracturing Fault
- No Air Friction
- Shake Table
- Volcano Quiz
- Wind Tunnel

**Contexts** — Earth science, Earthquakes and plate tectonics, Earth’s processes

#### Inferences — Ngā hīkaro

Exhibits in this theme address specific learning intentions relating to the following: making careful observations and drawing inferences from them; and, the links between cause and effect. Exhibits include:

- Bernoulli Circuit
- conductor & Insulators
- Density Ball
- Disappearing Discs
- Hidden Levers — Magneto
- Roller Can
- Magdeburg
- Rise and Fall — Special Beaks
- Special beaks — Size of Servings
- Solar Generator — Strength of wool fibres
- Viscosity

**Contexts** — Nature of Science / Science Capabilities

#### Movement — Te nekeneke

Exhibits in this theme address specific learning intentions relating to the following: acceleration; gravity and its effects; forces; friction; magnetic forces; the behaviour of pendula; balance; speed and movement; and, types of wheels. Exhibits include:

- Acceleration due to G.
- Airfoil
- Awesome Augers
- Balancing Sticks
- Balloon Hovercraft
- Balancing Sticks
- Couple Pendula
- Friction Alleys
- Impact Point — Mass Pendulum
- Magnetic Collision T.
- Speedy Curve — Staying on Track
- Speed Ball Radar
- Wind Tunnel

**Contexts** — Forces and motion

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**Exhibits**

Each year we identify six conceptual Themes under which we group our exhibits. By ensuring that exhibits fit within a particular Theme we are able to provide a number of experiences that build on each other, ensuring students have the greatest opportunity to expand their knowledge base.

The notes on this page and the next page highlight the concepts that are covered within each of these Themes and may help you to focus pre- and post-visit activities and educational opportunities for your students.

Although our primary focus is on objectives from the Science Curriculum, the exhibits also contribute across most other curriculum areas, particularly by providing students with opportunities to engage with others, to discuss what they are doing, and work cooperatively on a range of experiences not normally available to them within the school environment.

**Effective use of Explainers**

Explainers are students selected from the host school to assist with explaining and demonstrating exhibits to visiting students. (They also play a vital role in assisting with setting up exhibits and later packing them away in the truck!) To prepare Explainers for their involvement we ask that before the Roadshow visit, teachers outline the following key aspects of the role with the chosen students.

Explainers are to:

- Assist others to learn (and in doing so, they will learn a lot themselves).
- Give hints and suggestions about how to use exhibits.
- Show enthusiasm and encourage involvement from visiting students.
- Ensure safe use of equipment.
- Prevent mistreatment of Roadshow equipment.

All in all, we hope that students enjoy their experience as Explainers and maximise their own learning by active, positive and enthusiastic involvement.

**Extras for experts**

The purpose of this challenge is to stretch more able and/or determined students and encourage active learning through involvement with exhibits.

How it works: Each year three or four exhibits are chosen for more detailed study. These are ‘flagged’ to identify them so that during the ‘floor session’ when students are using exhibits, they know which ones are for the ‘extras for experts’ challenge.

At any time during this part of their visit, students have the opportunity to use and study these exhibits in detail, then to explain how they work to nominated adults (who have model answers). If they explain a given exhibit correctly, they have a card clipped. They repeat this process with the experts’ challenge.

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At any time during this part of their visit, students have the opportunity to use and study these exhibits in detail, then to explain how they work to nominated adults (who have model answers). If they explain a given exhibit correctly, they have a card clipped. They repeat this process with the other exhibits and once they collect at least two clips, they are eligible for a prize drawn at the end of their visit.

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**Note:** While every effort is made to have these exhibits on offer, we cannot guarantee that all of them will be on display at any one time.

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* House of Science website [https://houseofscience.nz/resources/]
Curiosity probe
A new type of exhibit is on display this year focusing on experimentation. Look for the exhibit with the big yellow question marks. The experimental scenario probes into student understanding of a science idea. The necessary equipment is displayed and students are expected to think about the outcome of the experiment before they check the answer and explanation. Students and teachers are also encouraged to discuss and/or perform the investigation back in class.

Back in class
Repeat the setup in class and run the experiment in order to discover the outcome. This should lead to discussion around relevant key concepts and further questions could lead to student lead investigations. Probes like this can be used as a diagnostic or formative assessment tool.

Setup
Using two identical thermometers, place one inside a mitten (or oven mitt) and leave one alongside the mitten. Check both their temperatures one hour later. (Ensure that the room temperature has not changed significantly over that period.)

Question. Which of these outcomes will occur?
1. The thermometer inside the mitten will show a lower temperature than the one outside.
2. The thermometer inside the mitten will show a higher temperature than the one outside.
3. Both thermometers will show the same temperature.

Ask the students to explain their thinking.

Outcome
Both thermometers will show the same temperature. This is because over the period of one hour, all items involved — the mitten and the two thermometers — will settle to room temperature, say 21°C. There is no heat source like a warm hand inside the mitten, so there is nothing to heat up the inside. The common misconception that it will be warmer on the inside comes from the fact that when your hand is inside the mitten it feels warmer than when it is outside the mitten. However, it is only the heat from your hand, trapped by the insulating fabric of the mitten, that elevates the temperature inside. This probe explores energy, heat and temperature.

My body — Tōku tinana
Exhibits in this theme address specific learning intentions relating to the following: blood, blood pressure and the heart; breathing; the skeleton; skin structure; and, diet. Exhibits include:
- Blood
- Calcium in Bones
- Helping the Heart
- Strong Bones
- — My body. The human body.

Scientific instruments — Ngā taputapu pūtaiao
Exhibits in this theme address specific learning intentions relating to the following: reading meters and gauges; detection; how instruments enhance our senses and make observations more accurate and objective; how some instruments detect things our senses cannot; and, units of measure; Exhibits include:
- Balance Bubble
- Expansion of Metals
- Hand Grip
- Linear Measurement
- Reflected Sunlight A.
- — What Weighs What?

Contexts — Nature of Science / Science Capabilities

Sight and illusions — Te kitenga me ngā kitenga mariko
Exhibits in this theme address specific learning intentions relating to the following: how the eye works; visual learning behaviour; binocular vision; blind spot detection; visual illusions and tricks; virtual images; the brain's interpretation of visual messages; 3-D perception; and, persistence of vision. Exhibits include:
- Benham's Disc
- Happy or Sad?
- Pinhole Camera
- Thaumatrope
- Colour Words
- Hole in the Hand
- Pupil Effect
- Thread the Needle
- — Eye Testing
- Pig in Space
- Secrets of the Strobe
- Triangle Illusion

Contexts — Our senses


Related science kits: House of Science® Micro-Exploration, Climate Change.


Related school kits: * House of Science website https://houseofscience.nz/resources/
Shows

While being exciting and entertaining, our shows provide a great opportunity to enhance student knowledge in two science areas each year. The shows for 2020 are Balloons and Bernoulli, an investigation into pressure, and The Scientific Pantry, focusing on science relating to food and liquids you find in your pantry.

To assist you in preparing for your visit, we've developed a unit plan called Weather — found in this book — that complements the Balloons and Bernoulli show and the exhibit thematic Earth Science. Also relating to this show is the unit called Pressure from the 2013 Resource Book. Past units relating to The Scientific Pantry include: Kitchen Chemistry 2008 (may be found in your school’s resource room), Mighty Materials 2016, Spectacular Changes 2017 and Useful Chemicals 2019. All these except the 2008 unit, are free to download within the Resource Books found at: https://www.roadshow.org/content/scienceRoadshow/resources.php.

Balloons and Bernoulli — Ngā puangi me Bernoulli

This show covers specific learning outcomes relating to pressure, including the following:

- pressure is force applied over a given area
- when a force is applied to a very small area, the pressure at that point can be huge
- a vacuum occurs when no air (or other gas) is present
- partial vacuums and total vacuums can result in unbalanced pressures
- unbalanced pressures can cause enclosed spaces to expand or collapse
- weather changes can be due to changes in air pressure
- the faster a fluid is moving, the lower its pressure (the Bernoulli Principle)
- air is elastic (compressible)
- explosive releases of air pressure can create violent movement.

Kitchen Chemistry — Te pūtaiao ā-kihini

This show covers specific learning outcomes relating to the science of things found in a typical kitchen pantry, including the following:

- density of liquids
- the refractive index of liquids
- acid–base indicator substances
- how bleaches destroy pigments
- acid–base neutralisation
- coagulation of proteins
- molecular weight and viscosity
- CO₂ release in reactions.

General Learning Outcomes relating to Shows

After attending the shows students will have increased:

- interest, enthusiasm, understanding and knowledge of scientific and technological principles and processes
- understanding of the Nature of Science and Science Capabilities.


Key School Journal References:
A cloud in a bag Article 3 1978 Pt 01 No. 6 Pgs 2-5; 
Bottles into rockets Article 5 2003 Pt 03 No. 2 Pgs 12-15 EAGLE, Rex; 
Hot air Article 1999 Pt SL No. 3 Pgs 2-16 SCOWN, Jenny; Race you to breakfast Article 5 1997 Pt 02 No. 3 Pgs 32-40 JOSEPH, Vivienne; 
The water we breathe Article 6 1978 Pt 03 No. 2 Pgs 44-48 CROOK, Gillian SHANNON, Gillian; What Makes the Weather? Article 6 2012 Pt CN No. 3 2-16 BRENSTRUM, Erick. Air, air, everywhere, FITZGERALD, Tangihoro

Key ‘Building Science Concepts’ references:
Book 17 Flight: Control in the air.
Book 31 Water and weather: The water cycle and the atmosphere.

Related science kits: House of Science* Sweet & Sour, Food for Thought, Float my Boat.

Key School Journal References:
Grow your own crystals Article 5 1982 Pt 01 No. 4 Pgs 28-29 SOUTHGATE, Brent; 
Hokey-pokey Article 1998 Pt CN No. 3 Pgs 28 YOCUM, Eva; 
Tricky science Article 5 1997 Pt 01 No. 3 Pgs 18-20 ANDERSON, K. E.; Windows made of water Article 4 1982 Pt 01 No. 2 Pgs 24-25 SOUTHGATE, Brent. Fast rust, WALL, Bronwen, Article Year 5, Connected No. 03, 2013, pp14-17.

Key ‘Building Science Concepts’ references:
Book 23 Fresh food: How food keeps and loses its freshness. 
Book 24 Preserving food: Processes in food storage. 
Book 56 Bread: The chemistry of breadmaking. 
Book 57 Eggs: Mixing, beating, crushing and heating. 
Book 58 Ice: Melting and freezing.

*House of Science website 
https://houseofscience.nz/resources/
Stop that erosion! page 9

Challenge 1: Same force used to compact the soil; measure the same amount of water poured each time; pour water from same height; measure the height of the remaining ‘castle’, or, estimate the percentage remaining; use the same system and units of measurement each time. Challenge 2: Soil plus grass clippings should prevent erosion more than the others, as shown by measurements. Challenge 3: Possible ways of reducing erosion: bind the soil with organic matter, cover the soil with humus, straw, weed cloth, etc.

Catch the money! page 10

3) The screwed up paper is easier. 4) The flat paper fell more slowly, but fluttered back and forth and spun erratically as it fell. The screwed up paper fell quickly, but in a straight line.

Observation Inference

I saw the flat paper move side to side. Its jerky movement made it harder to guess which way it would go.

I saw the flat paper spin as it fell. The spinning made it harder to grab.

Timing showed the screwed up paper dropped more quickly. There is less air resistance on the screwed up paper.

I saw the screwed up paper travel straight downwards. I could guess where it would travel, so it made it easier to catch.

The flat paper was harder to catch than the screwed up paper. Speed of flight is less important than jerkiness of flight regarding difficulty in catching.

Game of chance: “I’ll give you the value of the note if I can catch it. You give me the value of the coin if I can catch it.” (This might work in favour of the person catching the coin, since even though the note is more valuable, it is much harder to catch. Multiple tests would find if statistically this were true.)

Walking beans page 11

Challenge 1: Slope the tray or board so the bean walks lengthwise end-over-end. It doesn’t walk if the bean just rolls side-on. Slightly rough surfaces are best.

Challenge 2: The obstacle course could have up and down ramps, fences and gates. Explanation: The marble rolls down the inside of the light-weight foil tube and hits the inside of the rounded end. As it does this, it pushes the tube over lengthwise and down, then keeps on rolling inside the tube, spinning it over each time it hits the end. Challenge 3: Answers will vary.

My reflexes page 12

Challenge 1: The lower leg jerks upwards. It works when the leg is relaxed and dangling. It won’t be obvious if tested when standing or when tensing the leg muscles. It is part of an automatic nerve system that helps us walk and balance.

Challenge 2: Findings will vary. In general, reflexes work automatically to keep us comfortable and safe, help us move and keep body functions going. They work without us thinking about them. Challenge 3: Answers will vary.

Water clock page 13

4) Reliability will vary, but it can be improved by repeated timings to ensure the original marks are in the correct place. 5) To make it more accurate over shorter periods, use a larger hole in the lid. (You need to re-mark the 30 second interval lines.) Or, use a slimmer, taller collection vessel at the bottom. This way, the 30 second interval lines will be further apart.

Dominant eye page 14

5) Your dominant eye is often on the same side of your body as your writing hand. 6) Your aiming eye is often your dominant eye. 8) Most people’s dominances are on one side of their body, e.g. if they write with their left hand, then they will also do most other things with their left hand, arm, leg, eye and ear. That said, some people have a dominant right eye, but are dominant on the left with most other tasks, and vice versa. 9) Most people are right side dominant. Perhaps because speech and language are controlled by the left side of the brain (the same side that controls the right hand), this is why most people tend to be right handed. (In contrast, the right side of the brain controls emotions, intuition, creativity, art and music.) But, genetics, training and social norms may also play a part in the right side being more often dominant.
You don’t need to teach a child curiosity. Curiosity is innate. You just have to be careful not to squash it. This is the challenge for the teacher — to foster and guide that curiosity.

Sir Paul Callaghan

The Sir Paul Callaghan Science Academy runs intensive, four day professional development programmes that aim to build excellence in the teaching of science. Our vision is to create primary and intermediate teachers who celebrate science and inspire their students to explore and engage with the world through science.

www.scienceacademy.co.nz

The Academy Programme

A variety of excellent facilitators present the Academy programme. It is insightful, dynamic and interactive, as well as practical and hands-on, bringing a variety of best practice techniques and experiences to the fore. The following is a snapshot of some key themes that will be the focus over the four days:

• 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.
• Discover that you don’t need to be an expert in science to teach science well.
• Being a Science Champion within your school or area and inspiring science learning in all classrooms.

The National Science-Technology Roadshow Trust

“You don’t need to teach a child curiosity. Curiosity is innate. You just have to be careful not to squash it. This is the challenge for the teacher — to foster and guide that curiosity.”

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