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- Mighty Materials
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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 overriding objective is to enhance learning outcomes for students.

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Numeracy and literacy

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

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 Booklet. And, we have exhibit themes called ‘Gathering and interpreting data’ and ‘Observations’.

New resources to support science education

We would like to draw your attention to a new range of resources for science teaching made available through the TKI site at: www.scienceonline.tki.org.nz. More than sixty existing resources are adapted to meet the needs of the science curriculum based around the five Foundational Science Capabilities (that link to the key competencies of the New Zealand Curriculum) and relevant Nature of Science concepts.

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 E Instructional Model which 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 at www.scienceacademy.co.nz.
Earth Science

SCIENCE VOCABULARY PUZZLE

Rocks double puzzle

Unscramble each of the clue words about rocks and the rock cycle. 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 rocks.

Clues | Unscramble
--- | ---
NOLCOVA | VOLCANO
AAVL | AV
HSA | 
TAEH | 
LYRASE | L
IEASMNRL | AL
ESOEGMTNS | SS
EOSMLNTEI | LS
OSTIPDE | OS
FLISSSO | OS
SSUERERP | SS
AVCSE | VS
SKCRO | C

Extension
- Find out about the rock cycle and how, over time, rocks are changed from one form to another.
- Learn about the main rock types and how you identify them.

The Academy offers a fresh approach to equipping primary and intermediate school teachers with skills, resources and techniques to feel more confident in delivering the science curriculum — especially the Nature of Science strand — through an intensive, four-day programme, followed by on-going interaction and support through the alumni network and its events.

2016 Academy Dates:

Whangarei Mon 18 – Thu 21 April (school holidays)
Palmerston North Tues 24 – Fri 27 May
Auckland Mon 18 – Thu 21 July (school holidays)
Tauranga Tues 9 – Fri 12 August
Christchurch Tues 13 – Fri 16 September
New Plymouth Mon 3 – Thu 6 October (school holidays)

NO FEES

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**SCIENCE VOCAB PUZZLE**

**Gathering and interpreting data involves...**

Find 30 hidden words in the grid below. Twenty five of the words are given to the right. Can you find the five extra mystery words? The words can be found diagonally, vertically and horizontally.

**Word list**

INQUIRY, SYSTEMATIC, METHOD, RESULTS, PATTERNS, CLASSIFYING, OBSERVATIONS, DATA, AIM, CREATIVE, SCATTERGRAM, INTERPRETING, SENSES, QUESTIONS, MODELS, INFERENCE, PREDICTING, COUNTING, VARIABLES, EXPLORATION, DRAWING, AVERAGES, RECORDING, FAIRTESTING, GRAPHING.

**Extra five mystery words (list):**
Fill in the grid below with the words from the list. Some letters are given as clues. There will be two words left over from the list. Use them to complete the two statements about movement.

**Word list**

- gravity
- circular
- bullet
- spin
- momentum
- direction
- rocket
- friction
- force
- wheels
- inertia
- bearings
- acceleration
- gyroscope
- deceleration
- orbit
- rolling
- time
- pendulum
- centripetal
- projectile
- speed
- distance
- motion
- rotate
- slowing
- mass

**Statements about movement**

1. A _________ is needed to get something moving.
2. When something is moving it travels a certain _________ within a certain time.

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**Love Science? Get your class to Love Maths too!**

*Levels 3 & 4*

**0800 MATHS4U**

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My body

SCIENCE VOCAB PUZZLE

Body parts

Use the clues to label the body parts, or where the body parts are found. Now, use the numbers below your labels to solve the puzzle at the bottom of the page.

Clues

femur, leg, brain, kidneys, jaw, skin, skull, joints, kneecap, nostrils, torso, trachea, collarbone, heart, teeth, stomach, pelvis, liver.

Solve the puzzle here

1. The scientific name for human beings is:

2. The group they belong to, including the monkeys, apes, and lemurs is:

Features

• Over 78sqm of environmentally controlled open space (no pillars), with carpet, built in lighting, and air-conditioning
• Easy access (including disabled) up ramp and through toughened glass doors
• Onboard generator with external supply mounted single phase points
• Large travel load capacity and storage
• Security alarmed
• Separate staff area

Capabilities

• Almost anywhere at any time!
• Display and transport problems solved in one go!
• Price competitive with hired marquees of similar size.
• Easily branded for one-off or repeat usage.

www.upv.co.nz
Improving our senses

Using a pencil and ruler, draw straight lines to link the pictures with their correct clues. Make sure you join the dots carefully. Circle the letter that each line passes through. Write these letters in their numbered spaces below to find the answer. Clue 7 has been done for you and two other clues are given in the grey squares.

**We use instruments in science to help us make more accurate _______ and recordings.**

**Your answer:**

1. measuring cylinder
2. stethoscope
3. barometer
4. force meter
5. voltmeter
6. scales
7. thermometer
8. telescope
9. stopwatch
10. microscope

---

**Electricity Kits for Hire**

Level 3/4 Science

*Hands-on, Science Capabilities focus*

Hire up to four class kits at a time. Make reservations online at:

www.scienceresourcebox.co.nz

Our kits are designed to take the hassle out of developing science programmes, freeing up the teacher to concentrate on what is important — their students.
Pressure puzzle

The pressure wave from an explosion has scattered the letter tiles making up two sentences. Unscramble the tiles to reveal a message about pressure.

Solve the puzzle here

Paste or write your unscrambled message here.

A visit to the Science Roadshow is a fun, exciting and interactive learning experience of science for children.

It includes live shows and hands-on exhibits that broaden students’ knowledge of science, technology, engineering and mathematics. It strongly supports the Nature of Science strand and the Five Foundational Science Capabilities.

Each year our shows, themes and exhibits change, so there’s always something new for students to learn and engage with.

Book online: www.roadshow.org
Dissolving limestone

Learning intentions

What to do

1. Make a thick mixture of garden lime and water by adding small amounts of water to a cupful of lime. [Care: Keep lime away from your eyes and wash your hands after handling it.]
2. Pour small blobs of the mix out onto paper and form it up into little ‘limestone rocks’ each about the size of a marble. Leave them to harden overnight.
3. Once dry, these little ‘rocks’ need to be handled carefully so they don’t shatter. Imagine these are limestone rocks that formed millions of years ago beneath the sea from dead shellfish. As they formed layers on the seabed, pressure made them form into rocks. By creating your ‘rocks’ you have just modelled this part of the rock cycle.
4. List some careful observations of your rocks. What do you see, hear, feel and smell? Are there any useful measurements you could make?
5. Put a rock sample into pure water and make careful observations of what happens. What instruments could you use to improve your observations?
6. Put another rock sample into white vinegar and make careful observations.

Making inferences
An inference is a conclusion you draw from observations, in other words, the meaning you make from observations.

7. Here is a fact: Rainwater is usually slightly acidic, like vinegar, but weaker. What can you infer about what breaks down limestone rock in nature, to form the vast underground caves and holes commonly found in limestone hills and mountains? Would pure water that is neutral (not acidic) do this as quickly? What evidence do you have to support your answer?

8. Rainwater may help to break down rocks in other ways. How?

Showing others:
There are many ways of showing or telling others what you have done and found. Ideas include: write a poem, rap or song; create a poster; write a newspaper article; do a demo or show, with each person in your group playing different parts; write a report; draw a labelled picture; draw a flow chart; use others as ‘guinea pigs’ to show how something works; mime what you did; build a working model; write a story; draw graphs; use photos or a video; do a PowerPoint show.

Key School Journal References:
Rock doc Article 3 Junior Journal 21 1999
ANDERSON, K. E. Limestone Article 6 02 3 1996
MAGUINESS, Jan. How to make a limestone cave Article Connected 1 2007
LOVELESS, Mary.

Key ‘Building Science Concepts’ references:

Garden lime made from mined and crushed limestone.

Teacher: Engagement activity ideas
Challenge 1

Make close observations
Can you compare how long it takes for ‘trees’ (rulers, poles, etc.) of different heights to fall? How can you make sure they are fair tests? How many trials should you do? Make sure you call “timber” so everyone knows to get out of the way!

Can you make up a general rule about the length of the pole and the time it takes to fall? (Scientists would call this a ‘Law’)

Do two poles of the same length but different thicknesses or weight fall at about the same time? Compare your results with others. Are they similar? Can you make up another law?

Challenge 2

Gather data
Time how long it takes for ‘trees’ (rulers, poles, etc.) of different heights to fall. This will take practice and you need to work in a team so you can get accurate results. Once you have developed a good system, do 10 trials and find the average (mean) for each ‘tree’ height.

Use your evidence to support one or more of your laws.

Critique your method. Are there any improvements you can make?

Challenge 3

Making it more real
Create a tree (see to right), or use a long branch with leaves. Find out if the twigs and leaves change how long it takes for your tree to fall. Does wind play a part too?

Give your recommendations
View and time YouTube clips of trees being felled. Time how long it takes them to fall and use this as evidence to suggest how long a large tree might take to fall. What are important safety things to think about?
The seconds pendulum

Learning intentions Science Capabilities: Gather and interpret data. Physical World: How do pendulums of different lengths behave?

What you will need:

(per group)

- String.
- Ruler.
- Scissors.
- Lead weights of two or more sizes (e.g. fishing sinkers).
- A device with a stopwatch.

Setting the scene

Why do some large clocks have a pendulum in them? Here is a modern grandfather clock showing its pendulum. These clocks have been made for hundreds of years. The pendulum keeps the clock in time. Without it, it just wouldn’t be accurate, but why?

To investigate this, make a simple pendulum by tying a heavy weight, like a lead fishing sinker, to a length of string. Hold onto the end of the string and swing the pendulum back and forth. Explore by changing the length of string and see what happens. Does the pendulum swing at different speeds? What happens when you change the weight?

Challenge 1

Collect data

How do you know your pendulum swings at different speeds when you change the length of string? Design a way of testing this accurately. How much data do you need to collect to be sure? How have you made sure you are doing a fair test?

Changing the weights

If you keep the length of string the same, but change the weight, does this change the time it takes to swing back and forth? Remember to perform fair tests.

Challenge 2

A ‘seconds pendulum’

Can you create a pendulum that takes exactly one second to swing from one side to the other (that is, it takes two seconds to swing back and forth)? How long is the string? You have created a ‘seconds pendulum’ and this is exactly the idea used in a grandfather clock to measure time.

Making it accurate

How can you make sure your seconds pendulum works accurately? Check your ideas against those of others. Whose pendulum is most accurate over one minute? Try longer time periods.

Challenge 3

A half second pendulum

How long does a pendulum need to be, to measure a half second (that is, the time to swing from one side to the other)? Again, check for accuracy and compare your data with other groups.

Simple laws

Make up some simple laws about how pendulums behave.
INVESTIGATION

Cooling sweat

What you will need:
(per group)

★ Water.
★ Methylated spirits (meths).
★ Rubbing alcohol (iso-propyl alcohol, optional).
★ Two thermometers of the same type.
★ Cotton wool, cling wrap.
★ Rubber band.
★ Spray bottle containing water.

Learning intentions
Science Capabilities: Using evidence.
Living World: How does sweat cool us down?

What to do

ON A WARM DAY ...

Observe sweating
1. Run around vigorously on a warm or hot day, then check your skin for dampness. Using a magnifying glass, observe where on your skin the sweat comes from. If you wipe the sweat away, does it come back?
2. Wipe some sweat away and replace it by spraying some water onto your skin. Does this help to cool your skin too?
3. Once you are back to normal. Dampen your skin using wet cotton wool. Does it feel cooler? Do the same with some meths and if available, rubbing alcohol. How do they feel on your skin?
4. Measure and record the temperature of the water, meths and rubbing alcohol you used in 3) above.

Prepare a ‘wet bulb thermometer’
5. Wrap some cotton wool around both sides of the bulb of one thermometer and hold it in place with a rubber band. Dampen the cotton wool with water and wait five minutes. Compare the temperature of this wet bulb thermometer with the other ‘normal’ dry bulb thermometer.
6. Repeat 5) above, but instead of water, use rubbing alcohol, and finally repeat with meths. What happens to the ‘wet bulb’ temperature compared with the dry bulb temperature?
7. If you move the thermometers back and forth, does the temperature change? Is the temperature difference between the wet and dry thermometers greater or less?
8. Use some cling wrap to cover up the wet bulb. Check the temperature over the next 10 minutes. Does it change?

Inferences
9. Make inferences and create an explanation about what causes sweat to cool your skin.

Showing others

There are many ways of showing or telling others what you have done and found. Ideas include: write a poem, rap or song; create a poster; write a newspaper article; do a demo or show, with each person in your group playing different parts; write a description or report; draw a labelled picture; draw a flow chart; use others as ‘guinea pigs’ to show how something works; mime what you did; build a working model; write a story; draw graphs; use photos or a video; do a PowerPoint show.

Key School Journal Reference:
Heat thieves Article 3, Connected 01, 2010 BENN, Ken. Investigating insulation Article 3 Connected 01 2010 HINCHCO, Selena. Warming up, cooling down Article 3 Connected 01 2010 WALL, Bronwen.

Key 'Building Science Concepts' references:
Boiled or raw?

Learning intentions
Science Capabilities: Observations and inferences.
Physical World: Momentum, spinning, friction.

What to do

You have a problem. Earlier today you hard boiled some eggs to take them along to a party for a salad, but someone has mixed them up with some raw eggs by mistake. How can you tell which are which without breaking any eggs? You don’t want to waste any by breaking the raw ones by mistake!

1. Without breaking your eggs, explore ways of detecting which is raw and which is boiled.
2. Someone said that you can tell the difference by spinning them on a flat surface, but how? Test your two eggs to see if there is any difference in how they spin. Record your observations.
3. If you are now given an egg that you definitely know is raw, can you tell which one of your ‘unknown’ eggs is raw and which is boiled?
4. Fill a film canister with water and another one with dry rice. Make sure they are filled to the top and push their caps on. Without knowing what is inside each canister — so get someone to secretively mix them up — can you use your spin technique to find out which is which? Open them up to find if your idea worked.

Making inferences
An inference is a conclusion you draw from observations, in other words, the meaning you make from observations.

5. Make inferences about what might be happening inside the raw egg to make it behave like this when spun. Do the same for the hard-boiled egg.

Making inferences
6. The film canisters model the behaviour of the eggs. Models can be used to help us understand a scientific idea, but they are never perfect. In what ways are your film canister models similar to the eggs? How are they different? How are they useful for understanding what is happening?

Share your observations and inferences

1. Compare your list of observations with those of another group. Did your group list any that the other group did not have? Are there different ways of writing about the same observation?
2. Compare and discuss your inferences with those of another group. Discuss how the film canisters might be useful as models.
Pressure

CHALLENGE

Road spikes!

Learning intentions Science Capabilities: Gather and interpret data from observations and measurements.

Physical world: Pressure is the force applied over a given area.

What you will need:
(per group)
- Water balloons and a balloon pump.
- Drawing pins.
- Firm cardboard pieces at least 20 cm x 10 cm.
- A piece of board about 15 cm x 15 cm.
- A ruler and pen.

Setting the scene

Sometimes police have to stop criminals and people behaving badly when driving their car. One way is to place a row of road spikes across the road in front of the car so that when the car drives over it, the tyres burst and the car is stopped. For this to work, the police need to know which direction the driver is going. And, sometimes tyres do not pop, so the ‘baddie’ gets away.

Can you help the police by creating the best road spikes possible?

Challenge 1

Explore some ideas

Start by making a model of road spikes using drawing pins and a piece of cardboard. Use the pump to blow up a water balloon (with air only) and use a piece of board to push the balloon down onto the spikes. What happens to the balloon (the ‘car tyre’)?

Warning: Always push down using a board so that you do not spike your hands!

Push

Board

Water balloon

Drawing pin

Cardboard

Challenge 2

Gather data as evidence

If you use too many drawing pins, will your road spikes still work? If you use too few, what might happen? Design investigations to answer these questions.

How can you create fair tests?

What things must you think about to make sure each test you do is a fair test? (Hint: Think about using measurements and a set of steps you always follow.)

Challenge 3

The ultimate road spikes

Can you create an even better set of road spikes? Use any method and materials you can come up with to improve on the road spikes. Use evidence to show how your new spikes are better.
**Mighty materials — Ngā matū miharo**

**Topic:** Mighty materials

**Science Concepts**

Key concepts relating to the properties of materials, including:
- dissolving and diffusion
- capillary action and siphoning
- absorption and consumer testing
- acids, bases and neutral substances and how to detect them; indicator paper
- chalk-making
- chromatography, solvents and solutes, pigments
- fermentation as a biochemical process; the release of carbon dioxide.

**Contexts:**

Applied chemistry, Chemistry and society.

**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 the 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 Aims**

**Nature of Science (NoS)**

Approaches to the five Foundational Science Capabilities, namely 1. Gather and interpret data, 2. Use evidence, 3. Critique evidence, 4. Interpret representations and 5. Engage with science, are outlined in the specific activities.

**Contextual**

Material World: Chemistry and society:

Make connections between the concepts of chemistry and their applications and show an understanding of the role chemistry plays in the world around them.

**ICT**

Websites and YouTube demonstrations as outlined in specific activities.

**Resources**

School Journals and Building Science Concepts books as outlined for given activities. Resources as outlined with each activity. Most items and consumables listed are easily sourced from around the home, at the supermarket or at $2 shops.

**Achievement Objectives**

**Nature of Science (NoS)**

Levels 1–4

As above.

**Contextual**

Material World: Chemistry and society

Levels 1&2

Find out about the uses of common materials and relate these to their observed properties.

Levels 3&4

Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes.

**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). In summary (and see the web link www.miamisci.org/ph/5pintro5e.html for more detail):

Engage — ignite the students’ interest and enthusiasm.

Explore — give student 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**

Paper towel bridge p19: Challenge 1. If the paper has been cut the same way (e.g. across the roll), the water will travel at about the same speed. Cut strips of the same orientation, for example across the roll, and hang them in coloured water at the same time. Compare. This can be repeated with long-ways strips. Challenge 2. Water moves from the full to the empty cups till their levels even out. When the different colours combine, they make new colours in the previously empty cups. Challenge 3. Water will move from a higher to a lower cup, but not the other way around. Water will move at least 50 cm downhill through the paper.

Paper towels — how absorbent? p20: Challenge 1. Things to keep the same: The time the paper is soaked, the time it hangs, the amount of effort used to squeeze out the water; how the water is collected. Challenge 2. For a fair test, all parts of the method would have had to be the same except the brand of paper towel. The larger the volume of water squeezed out, the better the towel. Students should have done more than one trial for each brand of paper towel. The larger the volume of water squeezed out, the better the towel. Students should have done more than one trial for each brand of paper towel.

Red cabbage indicator paper p21: 2) & 3) The paper goes green with baking powder (base) and purple with vinegar (acid). Other bases make the paper go green: cloudy ammonia, washing powder. Other acids make the paper go purple: citric acid, tartaric acid, lemon juice, orange juice. Water = blue = neutral. 4) The colour is closer to blue (neutral) 6) The colours are stronger and ‘further’ from blue colour. Weaker acids and bases are closer to blue colour. In everyday life: Vinegar for preserving (stopping bacterial and fungal growth). Citric acid for tanginess. Baking soda for creating holes in baking dough.

Chalk chromatography: p 22: 3) The colour moves up the chalk stick and if the pen colour is made of more than one pigment, they will separate out because some colours move faster than others. 7) Inferences may include: some pen colours are made of a mixture of pigments, some are not. Some pigments have more ‘difficulty’ travelling up the chalk, since they don’t travel as quickly. This may be because they are made of larger particles which ‘struggle’ to pass through the chalk surface.

Fermentation p23: Challenge 1. Observations include: a hissing sound, tiny bubbles rising and popping, a sediment layer forms on the bottom, frothy layer on the top, a yeasty smell and taste. Fermentation doesn’t occur if any ingredient is missing. It occurs slowly with cold water. Challenge 2. Fair test comparisons involving the same amounts of ingredients started at the same time. How quickly does froth form, how high does it become. etc? Challenge 3. Foods that work: icing sugar, table sugar, honey, golden syrup, brown sugar, maple syrup. Foods that don’t work: salt, corn starch.
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 open-ended lines of inquiry.

c) Nature of Science (NoS) components (and therefore the recently launched 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 the ‘Mighty Materials’ context plays a supporting role only. That is, the emphasis is less on content coverage, and more on the Nature of Science.

Note, you do NOT need to cover all sections — as there are a large number of 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.

Specific Learning Intentions Learning Activities through 5Es model

**Foundational Science Capabilities**

*which are a functional interpretation of the Nature of Science, see TKI Science: www.scienceonline.tki.org.nz/Introducing-five-science-capabilities*

- **Gather and interpret data:** Learners make careful observations and differentiate between observation and inference.
- **Use evidence:** Learners support their ideas with evidence and look for evidence supporting others’ explanations.
- **Critique evidence:** Learners understand how to critically appraise the quality of evidence and the validity and ‘fairness’ of methods.
- **Interpret representations:** Learners and scientists are able to represent their ideas in a variety of ways, including models, graphs, charts, diagrams and written texts.
- **Engage with science:** Students use their other capabilities to engage with science in ‘real life’ contexts.

**Content**

Content ideas will be specific to those investigations you choose to do. All those on this page are well supported with online content information. Initially see the YouTube clips listed for each activity.

**Vocabulary:**

NoS: see word list on p24.

**Content:** Agitating, butter, buttermilk, fat globules, chemical reaction, extinguishing, carbon dioxide, baking soda, vinegar, released, simmer, sugar (sucrose), evaporate, plastic, coagulate, casein, Plaster of Paris, calcium sulphate, gypsum, exothermic, moulds, temperature.

**ENGAGE Ignition activity**

Explore one or two of these simple investigations relating to Chemistry and Society. These emphasise the practical applications of chemistry in real life:

- Butter making by agitating cream till it passes through the phases: soft peaks, stiff peaks, crinkly cream, and finally, butter plus buttermilk. [www.youtube.com/watch?v=Wt_RG42N3GM](http://www.youtube.com/watch?v=Wt_RG42N3GM)
- Cleaning copper (10c) coins using white vinegar and salt. [www.youtube.com/watch?v=H4N-iGvYrbM](http://www.youtube.com/watch?v=H4N-iGvYrbM)
- Extinguishing fires using the carbon dioxide released from the reaction between baking soda and vinegar. [www.youtube.com/watch?v=co2iJh8j8bc](http://www.youtube.com/watch?v=co2iJh8j8bc) and [www.youtube.com/watch?v=1z_ApF2n-SY](http://www.youtube.com/watch?v=1z_ApF2n-SY)
- Simmering coca-cola to find how much sugar it contains. (All the water is evaporated off and only black-coloured sugar syrup is left.) [www.youtube.com/watch?v=OBzvN9FLx4Q](http://www.youtube.com/watch?v=OBzvN9FLx4Q)
- Making plastic from coagulated milk (make sure you use whole milk). [www.youtube.com/watch?v=VFvIk_TH4cNQ](http://www.youtube.com/watch?v=VFvIk_TH4cNQ) and [www.youtube.com/watch?v=akhs3wcSDGA](http://www.youtube.com/watch?v=akhs3wcSDGA).

**Chalk making**

Include chalk making as one of your activities. See [www.youtube.com/watch?v=a95PfaDFSc](http://www.youtube.com/watch?v=a95PfaDFSc) Some of the resulting chalk sticks will be used in the later investigation called Chalk Chromatography.

**Making ‘pavement chalk’** (hard chalk suitable to use on asphalt and for chromatography)

- Per group: Sprinkle 250 mL of Plaster of Paris (a Gibb product) powder into 140 mL of water. Let it sit for two minutes, mix thoroughly, then pour into moulds. A mould for a thick chalk stick can be made from a toilet roll inner or similar cardboard roll. Stand the mould upright on a tray and while holding it in place, fill it with the liquid Plaster of Paris. Leave this standing for 1–2 hours. Use your hand to feel the heat released in this exothermic reaction. Can you measure the temperature?
- Make some thin chalk sticks by pouring the same mix into ‘thick shake’ straws that have been slit lengthwise.
- Colour some of your chalk sticks by mixing food colouring or tempera paint into the wet Plaster of Paris, but make sure you make enough white sticks for the Chalk Chromatography investigation.
- The next day extract your chalk sticks by peeling the mould off. When dry, try the chalk on asphalt. (Note, this type of chalk is too hard for use on blackboards.)
<table>
<thead>
<tr>
<th>Specific Learning Intentions</th>
<th>Learning Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Foundational Science Capabilities</strong>&lt;br&gt;(As on the previous page.)</td>
<td><strong>EXPLORE, EXPLAIN AND ELABORATE</strong></td>
</tr>
<tr>
<td><strong>Content</strong>&lt;br&gt;Diffusion of pigments in water; capillary action (which allows paper towels to soak up water). Paper fibres act like a wick. Absorption by a paper towel (which acts like a sponge to soak up spills). Consumer testing of paper towel products. Red cabbage juice can be used to make indicator paper that detects acids and bases. Water is neutral. Examples of acids and bases and their uses. Chromatography involves separating out the pigments that are present in a substance (like a water-based pen's ink) in order to discover what is there. Different pigments move at different speeds by capillary action. Fermentation. How yeast needs certain foods so that fermentation can occur. Carbon dioxide is released in the process.</td>
<td>Perform each of the following investigations or challenges. Each one gives ample opportunity for children to <strong>explore, seek explanations</strong> and then <strong>elaborate</strong> by branching out into student-lead investigations based around their own questions. It is suggested that you make one or more of the Five Science Capabilities explicit.</td>
</tr>
<tr>
<td><strong>Vocabulary:</strong>&lt;br&gt;NoS: see word list on p24.</td>
<td><strong>Capillary action</strong>&lt;br&gt;- Discover ideas relating to capillary action using paper towels to transfer coloured water from one container to another. How fast and far does water move through paper towels? Use the techniques learnt to perform consumer testing on different brands of paper towel. <strong>[Paper towel bridge Challenge sheet]</strong>&lt;br&gt;- Youtube: <a href="http://www.youtube.com/watch?v=FAdmTzD46Kg">www.youtube.com/watch?v=FAdmTzD46Kg</a>&lt;br&gt;www.youtube.com/watch?v=2lnzgDIiM0Y&lt;br&gt;www.youtube.com/watch?v=jbzd1FFVIRQ&lt;br&gt;www.youtube.com/watch?v=eQXGpturk3A&lt;br&gt;<strong>How much water does a paper towel hold?</strong>&lt;br&gt;- Find out how much water a paper towel can absorb. Use the techniques learnt to perform consumer testing on different brands of paper towel. <strong>[Paper towels — how absorbent? Challenge sheet]</strong>&lt;br&gt;- Youtube: <a href="http://www.youtube.com/watch?v=a-KoPk_ThPY">www.youtube.com/watch?v=a-KoPk_ThPY</a>&lt;br&gt;<strong>Discovering acids and bases</strong>&lt;br&gt;- Find out how to make red cabbage juice indicator paper then find out what colours it becomes in acids, bases and neutral substances. Use the ideas discovered to test other unknown substances. <strong>[Red cabbage indicator paper Investigation sheet]</strong>&lt;br&gt;- Youtube: <a href="http://www.youtube.com/watch?v=9QR00dAxi0g">www.youtube.com/watch?v=9QR00dAxi0g</a>&lt;br&gt;www.youtube.com/watch?v=1l8Ki2upEHLc&lt;br&gt;<strong>Separating pigments using chalk chromatography</strong>&lt;br&gt;- Use the thin white chalk sticks made earlier to perform chromatography investigations on water-based coloured felt pens using water as the solvent. What pigments are used to create the different pen colours? Elaborate by changing the solvent to methylated spirits and test permanent felt pens too. <strong>[Chalk chromatography Investigation sheet]</strong>&lt;br&gt;- Youtube: <a href="http://www.youtube.com/watch?v=loakplUEZYQ">www.youtube.com/watch?v=loakplUEZYQ</a>&lt;br&gt;www.youtube.com/watch?v=VgiIAwQZAZc&lt;br&gt;<strong>Making ginger ale through fermentation</strong>&lt;br&gt;- Mix yeast, sugar and water in a glass and put it in a warm place. The yeast will ferment the sugar, which is their food, to create carbon dioxide bubbles. <strong>Beware,</strong> ginger ale also contains a tiny amount of alcohol, e.g. the commercial brand Bundaberg contains 0.5% alcohol. When you add too much sugar, the alcohol content can go higher than this. If you are concerned about the alcohol content, do not allow the children to drink their fermented products.)&lt;br&gt;- Use this basic idea that fermentation releases carbon dioxide to investigate what different foods yeast will feed on. Make some real ginger ale and drink it. <strong>[Fermentation — ginger ale Challenge sheet]</strong>&lt;br&gt;- Youtube: <a href="http://www.youtube.com/watch?v=BNaTYnaM4_Q">www.youtube.com/watch?v=BNaTYnaM4_Q</a>&lt;br&gt;www.youtube.com/watch?v=wl-hExZuPAU [Advanced, but good ideas]&lt;br&gt;<strong>Science Roadshow visit</strong>&lt;br&gt;<strong>the Mighty Materials show</strong> is about applied chemistry and chemistry in society ideas.</td>
</tr>
<tr>
<td><strong>Integrate</strong>&lt;br&gt;It is recommended that you integrate your science with other subject areas. All of these science activities, investigations and challenges are highly engaging for children and can become a platform for Literacy and Numeracy programmes, as well as art, craft, and the social sciences.</td>
<td><strong>EVALUATE</strong>&lt;br&gt;Evaluation is about judging or measuring <strong>how well</strong> 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.</td>
</tr>
</tbody>
</table>
Theory notes

Mighty materials

Capillary action
When water is soaked up by a paper towel it makes its way into the fibres of the towel by capillary action (sometimes called wicking). The paper is said to absorb the water. This is because water is attracted to the paper fibres. Other examples: paint being drawn up into a paint brush, water rising up a thin glass tube.

Capillary action can be stronger than the pull of gravity, so the water is able to move upwards through the paper.

When food colouring is mixed in the water it diffuses in all directions to change its colour. The food colouring travels through the paper along with the water.

Capillary action can act like a siphon, moving water from one place to another. But, there is a limit of how high capillary action will lift water. We estimate this to be [use children’s findings].

Acids and Bases

Acids are sour tasting and corrosive substances. Sometimes they can be very dangerous, but mild acids are often used in cooking, baking and preserving foods. Examples of acids include: [children list].

Bases are soapy tasting and corrosive substances. Sometimes they can also be very dangerous. Example of bases include: [children list].

Red cabbage indicator paper can be used to test if something is acidic, basic or neutral. It changes to [purple/pink/red] in acids, [green/yellow] in bases and stays [blue] in neutral substances such as [water].

The strengths of acids and bases are measured on the pH scale [0 = very acidic, 7 = neutral, 14 = very basic]. When equal quantities of acidic and a basic substances of equal strengths are mixed they result in a neutral substance.

Chalk chromatography
Chalk chromatography uses capillary action to separate the different pigments found in water-based felt pens. Water is the solvent that carries the pigments (solutes) up through the chalk. Some pigments (probably made of smaller molecules) are carried faster and further than other pigments, allowing us to separate and see the different pigments used in the different coloured pens.

Fermenting ginger ale
Fermentation requires the following: [children list: water, sugar, yeast and warmth], but the flavour of ginger ale is helped by adding [ginger]. Fermentation results in carbon dioxide being released as bubbles and this gives the ‘zing’ to the taste. Yeast will only work with certain types of ‘food’ such as: [children list: table sugar, icing sugar, honey, malt, maple syrup, golden syrup, brown sugar], but not wok with [children list: corn starch, salt].

Science is about

Teacher to choose the most appropriate language and approach to the following core ideas. It is suggested that at least some of these ideas be taught explicitly in any given unit. See the following web link for more detail: www.scienceonline.tki.org.nz/introducing-five-science-capabilities.

Science is a way of finding out about the world. Doing good science means to:

1. Gather and interpret data:
   - Wonder, explore and play with ideas.
   - Ask good questions to investigate.
   - Make good observations using all our senses and sometimes use instruments to help make more accurate observations.
   - Make inferences which are [children complete: the meaning made from observations].
   - Follow steps and record them so we know what we did and how we might change things next time.
   - Repeat trials in order to find trends and patterns.
   - Collect data and results and think about what they mean.

2. Use evidence:
   - Support ideas or claims using evidence from our observations and data.
   - Sometimes reject ideas or claims using evidence.
   - Realise that a negative result is still useful.

3. Critique evidence:
   - Think about the strong and weak points of our methods, data, interpretation of data and the evidence and conclusions we have presented.
   - Be honest about what we see and what this might mean.

4. Interpreting representations:
   - Find good ways of communicating our methods, findings and conclusions. Sometimes this might include creating tables, graphs, charts, posters, written text, models and simulations.

5. Engaging in science:
   - Learn by having fun and through being ‘seduced’ by science.
   - Get emotionally involved in our learning.
   - Understand how science ideas relate to our everyday lives.
   - Use our science understanding in different situations.
   - Take action over important scientific issues.
Paper towel bridge


What you will need:
(per group)
* Clear plastic cups and other plastic containers.
* Paper towels (two brands).
* Food colouring (blue, yellow and red).
* Water.
* A bulldog clip.

Setting the scene
When we use a paper towel to mop up a watery mess, it seems to ‘suck’ the substance up. How does it do this? How far will the water travel through the paper? Water is a bit hard to see as it travels up the paper, so try using a few drops of red food colouring to make it easier to follow. Here is a strip of paper towel whose bottom end has been sitting in water.

Challenge 1
How far does water travel up a paper towel?
Set up an experiment like this. The bottom container has coloured water in it and the strips of paper towel hang down into it. One strip has been cut across the roll, the other along it. Does the water travel up both pieces at the same speed?

Which brand is best?
Can you find a way of testing if one brand of paper towel is faster at soaking up (absorbing) water than another? Is your test fair? Work with another group to critique each other’s methods.

Using evidence
Use your evidence to discuss which brand is better at soaking up water.

Challenge 2
Can you ‘move’ water?
Use rolled up paper towels to make bridges from one cup to another, like this. Put about one centimetre of coloured water in cups 1, 3 and 5. Cup 1 = blue, cup 3 = yellow and cup 5 = red. Do not put any water in cups 2 and 4. Leave a day or two. What happens? Can you create other colours?

Challenge 3
Going further
Using pairs of cups, can you move water from a higher to a lower cup? From a lower to a higher cup? What is your evidence that this does or doesn’t work? Can you show movement of water over ‘extreme’ distances?
Paper towels — how absorbent?

Learning intentions Science Capabilities: Gather and interpret data, Use evidence. Material World: How much water will a paper towel hold?

What you will need:
(per group)
* Two different brands of paper towels (2–3 sheets of each).
* A small funnel.
* Two test tubes or small containers.
* A measuring cylinder (optional).

Setting the scene
Often a paper towel is used to soak up water and other liquids. So, a brand of paper towel that soaks up lots of water might be a better buy than another brand that soaks up less.

Challenge 1
How do we collect data?
A simple way of measuring how much water a paper towel holds is to soak it in water, lift it out and hang it up for a few seconds, then carefully squeeze all the water out into a test tube, using a funnel to catch all the drops. Try this method. What things would you need to keep the same if you were to test different brands? Share and critique your ideas with another group.

Challenge 2
Which brand is best?
Use your ideas to measure which of two different brands soaks up the most water. How did you make sure it was a fair test?

Using evidence
Use data you have collected as evidence to say which type of towel is the best at soaking up water.

Paper towels are often different sizes and the roll length and prices will be different too. Can you figure out which brand might be better value for money?

Challenge 3
Comparing with other types of paper
Find a way of comparing how good toilet paper and paper towels are at soaking up water. Try other types of paper too.

In what ways do paper towels and toilet paper need to be different? Can you find evidence for them looking and behaving differently? Share your ideas with others.
What you will need:
(per group or as a demonstration)

★ A red cabbage per class.
★ Access to boiled water.
★ Two large bowls and a large sieve.
★ A knife and cutting board.
★ Paper towels.
★ Scissors.
★ Drying racks used in baking.
★ Substances to test (see list immediately below).

Teacher: Engagement activity ideas
Taste some different substances to see if they are acidic or basic, e.g. lemon juice, orange juice, milk, water, a solution of baking soda, etc. Discuss the different taste sensations. Discuss where other acids and bases are found: battery acid, stomach acid, washing powder (base), etc. and how dangerous these can be.

What to do

1. To prepare cabbage juice for the whole class: Cut a red cabbage into small chunks and put it into the bowl. Pour boiling water over it and leave it to stand. (For a more concentrated cabbage solution, boil the cabbage chunks in a pot on the stove for 10 or more minutes.) Once cool, pour it through the sieve into the second bowl and discard the chunks. Soak a paper towel in the juice, lift the towel to drain, then lie it flat on a baking rack to dry. Repeat for more paper towels using up all the juice. Once completely dry, cut the towels into ‘testing strips’ about 2 cm wide and 6 cm long. Keep these dry in a jar. (Note, the testing strips can also be used when wet.)

2. In groups: Use the testing strips to find out if common kitchen substances are acids or bases, and, how strong they are. To do this, dip one end of the strip into the substance. If any substances are solids, mix them with water before testing them. Try white vinegar (an acid) and baking soda (a base) first. What colours do they become?

3. Find other substances to test, but first ask an adult to make sure they are safe. Are they acids or bases? What colour does water make the paper become?

4. Select an acid and a base that you have already found. Mix them together in equal amounts and re-test them. How does this affect the paper colour?

5. Record your findings and dry your test strips for display. Label them.

6. How do you know that some substances are stronger acids or bases than others? Can you do an investigation to find this out? Start it with a good question or questions.

Showing others:

There are many ways of showing or telling others what you have done and found. Ideas include: write a poem, rap or song; create a poster; write a newspaper article; do a demo or show, with each person in your group playing different parts; write a description or report; draw a labelled picture; draw a flow chart; use others as ‘guinea pigs’ to show how something works; mime what you did; build a working model; write a story; draw graphs; use photos or a video; do a PowerPoint show.

Key School Journal References:
Pop! Froth! Fizz! Story 4 Connected L2 2014
BARTHOLOMEW, Rex.

Showing others

Find a good way to show and tell others 1) your questions, 2) how you did your investigations, 3) what you found out, 4) what you could do better, and 5) what new questions you could now ask. See ideas in box to left.

In everyday life

Find out what acids like vinegar and citric acid are used for in cooking, baking or preserving. What is baking soda used for in baking?
**INVESTIGATION**

**Chalk chromatography**

**Learning intentions**

**Science Capabilities:** Observations. Gathering and interpreting data.

**Material World:** Water moves through chalk by capillary action. Pigments in water-based pens can be separated by chromatography.

**What you will need:**

(per group)

- White chalk sticks (either bought, or ones you have made, see unit plan).
- Water-based marker pens, e.g. Crayola.
- Clear shot glasses.
- Water.

**What to do**

1. Using a water-based felt pen, make a line around the piece of white chalk about 1.5 cm from one end. (You could have made up many sticks of chalk yourself. See the Unit Plan.) Good pen colours you could choose from are the darker colours like: dark green, dark blue, black, dark purple, etc.

2. Carefully place the piece of chalk upright in a shot glass that has about 0.5 cm of water in it. The felt pen line on the chalk should be above the water.

3. Making sure you don’t knock it over, carefully observe what you see happening up the length of the chalk. You may need to make observations every five minutes over a 15–20 minute period. Do some colours travel faster than others?

4. Repeat for another dark colour of felt pen, but first predict what you think will happen. How good was your prediction?

5. Dry your chalk sticks by standing them upright in a warm location like on a windowsill.

**Asking your own questions**

6. Now that you know the basic technique of chalk chromatography, explore some other ideas. Now, ask your own questions and create investigations to find out the answers to them.

**Inferences**

7. Make inferences about the colours that make up the different felt pen inks.

**Showing others**

Find a good way to show and tell others (1) how you think the different colours of felt pen ink are made, and, (2) how you think the colours move up the chalk.

**Going further**

What questions could you ask about other coloured substances like beetroot juice, ballpoint pen ink, permanent pen ink, etc? Investigate.
**Fermentation — ginger ale**

**Learning intentions** Science Capabilities: Observations, fair tests and critiquing. Material World: Use of sugar and yeast to cause fermentation, with the release of carbon dioxide gas.

### Challenge 1

**Observations**
Use all your senses to make observations while your solution is fermenting. How many good observations can you make? Share them with other groups to create a master list of observations.

**What causes the fermentation?**
First explore, then set up some tests to find if fermentation happens without yeast, or without water, or without sugar, or using only cold water. Add a few drops of food colouring to make your experiment more interesting.

### Challenge 2

**Fair tests**
Now that you have tried some tests, can you design a fair test to find out what causes the fastest fermentation? How will you gather evidence to know which is fastest?

**Critiquing and sharing**
Before you start your investigations, discuss your plans with another group and help them by critiquing their methods. What are their strengths and what things might need improving? Try out your tests and share your results.

### Challenge 3

**Is table sugar necessary?**
Create a test to find if other ‘food’ can be used by yeast to make more carbon dioxide. How will you know if any one food is better than another? The following picture might give you some hints about how to do this, but you might create your own method.

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**What you will need:**

(per group)
- Dried yeast, e.g. Pams All Purpose Active Yeast. This must be fresh.
- Several large clear plastic cups.
- A number of different potential foods for yeast, such as: table sugar (sucrose), icing sugar, malt, maple syrup, corn starch, honey, golden syrup, brown sugar, salt, etc.
- Food colouring.
- Teaspoons (or optionally measuring spoons for accuracy).

**Setting the scene**
Ginger ale is a bubbly drink that is made using sugar, water and ginger. When yeast, a microscopic organism is added, it breaks down the sugar to make the bubbles that give it the fizziness. These bubbles are full of carbon dioxide, an important gas used to create the ‘holes’ in bread and cakes. It is also used in fire extinguishers because it can put out fires.

First explore fermentation by mixing a half teaspoon of yeast with one teaspoon of sugar in half a cup of lukewarm water. Leave it in a warm place and observe what happens over the next couple of hours.

Yeast cells under the microscope.

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Key School Journal Reference:
Bread and balloons Article S 01 4 1999 WELLINGTON, Sarah. Uncle Trev and his famous bread Story 4 03 1 1991 LASENBY, Jack.
One way of pre- and post-testing the knowledge of students on this Nature of Science (and specifically Science Capabilities) based unit of work Mighty Materials, is to use ‘mind mapping’. You can 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 Science is about — since this is the core of the unit — before they begin the unit. They repeat the same mind map after they have completed the unit and the scores are compared. Depending on the experience and ability of your students, it may be best to demonstrate how to create a mind map or two on a different topic before you begin.

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 words ‘Science is about’ 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 also help to explain 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 ‘pre-test’ on Science is about. Ticks are given to show how marks are allocated.
This student’s pre-test score was 6.

Science is about

Keyword list
Aim
Bias
Certainty
Checking
Classifying
Communication
Comparing
Conclusion
Creativity
Critiquing evidence
Data
Discussion
Drawing
Engaging with science
Error (identifying errors)
Evidence
Experiment
Explanation
Exploration
Fact
Fair testing
Gathering data
Graphing
Grouping
Honesty
Hypothesis
Identifying
Inference
Inquiry
Instruments (including named ones)
Interpreting data
Interpreting representations
Investigation
Knowledge
Law
Measurement
Method
Model
Objective
Observation
Prediction
Question (good questions)
Record
Repeating (replications)
Result
Scientist
Sharing (ideas)
Symbol
Systematic
Tentative
Terms
Theory
Trial
Unit (and units like kg, length, etc.)
Using evidence
Working together

Plus extra words at teacher’s discretion.
Mind map on ‘Science is about’

Name ___________________________ Date__________

Year level ______  School _______________________

Science is about
Teacher’s guide

DURING YOUR VISIT

Making the most of learning opportunities

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 opportunities for hands-on experience.
• 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.)
• Staff 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.

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 booklet.

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 the answer 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 during shows

Participating and contributing: students participate and contribute to shows, and interact enthusiastically with exhibits.

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 — www.scienceacademy.co.nz.

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Hints for teachers and helpers — during the visit and at home

Teachers: Please provide each of your helpers with a copy of this page before your visit.

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 nonscientist 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.
Teacher’s guide

EXHIBITS

Exhibits

Themes

Earth science — Te pūtaiao ā-nuku

Exhibits in this theme address specific learning intentions relating to the following: earthquakes; speed of ground acceleration; ocean wave patterns; earthquake epicentres; the tides; fault lines in the Earth’s crust; earthquake shock wave detection; the different causes of tsunamis; where the world’s water is found; and, hurricane wind speeds.

Exhibits include:

- Canterbury’s Earthquakes Epicsentre
- Ebb and Flow
- Shake Table
- Wind Tunnel
- Fracturing Fault
- Shock Box
- Double Wave
- Liquefaction
- Tsunami
- Earthquake
- Mineral Transparency
- Water: Where?

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


Gathering and interpreting data — Te kohikohi me te whakamārama i te raraunga

Exhibits in this theme address specific learning intentions relating to the following: observations; gathering data; interpreting data; measurements; and, using instruments to refine our observations. Exhibits include:

- Bending Light
- Body Analysers
- CENTRE
- Fixing the Waipuna
- Light Combo
- Centre of Mass
- Fixing the Waipuna
- Spectroscope
- Sugar in Foods
- Programming Effect
- Radiation Around
- Spectroscope
- Sugars in Foods
- TV Remote
- What Weighs What?

Contexts — Nature of Science, Foundational Science Capabilities


Key Building Science Concepts and other references based on the Capabilities: A host of resources based on the Building Science Capabilities series (and other common resources) have been adapted to support the Five Foundational Science Capabilities. These can be found at: www.scienceonline.tki.org.nz/New-resources-to-support-science-

Movement — Te nekeneko

Exhibits in this theme address specific learning intentions relating to the following: bearings reduce friction; length of a pendulum affects its period; gear combinations; friction on different surfaces; gyrosopic motion; levers affect speed and direction of movement; magnetic pendulum motion; momentum; speed of a projectile; movement of waves; wheels as simple machines. Exhibits include:

- Bearings
- Changing pendulum
- Cycle Gear Change
- Friction Alleys
- Magnetic Pendulum
- Roller Can
- Speed Ball Radar
- Hidden Levers
- String Ray
- Wheels

Contexts — Forces and motion


Key Building Science Concepts references: Book 42 Marbles L2-3.

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 there 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 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 other exhibits and once they collect at least two clips, they are eligible for a prize drawn at the end of their visit.

Please note: While every effort is made to display the complete range of exhibits listed, due to various factors out of our control, this is not always possible. Usually a minimum of 60 exhibits are on display at any one time.
Curiosity probe

When time allows before shows, our Presenters will introduce an experimental scenario with students that will probe into their understanding of a science idea. The necessary equipment will be displayed, its use explained and students will be asked to give their opinions about the possible experimental outcomes. The actual experimental results will not be given, so students will be encouraged to discuss or perform the investigation back in class.

Back in class

The equipment will be simple and accessible so that teachers will be able to repeat the setup in class and run the experiment in order to discover the outcome. This should lead to discussion around the key concepts and further questions could lead to further investigations. Probes can be used as a diagnostic or formative assessment tool.

This year’s probe 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 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 describe their thinking.

Answer

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.

More detail

More detail will be available when you visit the Science Roadshow.

My body — Tōku tinana

Exhibits in this theme address specific learning intentions relating to the following: sense of touch; digestion; bone structure; co-ordination; diet and health; heart health; binocular vision; internal body parts; and, vitamins. Exhibits include:

- Braille
- Breakfast Breakdown
- Calcium in Bones
- Coordination Tester
- Coloured diet
- Fat in Foods
- Food Additives
- Heart Beats
- Heart Size & Parts
- Helping the Heart
- Hole in the Hand
- Personalised Foods
- Size of Servings
- Soft Drink Diet
- Torso
- Vitamin D

Contexts — My body, The human body.


Observations — Ngā mātakitaki

Exhibits in this theme address specific learning intentions relating to the following: observations using different senses; and, making inferences from their observations. Exhibits include:

- Colour Words
- Hangi
- Happy or Sad?
- NZ Rocks
- Odours
- Unique You
- Vanishing Leprechauns
- Discovery Box
- Hearing Range
- Footprints
- Hollusion
- Toilet
- Peristaltic pump
- Space Bubbles
- Vanishing Leprechauns
- Water Siphon

Contexts — Nature of Science, Foundational Science Capabilities

Key School Journal References: My ant farm Article 5 01 5 1991 LEONARD, June Walker / WALKER, June. Galileo’s legacy Article 7 Connected 03 2009 HEAD, Marilyn. Take a Closer Look Article 4 Connected 02 2013 CAHILL, Margaret. A day in the life of my cat Story 1992 HEGARTY, Maria. Patterns Article Connected 1999 ELLIS, Julie. Key ‘Building Science Concepts’ and other references based on the Capabilities: A host of resources based on the Building Science Capabilities series (and other common resources) have been adapted to support the Five Foundational Science Capabilities. These can be found at: www.scienceonline.tki.org.nz/New-resources-to-support-science-education/Resources.

Pressure — Te pēhanga

Exhibits in this theme address specific learning intentions relating to the following: pneumatics; permeability of ‘solid’ materials, Bernoulli effect; resonance; pressure pumps; vacuum; differential air pressures; pressures within bubbles; venturi principle; principles of siphoning. Exhibits include:

- Air Jack
- Bernoulli balls
- Centrifugal Pump
- Peristaltic pump
- Air Through a Brick
- Space Bubbles
- Balloon Hovercraft
- Venturi Tube
- Beat out Tune
- Glass Handlers
- Water Siphon

Contexts — Forces, Pressure.


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.
While being exciting and entertaining, our shows provide a great opportunity to enhance student knowledge in two science areas each year. The shows for 2016 are Mighty Materials, all about applied chemistry, and the Sounding Out Waves show, focusing on the properties and features of sound.

To assist you in preparing for your visit, we’ve developed a unit plan called Mighty Materials — found in this booklet — that complements the Mighty Materials show.

If time permits within your classroom programme, you may like to use notes from the Sounding Out Waves show outlined below to develop your own pre- and post-visit unit to complement that show.

Mighty Materials show — Te whakaaturanga Matū Miharo

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
- industrial strength velcro.

Key School Journal References:

Key ‘Building Science Concepts’ references:

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 it travels through
- resonance
- volume and amplitude
- the many effects these have on things we can or cannot hear
- good observation skills.

Key School Journal References:

Key ‘Building Science Concepts’ references:

General Learning Outcomes relating to Shows

After attending the shows students will have improved:

- interest and enthusiasm
- understanding and knowledge of scientific and technological principles and processes
- greater understanding of the Nature of Science and Science Capabilities.
Rocks double puzzle page 3
There are three main types of rocks: igneous, metamorphic and sedimentary.

Gathering and interpreting data involves... page 4
Mystery words: measurements, comparisons, instruments, experiment, grouping.

Let’s move! page 5
Solution: force, distance.

Body parts page 6

Improving our senses page 7
Answer: observations.

Pressure puzzle page 8

Pressure is force applied to
a given area. A large force pushing on a small area gives
a high pressure.

Dissolving limestone page 9
4) Observations might include: whitish colour, tiny 'stones' bound together, soft and
flaky, powdery bits fall off when handled, length and height of rock, etc. 5) The rock
collapses and for a time a lot of tiny bubbles float to the surface. 6) The rock collapses
immediately, a huge number of large bubbles formed, hissing sound, less bubbles as
time passes. If left for some days, a white 'scum' forms on the vessel sides above the
vinegar. 7) & 8) The acid in the rain, although weak, slowly reacts with the limestone
and dissolves it away to form caves, holes and ravines. Pure (distilled) water is non-acidic
and would only break the limestone down slowly, largely by mechanically wearing it away
(due to friction).

Timber! page 10
Challenge 1: To make the tests fair, release at same time, use identical rods apart from
their lengths, have many people judging or timing, perform at least 5 to 10 trials each.
The longer the pole, the slower it is to fall. As long as they are the same length with
similar wind resistance, they will fall at the same speed. Poles of the same length and
air resistance will fall at the same speed. Challenge 2: Typical average times to fall:
0.4 m ruler is 0.8 s, 1.0 m ruler is 1.4 s, 2.4 m dowel is 1.7 m, 3.2 m pole 2.3 s. Evidence shows
that the greater the length, the slower they fall. Challenge 3: A 2.4 m 'tree' with leaves is
slower to fall (average 2.3 s) than another of the same height without leaves (average
of 1.7 s). If the tree with leaves is falling into the wind, it falls even more slowly. A large tree
may take four or more seconds to fall. Great care has to be taken to prevent the saw from
jamming and to get out of the way quickly when the tree begins to fall. There should be
no obstacles to prevent you from getting out of the way.

The seconds pendulum page 11
Challenge 1: Example: Repeat trials show it always takes longer to swing back and forth
20 times (say) when the string is longer. It takes less time to swing back and forth when
the string is shorter. Fair test: Keep the same type of string, same weight, hang it in the
same place, etc., just change the string length. The weight doesn’t change the speed of
swinging. Challenge 2: A seconds pendulum is approximately 0.98 m long. For accuracy
swing it from the same point every time; the arc of swing should not be extreme; the
string should be attached to a stable structure; timing should be done over many swings,
etc. Challenge 3: A ‘half second pendulum’ is about 0.25 m long. Simple laws: The longer
the pendulum, the slower it is to swing back and forth. The weight doesn’t change this,
but the heavier the weight, the longer the time it will continue swinging.

Cooling sweat page 12
1) Sweat comes from pores in the skin. 2) Yes, water is as good as sweat at cooling our
skin. 3) Dampness (water) makes the skin feel cooler, but meths and rubbing alcohol
make it feel even cooler. 4) If all are kept at room temperature (e.g. 20°C) then all three
liquids will be the same temperature (e.g. 20°C). 5) The wet bulb thermometer dampened
with water will be maybe 6°C cooler than the dry bulb. 6) Those dampened with meths or
rubbing alcohol will be up to 8°C cooler than the dry bulb. 7) The temperature difference
is greater. 8) The thermometer wrapped in cling wrap will have the same temperature as
the dry bulb. 9) When moisture, like sweat, is able to evaporate off the skin, it takes away
heat, thereby keeping us cool. It does not cause cooling unless it is able to evaporate.

Boiled or raw? page 13
2) & 3) Observations might include: It is harder to start spinning the raw egg, it spins erratically,
and, it spins for a shorter time than the boiled egg. If you quickly stop a raw egg while it is
spinning, then immediately let it go, it will start spinning again, while the boiled egg will not.
Average duration of spinning can be timed to show differences. 4) The water-filled canister
behaves like the raw egg, while the one filled with rice spins more easily, evenly and for longer.
5) It takes time to get the fluid inside the raw egg to move and it continues to slosh around
inside the egg, even if you quickly stop it. (This causes the egg to start spinning again once
released.) Because the yolk and white inside the boiled egg are solid, they spin in a regular
fashion. 6) Similar: liquid and solid contents; size; exterior hardness; etc. Different: shapes, not
exactly the same contents, etc. Models are useful for making comparisons and inferences.

Road spikes page 14
Challenge 1: It pops (with varying degrees of difficulty, depending on the number
of drawing pins used). Challenge 2: With too many drawing pins it is very hard to pop
the balloon. With too few there is a risk that the ‘tyre’ (the balloon) will miss touching
any spikes. Fair tests: Use a balloon that is the same size each time; position it in the
same way; add known weights on top of the board, etc. Challenge 3: Ideas: Sharpen
the drawing pins; use pins or longer nails instead of drawing pins; make the base of
the spikes bigger so more spikes can be added, giving a greater chance that tyres will be
spiked; etc. Evidence should be gathered to support any claims.
The new Junior Eureka programme is a tool for year 4 - 6 teachers to use creatively, ensuring students are fully engaged and excited about what they are doing.

Junior Eureka’s primary aim is to enable, encourage and engage young students to talk to their classmates, friends and families about their STEM project.

If you have any queries about Junior Eureka or want further information, please contact us at junior.eureka@eureka.org.nz

In teams students will:

- investigate their chosen theme
- write a story
- present their findings to their class
- receive a certificate

Learn more at junior.eureka.org.nz