2014

Science ROADSHOW

RESOURCE BOOK

The National Science-Technology Roadshow Trust

MINISTRY OF EDUCATION

$15 (including GST)
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.

GUIDE

**PREPARATION**

Before your visit

- TEACHER: Making the most ... p 26
- Hints p 27
- Initiate ‘Animals inside out’ unit relating to Am I Living? Show pp 15–25
- Exhibits and Shows for 2014 pp 28–30

**During your visit**

- TEACHER: Organisation
- Encouragement
- Safety
- Discipline

- STUDENTS: View Shows, see p 30
- Interact with Exhibits, see pp 28–29

- ADULT HELPERS: Encourage and assist students

**After your visit**

- TEACHER: Post-visit investigations pp 9–14 (Answers on p 31)
- Continue ‘Animals inside out’ unit pp 15–25

- STUDENTS: Post-visit science investigations linked to Roadshow Themes pp 9–14
- ‘Animals inside out’ unit pp 15–25

- ADULT HELPERS: Hints p 27

**Further support**

- TEACHER: School Journals relevant to Roadshow Themes and Shows pp 28–30

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.

Nature of Science

We have incorporated many implicit and explicit Nature of Science strand components both within our 80 minute Science Roadshow visit experience (exhibits and shows) and within this Resource Booklet. This year — for the very first time — we have an exhibit theme called ‘Nature of Science’.

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: http://scienceonline.tki.org.nz. More than sixty existing resources are adapted to meet the needs of the new curriculum based around five science capabilities (that link to the key competencies of the New Zealand Curriculum) and relevant Nature of Science concepts. There are also: discussions on the use of digital technologies in science learning; how the science community and schools can work more closely; and, the background research evidence and documents that point to how science education should look into the future.

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, 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 on the back cover of this book.
Find the following earth science terms in the wordsearch below.

Word list

<table>
<thead>
<tr>
<th>ATMOSPHERE</th>
<th>CLIMATE</th>
<th>CONTINENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRUST</td>
<td>EARTHQUAKE</td>
<td>EROSION</td>
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<tr>
<td>FAULT</td>
<td>FOSSILS</td>
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<td>HURRICANE</td>
<td>LIQUEFACTION</td>
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<td>MOUNTAINS</td>
<td>ROCKS</td>
<td>SEISMOGRAPH</td>
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<tr>
<td>TECTONIC</td>
<td>TORNADO</td>
<td>TSUNAMI</td>
</tr>
<tr>
<td>VOLCANO</td>
<td>WEATHER</td>
<td></td>
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</tbody>
</table>
Gravity double puzzle

Unscramble each of the clue words. Copy the letters in the numbered cells to other cells with the same number to find out something very important about gravity.

Extension

- Find out about the story of when an apple fell on Sir Isaac Newton’s head. Is it a true story? What other things did Newton find out about?
- How is gravity useful to us? When can it be a nuisance?
Use the clues to complete the crossword on heat. Some letter clues are given.

Across

1. When water turns from ice crystals to liquid water.
4. An old scale of temperature in which the freezing point of water was 32°F.
6. When solids turn to liquids as they get hotter.
8. When water gets so cold that it turns to a solid.
9. Something that is hard. Not a liquid or gas.
10. Something that is runny and is half way between a solid and a gas.
11. Not really cold.
12. Very cold, icy crystals on the grass during winter.
15. A state of matter in which particles are moving very quickly and are widely spaced.
17. The opposite of cold.
18. The ability to do work. Power. You may have lots of this before a game of rugby, but not afterwards.

Down

1. A measure of how hot or cold something is.
2. When something gets hot, these move quicker.
3. A scale of temperature. Using this scale, water freezes at 0°C.
5. Something that measures temperature.
7. Movement of gases or liquids from a hot region to a cooler region, in a cycle. Eagles soar on these currents.
13. You see this on a very hot day along a road, when it appears to turn watery.
14. The movement of heat due to particles bumping into each other.
Words that scientists use

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 materials.

Word list

Aim  Measurement  Measurement
Compare  Method  Method
Drawing  Model  Model
Error  Objective  Observation
Evidence  Observation  Observation
Experiment  Prediction  Prediction
Explanation  Record  Record
Fair testing  Results  Results
Graph  Systematic  Systematic
Grouping  Tentative  Tentative
Hypothesis  Theory  Theory
Identifying  Trial  Trial
Inference
Investigation
Knowledge
Laboratory
Law

Statements about science

1. A careful guess at what might happen is a __________.
2. The findings of an experiment are called __________.
Solving a fallen phrase is like decoding a ‘secret code’.

A fallen phrase is a puzzle in which a sentence is listed, and all of the letters that go into a particular column are listed below that column. The challenge is to ‘unscramble’ the sentence to reveal the original sentence.

Clue: Some of the words used to solve the puzzle are as follows: equals, always, angle, in. Some other letter clues are also given.

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L N A E N C L E I O
I N F I L E F N E T L O A
Q C A E E F E C T I O L E
E O U H D T G E A W G Y S
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SCIENCE VOCABULARY PUZZLE

Sound words!

These picture tiles will make you think!
Solve the problems with your brain by using the word picture details to work out the mystery words and terms about sound. The first one is done for you and some clues are given for the others.

1. falling frequency

2. f_____ note

3. m_____ C

4. opera _______

5. sound b_______

6. m_____ phone

7. voice _________

8. sound w_______

9. m_____ instrument

10. tunef____

11. _______ band

12. l_____ volume

13. _______ pitch

Extension
Find out what these symbols relating to sound mean: ♩, ♪, ♫, Hz, MHz, dB,
Learning intentions  Nature of Science: How observations and evidence can inform us about the distant past. Earth Science: How was evidence of dinosaurs preserved in rock?

What you will need:
(per group)
- Plaster of Paris.
- Paper cups.
- Water.
- A plastic container (that you can throw away).
- A spoon.
- Clay or Play-Doh.
- A model dinosaur, shells, fossils.
- Scissors.

Challenge 1
Make a fossil
Following the same method as the YouTube video, create your own fossil. This is called a positive cast as the object is the same shape as the original.

Colour your fossil
Once you have made a fossil, colour it realistically with water colour paints. Look up Google Images of fossils to see what the real colours look like.

Challenge 2
Make a negative cast
A footprint in sand is an example of a negative cast. It is still evidence that something existed, giving us a negative image of the animal’s foot. Think about the cast making process and come up with a way of creating a negative cast of a footprint, e.g. using a toy dinosaur’s foot.

Make a more realistic fossil
Can you make a more realistic looking fossil cast by adding a small amount of sand to the plaster mix?

Challenge 3
Make a trail of footprints using negative casting
Can you cast a trail of dinosaur footprints? Use two or more types of footprints (from different dinosaur species) and position them in such a way as to tell a story about the behaviour of the dinosaurs.

Communicate what you have found out
Demonstrate to the rest of the class how you made your trail of footprints. Discuss what the trail shows about dinosaur behaviour.

Improving your methods
What questions might you ask as starting points to investigate better ways to create your casts? Perform investigations that answer your questions.

Extension: Find out about what a palaeontologist does.

Ancient fossils

A large trilobite fossil about 500 million years old, from Morocco, North Africa (Middle Cambrian). Photo by Mike Peel.

The plaster of Paris recipe is 2 parts plaster to 1 part water, e.g. six spoons of plaster to 3 spoons of water.

Key School Journal References:

Key ‘Building Science Concepts’ reference:
Book 41 Fossils: Digging up the past L2-4.
**Challenge 1**

**Setting up a fair test**
In your group discuss and decide on how you can make a paper drop test as fair as possible. You will need to consider things like:

- how to make sure the two pieces of paper are dropped at exactly the same time
- how to measure the time it takes for each piece of paper to fall to the ground
- how to make sure your results are not chance events (hint, this involves repeating your tests).
- Using the same two pieces of paper you started with under ‘Setting the scene’ test your method to gain reliable data.

**Challenge 2**

**Testing different folding arrangements**
Decide on a simple question you are going to investigate, e.g. “Do two pieces of flat paper always land at the same time?” or, “Does a piece of paper that is folded in half fall twice as fast as a piece that is not folded?”
Agree on your method, then do the investigation. Keep a record of your results.

**Challenge 3**

**More tests**
Now that you have done some basic tests, can you come up with some really interesting fair tests you can do with two pieces of paper? (Hints: Different ways of scrunching paper up, different sizes of paper, cardboard, etc.)

**General rules**
Now that you have made a whole lot of observations and measurements, can you come up with some general rules about how fast paper sheets of different weights and sizes fall?
Asking a good question:
Every good investigation should start with a good question. The question is, what is a good question? As a general rule, ‘why’ and ‘how’ questions are hard to answer, so in the early stages of your investigation avoid these. Try questions like ‘Which one is ....’, ‘Where is it....’, ‘When does it....’, ‘Does such in such ...’

What you will need:
(per class)
★ A set of large plastic thermometers — one for each group (obtained from the $2 shop or similar).
★ Pen and paper.

Learning intentions
Nature of Science: Observations, measurements, data interpretation, applying knowledge.

Physical World: What places are cold and what places are hot?

What to do

Learn to read a thermometer
1. Place your thermometer alongside other thermometers and wait five minutes. Read the temperature and make sure everyone, including your teacher, agrees you are correct.
2. Check your thermometer with others to see if they all read exactly the same temperature when positioned in the same location. If they don’t how are you going to take this into account?

Taking measurements
3. Decide on 8–10 locations where your class will measure the temperature, e.g. on a sunny classroom wall, amongst some plants, under a veranda, etc. At a given time, e.g. at 11.30am exactly, each group should measure the temperature at their designated location.
4. On a labelled map, record the temperatures and compare the measurements. Discuss why you all took the measurement at the same moment in time, and, why the different locations had different temperatures. Also discuss how knowing the warm, medium and cool spots might be useful to you and other people.

Doing it yourself
5. Decide on a simple scientific question you would like to ask about temperature. Within your group, plan and set up an investigation to find answers to your question. (See ‘Asking a good question’ in box to left.)

Showing others
You must record what you did and found in such a way that someone else could come along later and repeat what you did. This is what scientists do, they check each other’s findings to see if they are true. Your task is to find a way of showing and telling others:
• your question
• what you did
• what you found, and
• what this meant.

You could write this down, but you do not have to. Perhaps you could make a video presentation, create a poster or even do a demonstration.

Extension
1. Investigate other aspects of temperature that you are interested in. Remember to first pose a good question to investigate.
2. Find how microclimates are important in horticulture and agriculture.
**Observations and inferences**

**Learning intentions** Nature of Science: Observations, inferences and evidence.
Living World: How are fossilised footprints used to inform us about dinosaurs?

**Challenge 1**

**Observations**
Based on the picture only, list as many observations as you can about these footprints.
If you were able to visit the real footprints found in rock, what extra observations might you be able to make?

**Challenge 2**

**Measurements**
List what types of measurements you can take on these footprints and how they might be useful in analysing more about the dinosaurs. Give examples of actual measurements.

**Challenge 3**

**Inferences**
From your observations and measurements, what inferences can you make about:
(i) how many dinosaurs were present
(ii) what direction they were moving and how fast
(iii) what happened
(iv) what type of food they ate
(v) why one set of prints disappears.

**Extension**
Use model dinosaurs to cast footprints into plaster of Paris. See this YouTube clip: http://www.youtube.com/watch?v=n3tavmKaSBI

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**Setting the scene**
An observation is something that you observe or detect using your senses, for example, something you are able to see, hear, touch, taste or smell. Observations are one form of evidence that scientists use. Another is measurement. While an inference is a conclusion that is reached based on evidence and reasoning.

Here are some fossilised dinosaur footprints produced over 70 million years ago. Your challenge is to use observations, measurements and inferences to find out as much as you can about these dinosaurs.

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**Key School Journal References:**
Perfect angles

Learning intentions
Nature of Science: Observations, measurements, comparisons, gathering evidence, linking science to everyday life.

Physical World: Is the angle of reflection the same as the angle of incidence?

What to do
1. Use blu tack to position a mirror flat against a wall at eye height above the ground. How far back can you go and still see yourself in the mirror?
2. Stand in front and to one side of the mirror. Have your partner move to a position where they can see your eyes reflected in the mirror. Explore this idea, then use masking tape to mark where both of you are standing.
3. Using the protractor and string, measure the angle of incidence and angle of reflection (diagram below) for the light bouncing off the mirror.

Doing it yourself
4. Perform investigations to answer the question “Is the angle of incidence always equal to the angle of reflection?” Here are some hints:
   i) Firstly improve the accuracy of your measurements. How would you do this?
   ii) Try measurements from wide out and directly in front of the mirror.
   iii) Instead of left and right reflections, what about up and down? What about diagonally?
   iv) Does a rubber ball bounding off a wall or the pavement behave in the same way as light reflections? How would you measure this? Test out your ideas. Does a plastic ball behave in the same way?
   v) Try as many ideas as you can.

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
Reflections are important in many aspects of everyday life. Find out how they are involved in: a torch reflector, playing squash or pool, echoes, fibre optic cables and mirages.
### What you will need:
(per student)

- Two or three thin straws.
- A slightly thicker straw that will slip over the other straws.
- Scissors.
- Paper.

### Learning intentions

**Nature of Science:** Observations, investigations, measurements, fair testing, being systematic.

**Physical World:** What changes the sound that a straw oboe makes?

### What to do

**Build a basic straw oboe**

1. Use scissors to cut the end off a thin straw to make a ‘reed’, then squash your reed flat, as follows.

   First make your reed by cutting the ends of the straw, then flatten it (see arrows to right).

2. Place the reed end of the straw into your mouth and firmly squeeze your lips around the reed end, then blow. Move the straw back and forth in your mouth till you find the best position for making sounds.

**Investigate what causes the sound of an oboe to change**

3. There are many things you can do to change the sound that a straw oboe makes. Examples:
   - Tighten and loosen your lips as you blow.
   - Change the length of the oboe.
   - Add ‘finger holes’.
   - Slide another straw over the first one and move it back and forth as you blow.
   - Make a cone-shaped amplifier for the end of the straw oboe.

Think like a scientist by doing fair tests on your oboe. This means only changing one thing at a time to see what effect it has on the sound.

Working in your group, make up some rules (theories) for how an oboe’s sound changes when you do certain things to it. Examples: What always happens when you shorten an oboe? What always happens when you make a hole in the side of the oboe tube? Etc.

### 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:


### Key ‘Building Science Concepts’ references:

**Animals inside out unit**

**SCIENCE UNIT PLAN**

### Animals inside out — He koiora mai i roto ki waho

**Topic:** Animals inside out

**Science Concepts**

Animals have special body structures and behaviours that help them to survive. These include:

- ways of moving and how their bodies are supported
- how they ‘breathe’
- how they sense the world
- how they grow and how big, long or tall they become
- how they reproduce, including life cycle concepts
- how they get rid of wastes (optional as this is difficult to teach)
- how they feed.

This unit compares the ‘human animal’ with other animal examples and treats the concepts at a simple level, using simple investigative approaches and concepts. (In contrast, at high school level these concepts are treated more deeply using a form and function approach as summarised by the acronym ‘MRS GREN’.)

**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.

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

**Human speed** p19: 3) Rules could include: start in crouched position, shoes on, start at the clap, false starts don’t count, time from start to when person’s chest crosses line, measure one person at a time, do 10 trials for each person, use 5 people, wait five minutes between trials to account for fatigue, etc.

**Lung volume** p20: 5) Lung volume for children is usually around 2–3 litres. 7) Examples of questions students could ask: Does how fast you blow change the volume of air passing into the bottle? Can a bigger person blow out more air? Is this always the case? Do girls (of a given age) have larger lung volumes than boys? Do adults have bigger lung volumes than teenagers? Do smokers have a lower lung volume than non-smokers?

**How good is your eyesight?** p21: 3) Knowing the difference between potential prey helps a predator (including humans) to assess if they are edible, then to stalk and catch them. 5) Examples of rules might include: the picture cards should be the same size; all experiments must be done at the same angle to the sun (e.g. the cards should always face the sun or always face away from the sun); the cards should be shuffled between trials; the same person always does the same set of trials; etc.

**Human height** p22: Challenge 1. Rules to follow might include: bare feet; heals to floor; straight ruler held horizontal on head and pushed down firmly; person measuring uses a chair to get up close to check the measurement; each measurement is repeated. Challenge 2. To show if the older group is taller either: average their 10 heights, or, add all 10 heights together and compare with the younger group. Challenge 3. Examples of questions that could be investigated: Are Year 8 students taller than Year 7 students? Are tall people better at high jumps? Does tallness run in families?

**Caring for babies** p23: Challenge 1. Examples: crying (to get attention); head turning and mouth opening when cheek is stroked (to locate nipple); holding breath when the face is under water (reduces chance of drowning); closing eyes to bright light (protection); grasp reflex (holding onto mother); swimming reflex (protection from drowning); learning (for survival to adulthood); sucking when finger placed in mouth (drinking milk). Search internet for lots of others. Challenge 2. Feeding, cleaning and bathing, keeping clothes clean, giving warmth and shelter, giving affection, etc. The primary purpose is to aid the child’s survival. Challenge 3. Examples of instincts: Baby bird raising its head when it feels vibrations on the nest (inference: it instinctively knows that food is coming); tadpoles dive for cover when disturbed (inference: to avoid being eaten); baby rabbits crouch in the grass when they sense a large animal nearby (inference: to avoid being seen and preyed on). Generally, the larger the offspring and slower their development, the more care the parents need to give.
**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 are inherent — as they are mandatory — and here we treat them in an explicit manner.

A combination of these approaches encourages skill development and Nature of Science (NoS) understanding, while the ‘Animals inside out’ 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.

<table>
<thead>
<tr>
<th>Specific Learning Intentions</th>
<th>Learning Activities through 5Es model. Humans compared with other animals.</th>
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</thead>
<tbody>
<tr>
<td><strong>1. Nature of science (NoS)</strong></td>
<td><strong>Movement — Ignition</strong></td>
</tr>
<tr>
<td><strong>Understanding</strong>: How scientists think. Science is based on observations and evidence.</td>
<td><em>Engage Human speed:</em> Show a YouTube video of Olympic 100 m sprint races and discuss speed, running styles, etc. <em>Explore</em> Set up start and finish lines and have running races. Teach examples of appropriate questions for investigation, e.g. How fast can you run 20 m? How would you measure this? (Contrast with ‘Why’ questions that are difficult to answer. <em>Explain</em> Introduce the idea of fair tests, timing with stop watches, repetitions and averaging results (age and ability appropriate). Discuss thinking like a scientist by identifying what errors are involved, e.g. timing the start and end of the races. How can we apply these skills to new speed investigations? <em>[Human speed investigation sheet]</em>) <em>Elaborate</em> Students apply the principles learnt to other questions, then investigate them, e.g. How fast can I run 20 m backwards? How fast can I crawl 20 m on hands and knees? Is my average speed over 20 m the same as over 100 m? Do I run faster into or with the wind? What aspects of our feet make it easier to run forwards than backwards?</td>
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<tr>
<td><strong>Investigating</strong>: What are good questions?; careful observations; inferences; using instruments (stop watches and measuring tapes) to perform measurements; identifying errors that arise in measurements; how repeating trials can reduce effects of chance events and measurement errors; how fair tests involve only changing one thing at a time.</td>
<td><strong>Speed of other animals</strong>: Investigate movement in other types of animals such as garden snails, worms, ants, spiders, frogs, fish, dogs, cheetahs and horses (some of which could be kept in the classroom). Decide on suitable questions to investigate, e.g. How fast does a dog run? What parts of a goldfish’s body are used in swimming? How does a snail move itself along? How is the leg of a chicken different from that of a human? How fast does a bird (e.g. a sparrow, seagull or pigeon) fly? Make some inferences from these observations, e.g. a sparrow flies fast because it needs to be able to escape predators. <em>Evaluate</em> What have I found? How could I improve my method? Do I understand a fair test? Why do repetitions? Compare findings with what scientists say. Discuss and communicate what you have found by a method of your choice, e.g. show and tell, create a poster or graphs, produce a video, etc. <em>[You may need to build up to the sorts of skills outlined here over a number of lessons.]</em></td>
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<tr>
<td><strong>Communicating</strong>: Discussions over questions to investigate, techniques and findings; communicating findings; reading scientific texts; symbols and specialised terms. <strong>Participating and contributing</strong>: Students relating findings to the functioning of their own bodies; links with potential careers.</td>
<td><strong>Support</strong> Decide on suitable questions to investigate about <strong>humans</strong> then contrast these findings with <strong>other animals</strong>. Examples: How do they stand up? How old are they when they learn to walk? How do they balance? Can they sleep standing up? How many legs do they use for running? Are some legs different than others? What parts of skeletons help support the body? Do insects have skeletons on the inside or outside of their bodies?</td>
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<tr>
<td><strong>Content</strong>: Understand that animals move and are supported in different ways. <strong>Vocabulary</strong> <strong>NoS</strong>: distance, speed, metres (m), metres per second (m/s), fair tests, repetitions, averages, results, errors, investigations, observations, inferences. <strong>Content</strong>: body, skeleton, bone, joint, muscle, tendon, ligament, bipedal, backbone, quadrupeds.</td>
<td><strong>[Theory notes titled ‘Movement’ and ‘Support’].</strong></td>
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**Science Roadshow visit: The 2014 Am I living? show is about key features of living things.**

<p>| <strong>2. Nature of science: As above.</strong> | <strong>Breathing</strong> |
| <strong>Content</strong>: Understand that animals ‘breathe’ in different ways. | <em>Engage Human lung volume:</em> Investigate how much air human lungs contain. <em>Explore</em> Play with the technique. <em>Explain</em> Reiterate fair tests, volume measuring, repetitions, averaging results, errors, units for volume, e.g. millilitres or litres. <em>[Lung volume investigation sheet]</em>) <em>Elaborate</em> Investigate new questions posed by the students, e.g. Do people of different sizes have different lung volumes? Can a real dissected lung be blown up? How many times per minute do we breathe? Do babies breathe quicker than adults? |
| <strong>Vocabulary</strong>: <strong>NoS</strong>: As above, plus volume, millilitres, litres. <strong>Content</strong>: breathing, respiration, inhale, exhale, breath, breathe, lung, windpipe, gill, spiracle. | <strong>Other animals</strong>: Investigate ‘breathing’ in other types of animals such as garden snails, worms, insects, frogs or fish (some of which could be kept in the classroom). Decide on suitable questions to investigate, e.g. How often do fish gills move? Is this different on a warm day and a cold day? Where is the breathing hole in a snail? <em>Evaluate</em> See previous investigations. Also: How good were my questions? How does lung volume relate to asthma, fitness and holding your breath? |
| <strong>[Theory notes titled ‘Breathing’].</strong> | <strong>[Theory notes titled ‘Breathing’].</strong> |</p>
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<tr>
<td><strong>3. Nature of science:</strong> As above</td>
<td><strong>Senses</strong>&lt;br&gt;&lt;br&gt;<strong>Human senses:</strong> <em>Engage</em> Watch a YouTube video on human eyesight or that of another animal. <em>Explore</em> How good your own eyes are at seeing small or distant objects. Students explore this idea. Introduce the investigation. <em>Explain</em> Reiterate fair tests, distance measurements and units, e.g. metres (m), repetitions, averaging results, errors. <em>How good is your eyesight? investigation sheet</em> Elaborate Students pose new questions, then investigate them, e.g. What is the easiest colour to detect at great distances? Can we identify shapes out to the sides of our vision? <strong>Other animals:</strong> Investigate senses in other animals, e.g. the stalked eyes of snails, the compound eyes of praying mantids, the touch sensitivity of woodlice. Decide on suitable questions to investigate, e.g. Will a woodlice move away from the touch of a small paintbrush? <em>Evaluate</em> See previous investigations. Also, how are senses important for survival? How is eyesight professionally tested? Careers relating to eyesight: optometrist, nurses, doctors.</td>
</tr>
<tr>
<td><strong>4. Nature of science:</strong> As above, plus graphs, scattergrams, research techniques.</td>
<td><strong>Growth</strong>&lt;br&gt;&lt;br&gt;<strong>Human growth:</strong> <em>Engage</em> Show pictures of the Guinness World Records’ tallest and shortest people who ever lived (NB. Care with children’s sensibilities about their own height.) <em>Explore</em> How tall are you? Measure each other’s height. Also measure each other’s handspans. <em>Explain</em> Reiterate fair tests, how we would do accurate height measurements and the units used (cm or mm), why measurements are done in bare feet, repetitions, averaging results, errors (e.g. hair, slouching, standing on tip toes, etc.) <em>Human height investigation sheet</em> Elaborate Students repeat their measurements to see how accurate they are. They can then pose new questions, then investigate them, e.g. Are boys taller than girls? What is the average height of people in our class? Are students in our class on average taller than another class? Do taller people have longer handspans? Height changes versus age, growth spurts, and changes in old age. <strong>Other animals:</strong> Investigate height of other animals such as giraffes or polar bears standing on hind legs, e.g. research data and average it. Draw scale outlines on a wall. Average times to full maturity of different animals. <em>Evaluate</em> See previous investigations. Also, use ‘physical graphs’ (e.g. stacks of blocks, markers forming scattergrams and outlines of people’s heights on the wall) to communicate findings. Careers: paediatricians, Plunket nurses, biologists (e.g. ornithologists who record bird measurements). Measurement is used extensively by builders, tailors, engineers and surveyors.</td>
</tr>
<tr>
<td><strong>5. Nature of science:</strong> As above.</td>
<td><strong>Reproduction</strong>&lt;br&gt;&lt;br&gt;<strong>Human reproduction:</strong> <em>Engage</em> Show some pictures or a video of little babies, or, have a mother visit class with her baby. <em>Explore</em> Discuss and make lists of what things a parent does to keep its new-born baby safe and happy. And, what can a new born baby do for itself? <em>Explain</em> Reiterate how scientists approach investigations. <em>Caring for babies investigation sheet</em> Elaborate Students pose their own questions about reproduction based around these age appropriate areas: how many babies are born (per birth), family sizes, baby sizes (weights and lengths), parental care, a baby’s instincts, gestation period, learning, time to maturity (adulthood), human life spans. <strong>Other animals:</strong> Observe or compare these aspects using other familiar animal examples, e.g. aphids, spiders, praying mantids, birds, sheep, rabbits, cats or dogs. <em>Evaluate</em> See previous investigations. Careers: Midwives, nurses, farmers, zoo keepers, vets, vet nurses.</td>
</tr>
<tr>
<td><strong>6. Nature of science:</strong> As above. (OPTIONAL)</td>
<td><strong>Ridding wastes</strong> (optional)&lt;br&gt;&lt;br&gt;This section is included for the sake of completeness, but is a difficult area to investigate at the primary school level.</td>
</tr>
<tr>
<td><strong>7. Nature of science:</strong> As above.</td>
<td><strong>Feeding</strong>&lt;br&gt;&lt;br&gt;<strong>Human feeding:</strong> <em>Engage</em> Show an X-ray video clip of a person eating [<a href="http://www.youtube.com/watch?v=ummm6A5IDyI">http://www.youtube.com/watch?v=ummm6A5IDyI</a>]. <em>Explore</em> What things happen in our mouth and throat when we eat and swallow a dry cracker? <em>Explain</em> Reiterate how scientists approach investigations. <em>Elaborate</em> Students pose their own questions about eating, then investigate them, e.g. How is eating different to drinking? How many times do we chew something before we swallow it? Is this dependent on how hard or dry the food is? How do we use our front teeth compared with our back teeth? What does our tongue do during eating? <strong>Other animals:</strong> Observe or compare these aspects using other animal examples, e.g. aphids, spiders, praying mantids, sparrows, sheep, rabbits, cats or dogs, lions, sabre tooth tigers. <em>Evaluate</em> See previous investigations. Careers: Dentists, doctors, dieticians, ear nose and throat specialists, zoologists, farmers, vets, vet nurses.</td>
</tr>
</tbody>
</table>
Movement
Movement is used by all animals to find food, mates and shelter, and, to escape danger. Humans use bipedal locomotion, that is, they use two legs. This frees up the front ‘legs’ (the arms and hands) for other very complex and useful activities. However, it is harder to balance on two legs than four.

Most mammals and reptiles use four legs. They are quadrupeds.

Legs have evolved to be effective for the lifestyle of the particular animal, e.g. long legs with hooves for fast running and short sturdy legs with large claws for digging.

Vertebrate animals (those with a backbone) use bones, tendons, muscles, ligaments and joints to create movement.

Other forms of locomotion include: muscular bodies (and an internal hydroskeleton) e.g. snails and worms; multiple legs, e.g. spiders; and, undulating bodies, e.g. snakes and fish.

Support
Bony skeletons, like those used by mammals, reptiles and birds, are also used for support. The legs and backbone especially, found on the inside of the body, form a solid structure to hold all the muscles and organs upright and in place.

In contrast, animals such as insects and crustacea (crabs, crayfish, etc.) have a shell-like skeleton on the outside of their bodies, while all the muscles and organs are on the inside.

Breathing
Breathing is used by animals to get oxygen into the body and carbon dioxide (a waste product) out. This is called gas exchange. When an animal is at rest, little gas exchange is needed. When animals are running, or fighting, more gas exchange is needed, so they breathe faster.

Different animals use different types of ‘breathing’ arrangements: in mammals, lungs; in fish, gills; in insects, tracheae; and, in worms, diffusion through the skin.

Senses
At the most basic level, even in humans, senses are used to find food, mates and shelter, to keep them away from predators and other harm, and to make sure the food they eat is edible.

Some animals have completely different senses than humans, e.g. pigeons can detect magnetism and snakes can detect infrared radiation. Some animals have senses that are much better than ours, e.g. an eagle’s eyes and a dog’s nose.

Growth
Growth is a key feature of living things. An animal cannot give birth to something the same size as itself (except in microbes, where they often split in half), so offspring must grow to maturity, before they can in turn reproduce.

Like other animals, humans grow in height (length) and weight and some of our features change with maturity. Adult male mammals, including humans, are usually larger than females.

Animals are tall, short or long for survival reasons, e.g. a tall giraffe can reach leaves on trees that other animals cannot reach.

Reproduction
Humans usually have one baby at a time that then takes up to 20 years to become an adult. So, human parents do a lot of work to get their babies to weaning (independence, when they can live by themselves). As a result, they don’t have many offspring in their lifetimes.

Other mammals like rabbits have litters of many babies and over their lifetimes they may have 50 or more offspring in total. Some fish and insects might have thousands of offspring, but their chances of survival are much poorer than human babies.

Life cycles
Life cycles in which the animals look completely different at every stage help to aid survival. For example, a monarch butterfly changes from egg (a dormant over-wintering stage) to caterpillar (the main feeding stage) to chrysalis (change in form stage) to adult (distribution and reproduction stage).

Ridding wastes
Our main body wastes are carbon dioxide and urine. Faeces (poos or dung) are the leftover products of digestion, so they are not true excretoy products.

Feeding
Feeding gives animals energy for their daily activities (muscle movement, heat production, nerve impulses, digestion, etc.) and the building blocks for growth and repair of the body.

There are two main stages in feeding: 1) physical breakdown of food particles by biting and chewing (and in birds, grinding with stones in the gizzard), and 2) chemical breakdown using acids and enzymes from saliva, the stomach and the intestine.

Animals have specialised ways of gaining their food and then processing it, e.g. praying mantids have long grabbing front legs, tigers have stabbing canines for grabbing prey and horses have huge wide ridged molars for grinding tough grasses.
Learning intentions

Nature of Science: Timing, measurement, fair tests.

Living World: Investigate running speed and what things change our running speed.

What to do

Measure your running speed.
1. Decide on a start line, then measure out 20 m and mark a finish line.
2. Warm up and stretch first, then do some sprints over 20 m and time how quickly you run the distance.
3. Think about how you can make your sprint trials as fair as possible. Discuss your ideas and decide on a set of rules for your sprint race challenges. You might like to consider:
   • the person’s starting position
   • if shoes should be on or off
   • how the race is started
   • what to do about false starts
   • how to accurately time the race
   • do you only have one person sprinting at a time or several people?
   • what data are you going to collect and from how many people?
   • the effects of tiredness.
4. Run sprint trials based on your rules and record your findings. Discuss.

Doing it yourself

5. Decide on your own questions that you would like to ask about sprint races. (See ideas in box to left.) Decide on how you will investigate these questions, then do some fair tests to find answers. Here are some examples:
   • Does a person run faster in bare feet or in shoes?
   • Do boys run faster than girls?
   • Does a squatting start lead to a quicker 20 m time than a standing start?
   • Is running into the wind slower than running with the wind? By how much?
   • How much does long grass slow you down?

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

Discuss where being quick over 20 m is really important in sports.
Lung volume

What you will need:
(for a demonstration or per group)
- Access to a sink or a large container (like a plastic aquarium).
- 1 metre of plastic tube.
- A large plastic bottle (at least 4 litres in volume).
- A measuring jug.

Teacher: Engagement activity ideas
Discuss how our ribs and diaphragm are involved in breathing; how long can you hold your breath; how many breaths do you take per minute?

Learning intentions
Nature of Science: observations, measurements, investigations, fair tests, comparisons, linking science to everyday life.

Living World: Investigate how much air is stored in our lungs.

What to do

1. Half fill the sink with water.
2. Fill the plastic bottle right to the top with water, block the end with your hand and turn it upside down. Sit the bottle so its opening is under the water then take your hand away. The water will stay in the bottle.
3. Feed the hose into the bottle while all the time keeping the mouth of the bottle under water.
4. Take a deep breath and blow through the tube into the bottle.
5. Mark where the water level drops to. The air in the top of the bottle equals the amount of air in your lungs. How much is this?
6. Compare how much air your lungs hold compared with your classmates.

Doing it yourself
7. Decide on your own questions that you would like to ask about how much air your lungs hold. Decide on how you will investigate these questions, then do some fair tests to find answers. Here are some hints: how quickly you blow; how big the person is; boy or girl; child or adult. Remember, you need to decide on a good question before you begin investigating.

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:
Animals inside out unit

ACTIVITY SHEET

How good is your eyesight?

Learning intentions
Nature of Science: research, observations, measurements, investigations, comparisons, fair tests, linking science to everyday life.
Living World: Investigate how good our eyes are at seeing things that are far away.

What to do
1. Research into how big (in cm) a sparrow is and also a mouse.
2. Draw a sparrow to real size on a piece of cardboard and colour it in. It does not need to be detailed. Do the same for a mouse. They should end up being about the same size and they should both be largely brown in colour.
3. Have a friend hold both pictures a few metres away from you. Can you tell which is which? Why might this be important for you, or a predator like a hawk? Predict which one will be easier to name when far away.
4. Have your friend hold the pictures further and further away from you until you can’t tell the difference between the sparrow and the mouse. At what distance is this?
5. Think about how you would make this test fair for anyone doing it and so people can’t ‘cheat’. Make up some ‘rules’ or steps you would always use.

What you will need:
(per group or as a demonstration)
★ Felt pens or coloured pencils.
★ Light weight cardboard.
★ Long measuring tape.

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.

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 about how eyesight is tested and what the tests mean.
Find out about how good the eyesight of a hawk or eagle is compared with humans. Also, how good is a dog’s sense of smell compared with ours?

Key School Journal References:
Hunting the hunters Article 5 2000 Pt 04 No. 3 Pgs 7-9, SUTHERLAND, Mary. What do you see? Article 1998 Pt CN No. 1 Pgs 12-13, BOWES, Clare. Your marvellous sense of touch Article 4 1994 Pt 01 No. 3 Pgs 8-9, BIRCHALL, Brian.
**Challenge 1**

**Making accurate measurements**

As a group, come up with ways to make sure your height measurements for each person are always the same. Record what you did as a series of ‘rules to follow’. Someone else should now be able to come along and follow your rules and get the same height measurements. Test this out on some people from other groups!

**Challenge 2**

**Measurements by age**

Find out who are the 10 oldest students in your class and the 10 youngest and record their names. Using the rules you developed earlier, measure the height of each of the older students. Repeat for the 10 youngest. Find a way of showing if there is an overall difference in the height of students from the older group compared with the younger group.

**Challenge 3**

**Other comparisons**

Decide on other experiments you would like to do on human height. Choose the best, decide on a good question to investigate, then do the investigation.

**Showing others**

Find a good way to show and tell others 1) your question 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.
**Challenge 1**

**Human instincts — babies**

Observe (watch carefully) a newborn human baby and listen to someone talking about its behaviour and its daily needs. Also interview your parents or any other adults to answer these questions. What instincts do babies have? And, how do these instincts help them survive?

**Challenge 2**

What does the human mother need to do?

What basic things does a human mother (or father) need to do to care for their baby so it grows up healthy and happy? Observe (live, or on video) mothers or fathers with babies and what they do. Also interview your parents or any other adults. Why do they do these things?

**Challenge 3**

Comparing with other animals

Observe two or three completely different types of animals in detail, e.g. a bird, a frog and a rabbit. What instincts are their babies born with? Make inferences (conclusions reached from evidence and reasoning) about why they have these instincts. Do their parents help their babies and if so, how? Make inferences about why they do or do not help their offspring.

**Extension: Animal reproduction**

Investigate into some other aspect of animal reproduction, e.g. ‘How many offspring do certain animals have?’ or, ‘How long does it take to become an adult?’ etc.

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**What you will need:**

(Per class)

- A visiting speaker who is a new mother, along with her baby, OR, a YouTube clip about a human baby’s instincts and the care it gets.
- Access to observe animals with babies, e.g. a springtime farm or zoo visit, OR, access to the internet to view video clips of animal parents caring for their babies.

**Setting the scene**

Some animal babies are born ‘knowing what to do’ to survive and they get little or no help from their parents, e.g. houseflies and kiwi. Others need a lot of help from one or both of their parents, e.g. humans and whales.

In this challenge you are going to try and answer some ‘how’ and ‘why’ questions about the instincts animal babies are born with and the care that parents give, or do not give their babies.

To do this, you will need to make observations, then come up with inferences about what you have observed. An inference is a conclusion reached from evidence and reasoning.

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**Key School Journal Reference:**

Cicada lays her eggs Article 5 1992 Pt 01 No. 4 Pgs 8-10, MAGUINESS, Jan. The monarch butterfly Article 5 1978 Pt 01 No. 5 Pgs 28-32, RICHARDS, Grace. Our tame eels Article 1997 Pt YP No. 1 Pgs 4-6, GOULD, Alana GOULD, Tamara LEE, Briana. Red Admiral Article 4 1983 Pt 01 No. 1 Pgs 19-23, COOK, E. M. Whitebaiting Article 4 2004 Pt 01 No. 4 Pgs 2-7, TRAFFORD, Jan.

**Key ‘Building Science Concepts’ reference:**

One way of pre- and post-testing the knowledge of students on this Nature of Science based unit of work *Animals Inside Out*, 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 mark 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.

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**Keyword list**

- Aim
- Bias
- Certainty
- Checking
- Classifying
- Communication
- Comparing
- Conclusion
- Creativity
- Discussion
- Drawing
- Error (identifying errors)
- Evidence
- Experiment
- Explanation
- Exploration
- Fact
- Fair testing
- Graph
- Grouping
- Honesty
- Hypothesis
- Identifying
- Inference
- Inquiry
- Instruments (including named ones)
- Investigation
- Knowledge
- Law
- Measurement
- Method
- Model
- Objective
- Observation
- Predict
- Question (good questions)
- Record
- Repeating (replications)
- Result
- Scientist
- Sharing (ideas)
- Symbol
- Systematic
- Tentative
- Terms
- Theory
- Trial
- Unit (and units like kg, length, etc.)
- Working together

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

Name __________________________ Date________

Year level _____ School ________________________

Science is about
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 divide your class into six groups corresponding to the six exhibit Themes. Each group is responsible for reporting their understanding of 3-4 exhibits (selected from their Theme) back in class. 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 digital camera or video camera 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.

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 later 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

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

Future focus:
- Future-focused issues relating to science and technology, innovation, medicine and communications.

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.
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 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 which 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 a-ñuku**

Exhibits in this theme address specific learning intentions relating to the following: crude oil, where and how it’s found, its products and their energy content; Earth’s magnetic field; fossils and modern day equivalents; how old Earth is; where minerals come from; and, the availability of water and how it is used, including our personal water use. Exhibits include:

- Crude oil products
- Earth’s magnetic field
- Energy value in fuels
- Fossils
- How deep?
- How old?
- Oil formation
- Mineral origins
- Seismic surveying
- My water use
- Water availability and use

**Contexts — Earth science; Planet Earth.**

**Gravity — Te tō ā-papa**

Exhibits in this theme address specific learning intentions relating to the following: centre of gravity; elasticity; conservation of momentum; strong building structures (arches); gravity as a pull force; magnetic forces versus gravitational forces; rotational forces that overcome gravity; potential energy conversion to kinetic energy; and, the weight of objects on different planets. Exhibits include:

- Balancing pins
- Bouncing balls
- Chain siphon
- Catenary arch
- Local gravity
- Planetary weights
- Potential energy
- Bowling ball piston
- Levitating pencil

**Contexts — Gravity, Forces.**

**Heat — Te pōkākā**

Exhibits in this theme address specific learning intentions relating to the following: hot air rises; thermochromic materials; infrared radiation; insulation; heat moulded plastics; solar hot water heating; and, measurement of temperature. Exhibits include:

- Air balloon
- Hot colours
- Plastic moulding
- Solar water heater
- Infrared camera
- Insulating with batts

**Contexts — Heat, Energy.**

The notes on this page and the next page highlight the key 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 explore and discover. 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 set 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/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 clamped. 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.
The big questions
Before we start our second show we ask the students one or two ‘big’ questions about key ideas associated with exhibit themes. For 2014, these are as follows:

Earth Science
A. Why is crude oil so useful? (It can be made into many different useful substances like plastic, nylon, paint and cosmetics, and is also used as a convenient energy source, e.g. petrol and diesel.)
B. What is the name of a solid substance that has a crystal structure and comes out of the earth? (A mineral. Examples include: silicates, mica, diamond and quartz.)

Gravity
A. Is gravity a push or a pull? (Always a pull, never a push, here’s an example, during a storm you see the flash of lightning before you hear its sound — which we call ‘thunder’. In fact, in one second light travels 7.5 times around the Earth, but in one second sound only travels 343 metres.)
B. Does a small object like ‘me’ have gravity? (Yes, but my gravitational pull is very, very, very small. The bigger the object, like the Earth or the sun, the bigger its gravitational pull.)

Heat
A. Do particles moving up a hot object move faster or slower than in a cold object? (Faster. So, are water particles moving at all at 0°C? (Yes, but they’re just jiggling on the spot.)
B. Do temperatures ever go below 0ºC? (Yes.) How far? (To -273ºC, which is absolute zero, the coldest possible temperature of anything.)

Nature of Science
A. What is a word used by scientists meaning to look really carefully at something? (An observation.)
B. When we carry out a series of steps in an experiment, then do the same again, but change ONE thing only, we call this ....? (A ‘fair test’, or for more advanced students, a ‘controlled experiment’.)

Reflections
A. The angle that light hits an object is always the same as the angle that it ....? (Reflects, or bounces off that object.)
B. Can reflections change what something looks like? (Yes, for example, the ripples in a pond make your reflection look ‘ripply’, and, light bouncing off a curved mirror can make things look bigger or smaller.)

Sound
A. Is there any sound in space? (No.) Why not? (Because sound needs something like air or water to travel through and there is none of this out in space!)
While being exciting and entertaining, our shows provide a great opportunity to enhance student knowledge in two science areas each year. The shows for 2014 are *Up, Down, All Around*, all about gases, and *Am I Living?*, focusing on important features of humans as living things.

To assist you in preparing for your visit, we’ve developed a unit plan called *Animals Inside Out* — found in this booklet — that complements the *Am I Living?* show.

If time permits within your classroom programme, you may like to use notes from *Up, Down, All Around* outlined below to develop your own pre- and post-visit unit to complement that show.

### Am I living? — Kei te ora ahua?

This show covers specific learning outcomes relating to characteristics of living things, including the following. Humans and other animals:

- move, using muscles in combination with a skeleton
- breathe (or respire), using lungs
- are sensitive to their environment, using sense organs like eyes and ears
- grow, in predictable ways
- reproduce, producing on average more offspring than is needed to replace the parents
- excrete, producing waste products like urine
- feed (undergo nutrition), taking in food and processing it for energy and building blocks.

### Up, down, all around — Kei runga, kei raro, hurinoa

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

- the gases in air
- coloured gases
- expansion upon heating
- contraction upon cooling
- dissolving of oxygen in water
- how heavy gases are
- gases in chemical reactions and explosions.

### 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.

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**Key School Journal References:**


**Key ‘Building Science Concepts’ references:**

Ancient fossils page 9

Challenge 1: Realistic colours for fossils: greys, earthy browns and blacks. Challenge 2: There are two ways of making a negative cast: i) allow plaster of Paris to almost set, then push footprints into the surface (it is best to spray the feet with cooking oil before you do so), or ii) make a positive cast of the footprints, spray on some cooking oil, then make a negative cast from this. The sand makes the cast look grainy like real sandstone (in which fossils are commonly found). Challenge 3: Possible stories: Footprints of an adult dinosaur walking across a bay (smaller prints of the same shape). Footprints of a predator encountering a prey species (different shaped prints), a scuffle, then only one set of prints leaving the site. Improving your cast making: What proportions of plaster and water make the best print? Does adding paint to the plaster mix make the cast stronger?

Paper drop page 10

Challenge 1: One person drops both pieces of paper; drop from as high as possible; make a mark on a wall to always drop from the same position; use a ‘stop watch’ function to time each drop; repeat each drop 10 times. Challenge 3: Examples of rules: The more times a piece of paper is folded, the faster it will fall; if a piece of paper is unchanged it will fall at the same speed (on average) in a predictable manner.

Hot places, cold places page 11

Taking measurements, #4: The measurements were taken at the same time to make the comparisons fair (the only variable being the location). The different temperatures recorded at different locations could have been due to sun or shade, orientation of the rooms, and so on. The observations were made at dawn and at dusk and so should always be compared at the same time of day and on the sunny side of a building throughout a sunny day. How does this compare with a cloudy day? During the day, does air temperature change more than soil temperature?

Observations and inferences page 12

Challenge 1: Observations: One type of footprint is larger than the other and the stride distance is greater on average. The large prints are more closely spaced at the start, then more widely spaced, then towards the bottom of the picture they are again closely spaced. The toes are pointing towards the bottom of the picture. The prints are mixed up near the middle of the picture, and only one set of prints leaves the scene towards the bottom. If able to visit the scene, the depth of the prints would give an indication of the weight of the animals, if they were off balance, and if the claws protruded downwards into the earth. Detail of prints might help identify the actual species. Challenge 2: Types of measurements: Width and length of footprints, length of stride. Challenge 3: Inferences: i) two dinosaurs were present at first, ii) they were moving towards the bottom of the picture; the larger one sped up before the two species met iii) there was an interaction or scuffle, e.g. the smaller one could have been eaten by the larger, or, they could have mated (unlikely due to the differences in the footprints). iv) the larger one may have been a meat eater, v) the smaller animal may have been eaten by the larger one, or, it might have flown away, or, it might have been carried away by the larger one.

Perfect angles page 13

Doing it yourself, #4: (i) Improve accuracy: Ensure the mirror is absolutely flat against the straight wall, e.g. a blob of Blu-tack behind the mirror could pose problems resulting in the mirror not being parallel to the wall, so instead use double-sided sellotape. Reduce the usable mirror size down so that only one eye can be seen in the reflection. Use a lead weight on a string as a ‘plumb bob’ in order to ‘project’ the position of each person’s eyes down to ground level, then mark that spot on the floor and measure the angles of incidence and reflection from them. ii) and iii) Likely outcome: Angle of incidence should always equal angle of reflection. iv) Likely outcome: A rubber ball bouncing off a wall or pavement will behave in the same way as light. However, a plastic ball may ‘slip’ as it bounces off a surface, so the angle of reflection may not equal the angle of incidence.

Straw oboe page 14

Examples of theories: The shorter an oboe, the higher its pitch. The tighter you squeeze the reed with your lips, the higher the pitch. By adding a single hole in the side of the oboe, the pitch goes higher. By adding a paper cone or funnel to the end of the oboe, the sound becomes louder and more resonant.
The Academy Programme

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 that aims 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.

The following are some of the key elements that will be the focus over the four days:

- What does the research into science teaching tell us?
- Exploring The Nature of Science strand.
- Doing hands-on inquiry science.
- Making science fun and practical for all cultures and learning styles.
- How do you know your students have learnt anything?

The Academy opened my eyes to a whole new way of thinking.

2014 Academy Dates

<table>
<thead>
<tr>
<th>Location</th>
<th>Dates</th>
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<tbody>
<tr>
<td>Wellington</td>
<td>Mon 28 Apr – Thu 1 May*</td>
</tr>
<tr>
<td>Hastings</td>
<td>Tue 20 May – Fri 23 May</td>
</tr>
<tr>
<td>Auckland</td>
<td>Mon 14 Jul – Thu 17 Jul*</td>
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<tr>
<td>Tauranga</td>
<td>Tue 12 Aug – Fri 15 Aug</td>
</tr>
<tr>
<td>Christchurch</td>
<td>Tue 9 Sep – Fri 12 Sep</td>
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<tr>
<td>Dunedin</td>
<td>Mon 6 Oct – Thu 9 Oct*</td>
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</tbody>
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* School Holidays

Plan in the Box

Plan in the Box involves working with your school and the TIC Science to set learning priorities and then to conjointly create the work programme. The output is a detailed plan complete with appropriate classroom ready activities/resources and “optional” integrated service delivery from a range of “best fit” external providers or collaborators.

Find out more: www.roadshow.org/planinabox

The National Science-Technology Roadshow Trust

“Providing quality interactive learning experiences in science, technology and innovation to Aotearoa, New Zealand.”

We specialise in developing and delivering nationally, quality science, innovation and technology education programmes and exhibitions for students, teachers and their wider communities.

www.roadshow.org