SCIENCE ROADSHOW 2025

The Science Roadshow is an exciting and entertaining learning programme.

Each year it has new shows, exhibits and resources that support the learning and teaching of science in schools all over New Zealand.

It is hands-on, minds-on with plenty for students and adults to explore and engage with.

THEMES

Applied science — ***Te pūtaiao whaipainga***

Detecting — ***Te tautohu***

Forces — ***Ngā tōpana***

Patterns — ***He tauira***

Structures – ***He hanganga***

Trees and environment — ***Ngā rākau me te taiao***

SHOWS

Planet Earth — ***Whakaaturanga Papatūānuku:*** matter cycles, energy flows and life webs.

Balloons and Bernoulli — ***Ngā puangi me Bernoulli:*** amazing pressure phenomena.

UNIT PLAN

Trees, trees, trees — ***He Rākau, he rākau, he rākau***

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Te Tāhuhu o te Mātauranga
Ministry of Education

Science ROADSHOW

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This booklet

This resource contains language-based puzzles and hands-on activities that relate to the exhibit themes in the Science Roadshow's 2025 programme. Also included is a unit of work called *Trees, trees, trees / He Rākau, he rākau, he rākau* which relates to the programme's *Trees and environment / Ngā rākau me te taiao* theme.

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Local Curriculum

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

Mātauranga Māori

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

Cross-curriculum

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

Foundational Science Capabilities

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

Science kits to support science education

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

House of Science website https://houseofscience.nz/science-kits/.

Science Learning Hub (SLH)

The SLH has a great range of online resources. They have put together a collection to complement the 2025 Science Roadshow. You can learn how to create and refine SLH collections here.

Sir Paul Callaghan Science Academy

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

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

Resource Booklet prepared by Peter E. Smith

Overview

Science puzzles (pages 4–9)

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

For puzzle answers see page 27.

Hands-on activities (pages 10–15)

Two types of activities are included:

1) INVESTIGATIONS:

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

2) CHALLENGES:

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

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

Abbreviations used throughout booklet

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

WILF = What I'm Looking For

TIB = This Is Because

For the teacher

Hands-on activity	Engagement activities ('hooks')	WILFs & TIBs	Resources SEARCH WORDS (Google, School Journals) Specific resources (Building Science Concepts **BSC**, House of Science kits **HoS**)
The dancing raisons mystery p 10	Place different objects in water and see if they float or sink. Discuss buoyancy.	**WILF**: Students will discover that the difference in density between an object and water will determine if the object sinks or floats. **TIB**: Gravity pulls down more strongly on denser objects causing them to sink and displacing water upwards.	BUOYANCY, DENSITY, FORCES **BSC:** BK 37 *Floating and Sinking* L1–2, BK 38 *Understanding Buoyancy* L3–4**. HoS:** *Float my Boat / Te Whakamānu i Taku Poti*
Invisible ink mystery p 11	Discuss secret messages and codes, often used by spies, criminals, secret agencies and warring countries.	**WILF:** Students will investigate how to create a secret message using 'invisible ink', then 'develop' it so that it becomes visible again. **TIB:** Certain chemicals, such as lemon juice, are invisible when they dry. However, when heated they are chemically changed and become visible.	CHEMICAL CHANGE, SECRET MESSAGES **HoS:** *Sweet & Sour / Te Reka me te Kawa*
The great ramp race! p 12	Show videos of cyclists racing down hill and how they need to control their descent. Discuss what the optimal slope might be for speed.	**WILF:** Students will learn there is an optimal steepness and also length of slope for producing the greatest speed and distance travelled. **TIB:** Too steep and short, and the car impacts the ground too hard and crashes; too shallow and long, then there's too much friction and not enough speed gained.	FORCES AND MOTION, GRAVITY, FRICTION **BSC:** BK 42 *Marbles* L3–4. **HoS:** *Flexi-Physics / Mātai Ahupūngao Pīngore, May the Force be With You / Kia Tau te Tōpana ki a Koe*
Best bird feeder p 13	Show video clips of tūī, korimako/bellbirds, tauhou/waxeyes, and sparrows at feeding stations.	**WILF:** Students will discover that different bird species have different food preferences and that the best bird feeders need to be compatible with their target species' natural behaviours. **TIB:** In nature, different bird species eat different foods and have different searching and feeding behaviours.	FOOD PREFERENCES, FEEDING BEHAVIOUR
The great straw skyscaper p 14	Demonstrate key components of a building structure — beams, columns and trusses (with diagonals).	**WILF:** Students will learn that beams and columns, combined with diagonal components (forming trusses) create very strong structures. TIB: Square building elements with four corners collapse easily, while triangular ones don't.	TECHNOLOGY CHALLENGES, STRUCTURES **BSC:** BK 51 *Standing Up* L1–2**. HoS:** *May the Force be With You / Kia Tau te Tōpana ki a Koe*
Trees versus temperature p 15	Discuss what it feels like to move under the shade of a big tree on a scorching hot day.	**WILF:** Students will understand that trees cool the environment, including us, on hot days. **TIB:** They block sunlight and increase moisture in the air because of transpiration (loss of water from their leaves).	TREES, MICROCLIMATES, TEMPERATURE **HoS:** *Climate Change / Huringa Āhuarangi*

SCIENCE WORD PUZZLE

Detecting things

Give a name for each of the scientific devices described by the clues. The first answer is given. Then learn how to spell each of the words. Finally, describe one or more practical uses of each device. (See example below.)

1

Clue: Magnifies objects that are too small to see with the naked eye.

Answer: _____

2

Clue: Uses invisible infrared light to measure the temperature of objects from a distance.

Answer: _____

3

Clue: Detects tiny amounts of light, helping us see at night.

Answer: _____

4

Clue: Allows scientists to see objects that are far away in space.

Answer: _____

5

Clue: Uses magnetism to sense hidden metal objects in the ground.

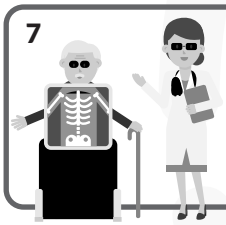
Answer: _____

6

Clue: Uses sound waves to create images of what is happening inside our bodies.

Answer: _____

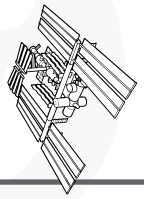
7



Clue: Shoots invisible x-rays through objects to detect bones and teeth.

Answer: _____

8



Clue: Can study weather and climate from space.

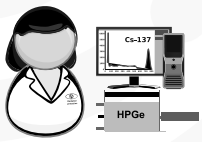
Answer: _____

9

Clue: Amplifies sounds from our heart and lungs.

Answer: _____

10



Clue: Identifies the individual atoms and molecules that make up a substance.

Answer: _____

Practical uses

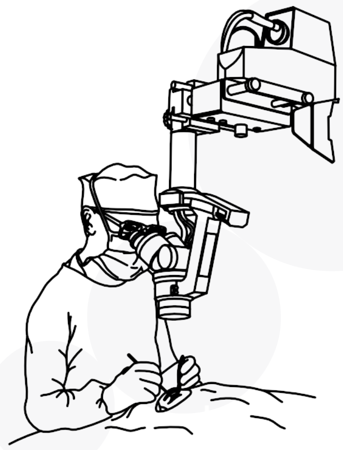
List practical uses of each of the devices. One example is given below.

Microscope — Can help to identify bacteria in my blood.

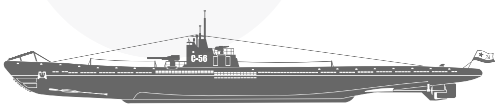
SCIENCE WORD PUZZLE

Applied science scramble!

Unscramble each of the words about how we apply science to practical outcomes. The first is done for you.
Copy the letters in the numbered cells to other cells with the same number to complete the mystery statement.



Clues	***Unscramble***	Numbered cells
ICEMDINE	8 cells	6 7 9 5 12
TCEPUROM	8 cells	2 15 11
TELPEESCO	9 cells	4 8 3
LTESATELI	9 cells	38 1 10
TLAISCP	7 cells	40 26 13
ROERFIGRETAR	12 cells	27 30 14
NOPETELHE	9 cells	34 36 23
RIMCOSOPCE	10 cells	33 16 24 17
TTABREY	7 cells	25 32
HISPOTLA	8 cells	18 35
PSAESHIPC	9 cells	19 20 39
ESUBMARNI	9 cells	29 21 22
PGOPHOTRAYH	11 cells	31 28



Mystery statement

1 2 3 4 5 6 7   8 9 10 11 12 13 14   15 16 17 18   19 20 21 22 23 24 25   26 7 27 28 29

30 31 32   33 34 35 36   15 38 39 40.

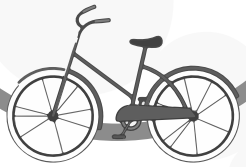
SCIENCE THINKING PUZZLE

Forces: brain teasers

Forces are pushes or pulls. Think about each brain teaser below relating to forces. Can you come up with a good answer for each, and, be able to give evidence to justify your answer? Try out some of them in real life.

Bike Brake Brainteaser

You squeeze the brakes on your bike to slow down. What force slows you down?



Swing high, swing low

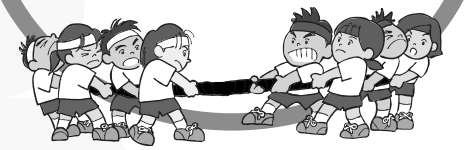
Think about a swing set. What two forces are acting on you when you swing back and forth?

Balloon Blast Off

You inflate a balloon and let go. The balloon zooms across the room! What force pushes the balloon forward?

Tug-of-War Twist

In a tug-of-war, two teams pull the rope in opposite directions with equal force. What happens to the rope?



Book Stack Surprise

You carefully stack five heavy books on a table. What force keeps the books from falling?

Bouncy Ball Bonanza

You throw a bouncy ball straight up. What force is pulling the ball back down to earth after you release it?

Magnetic Mayhem

A magnet attracts a paperclip with 1 Newton of force. Does the magnet pull the paperclip harder or softer if you bring them closer together?

SCIENCE NUMBER PUZZLE

Number pattern puzzlers!

Put on your science hat and use your number skills to solve these pattern puzzles!

The plant problem

Grace is sprouting bean seeds. She planted 5 seeds in one pot and observed their growth for two weeks. Here are their heights in centimetres (cm):

Day 0: All were 0 cm high

Day 7: 0.5 cm, 0.6 cm, 0.5 cm, 0.5 cm, 0.4 cm

Day 14: 12 cm, 12.5 cm, 12 cm, 11.5 cm, 12 cm

1. What is the average height of the sprouts on Day 7?
2. What is the average height on Day 14? Do you see a pattern in the sprout heights on Day 14?
3. What scientific questions could you ask so you can continue investigating in more depth?

Bonus challenge

Imagine you're measuring the temperature outside every hour for a week. What patterns might you see in the data?

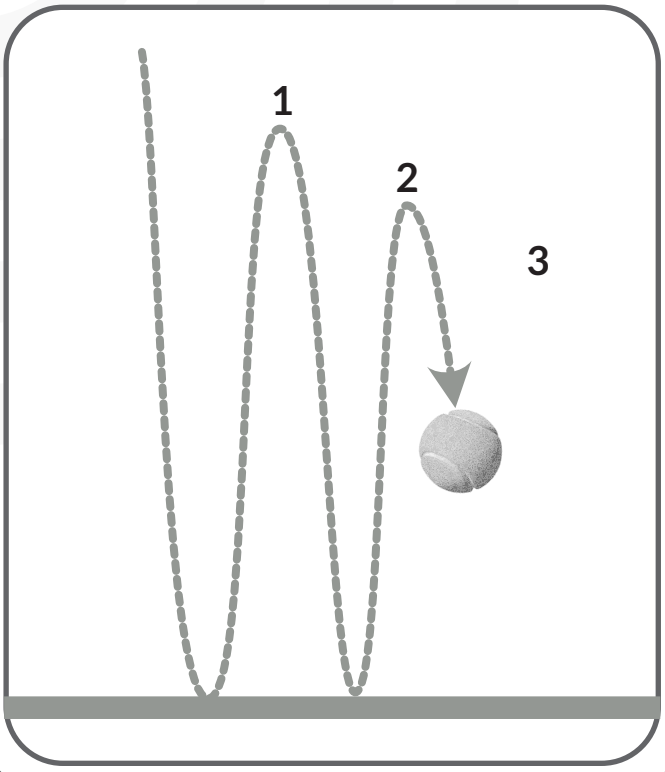
Bouncy ball challenge

Connor tests the bounce height of four different bouncy balls. He drops each ball once from the same height and measures how high it bounces back, when allowing it to bounce three times.

Here are his results:

	BOUNCE 1	2	3
Ball A:	30 cm,	28 cm,	26 cm
Ball B:	45 cm,	43 cm,	41 cm
Ball C:	20 cm,	18 cm,	16 cm
Ball D:	27 cm,	21 cm,	15 cm

1. What is the average bounce height for each ball?
2. Do you see a pattern in the bounce height for each ball?
3. What properties of the ball might affect how high it bounces?



SCIENCE WORD PUZZLE

Structures: word search

Complete the word search by finding 20 words that relate to structures. The words can be found across, down and diagonally, and the first letter of each word is circled.

(s)	j	u	k	p	v	b	s	f	f	o	t	h	(c)	o	l	u	m	n	d
e	u	g	l	h	j	p	y	m	b	p	h	u	(b)	r	i	c	k	g	(b)
(d)	u	p	g	y	a	p	a	a	f	p	v	w	d	(g)	(c)	i	t	a	e
(r)	a	(w)	p	f	x	x	h	q	n	r	z	h	e	l	a	d	l	q	a
(s)	o	m	i	o	b	h	s	n	c	h	f	l	j	a	b	i	f	(f)	m
d	c	c	i	n	r	e	l	d	b	e	(b)	i	p	s	l	f	p	r	g
l	h	r	k	a	d	t	n	m	x	x	o	r	r	s	e	u	d	a	q
b	j	v	e	e	e	m	p	l	(s)	g	v	b	i	k	f	q	j	m	y
r	t	m	y	w	t	q	i	h	i	t	w	p	s	d	t	z	p	e	a
r	l	m	x	c	e	h	e	l	p	c	e	q	v	x	g	h	n	(d)	g
k	z	d	l	o	y	j	f	z	l	v	z	e	r	k	y	e	w	o	a
c	r	j	n	d	n	z	c	b	k	g	u	a	l	n	m	f	t	m	l
q	j	(r)	e	i	n	f	o	r	c	e	m	e	n	t	a	g	f	e	g
e	g	s	e	w	p	t	s	i	w	v	i	q	a	h	q	l	y	f	p
x	r	a	j	h	z	j	m	n	(f)	o	u	n	d	a	t	i	o	n	t
x	p	g	j	v	u	q	c	e	d	c	y	v	j	n	s	l	a	g	e
(m)	a	c	h	i	n	e	p	(t)	u	n	n	e	l	p	t	r	y	r	k
s	e	j	x	k	i	k	p	k	(s)	h	i	p	e	w	g	d	z	n	k
i	q	w	v	b	l	o	q	t	j	d	v	t	(a)	r	c	h	w	v	r
w	w	e	a	x	b	f	t	m	p	p	q	h	l	b	c	a	x	m	d

Words I've found

Creative writing

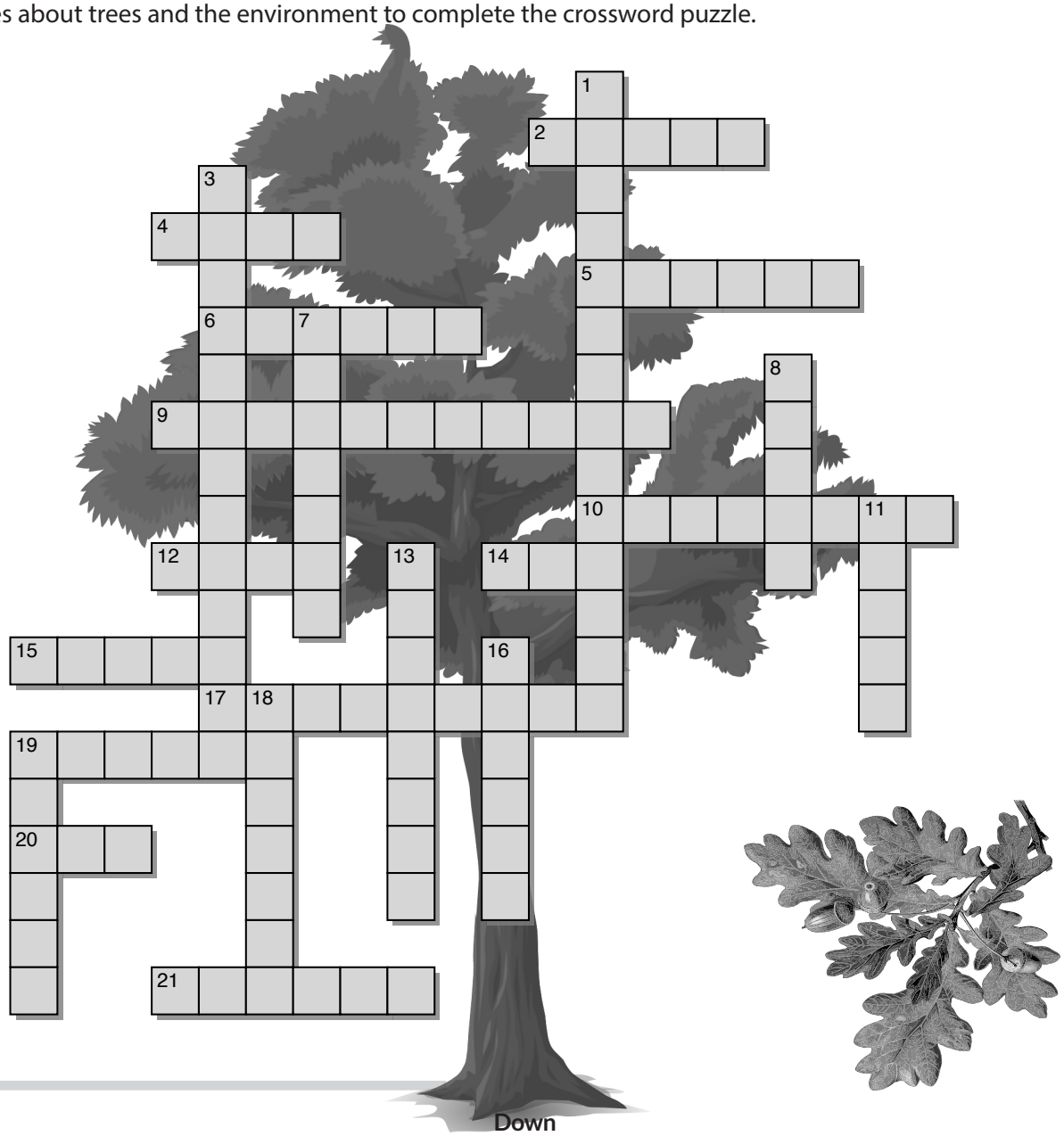
Write a funny rap using as many words as you can from the word search, about the structures used in a building. Here's an example of a chorus:

We got bricks like building blocks, stacked high to reach the sky,
Steel beams for extra support, so the roof ain't gonna fly.
Columns stand tall and proud, like a king with a golden crown,
Holding up the whole dang structure, never gonna let it down!

SCIENCE WORD PUZZLE

Trees and environment

Use the clues about trees and the environment to complete the crossword puzzle.



Clues

Across

2) Trees provide ..... that cools us on hot days
4) The rough outer layer of a tree trunk
5) Trees release this gas that is good for us to breathe
6) A woody arm that grows out from the main trunk of a tree
9) We should take care of trees to protect the .....
10) The natural homes of different types of animals
12) A network of tree roots helps to hold this in place
14) The number of rings in a tree trunk can tell you this
15) These tiny living things help tree roots take up nutrients
17) Types of trees that lose their leaves in autumn
19) A covering of fallen leaves and twigs on the forest floor
20) Trees help to clean the .....
21) The upper layer of leaves in a forest, like a leafy roof.

Down

1) The process where trees use sunlight to make food
3) Trees absorb this gas released by cars (two words)
7) Trees provide a home for many different kinds of these
8) Trees absorb water through these
11) The tall, strong part of a tree that holds it up
13) A large forest fire
16) A large area of land covered with trees
18) Trees help prevent this from happening to soil
19) The flat, green parts of a tree that capture sunlight.

Applied science

INVESTIGATION

The dancing peas mystery

WALT

- Investigate the concept of density.
- Observe how density affects buoyancy.
- See how this principle applies to real-world situations.

What you will need:
(per group)

- ✭ *A tall, clear glass.*
- ✭ *Warm water.*
- ✭ *Sugar (around 4–6 tablespoons).*
- ✭ *Watties frozen baby peas (5–10).*
- ✭ *Tablespoon.*
- ✭ *Optional: Food colouring (a few drops).*

Peas in water.

Extension

Describe some real-world situations where density and buoyancy are important.

What to do

Engage

Explore

Basic steps

1. Fill the glass halfway with water. Add a few drops of food colouring for a visual effect (optional).
2. **Observe the first batch of peas:** Gently drop about 5 peas into the plain warm water. Watch what happens! Throw away any peas that float. Remove and save the ones that sink.
3. **Create a denser solution:** Add 4 tablespoons of sugar to the water in the glass and stir until it dissolves completely. This creates a sugary solution denser than plain water.
4. **Test and observe the batch of peas again:** Carefully add the peas that had sunk previously to the sugary solution. How is their behaviour different?

Going further

5. Try different amounts of sugar to see how it affects the density of the solution and the behaviour of the peas.
6. Explore other liquids like oil or soda water (with adult supervision) and observe how the peas behave.

Explain

Questions and discussion

1. What happened to the peas in the plain water?
2. What did you observe with the peas in the sugary solution?
3. Why do the peas behave differently in the two solutions?
4. What did you find out by going further?

Elaborate

Discussion

- Discuss what density is.
- Discuss what buoyancy is.
- Discuss how buoyancy affects boats.

Evaluate

INVESTIGATION

Invisible ink mystery!

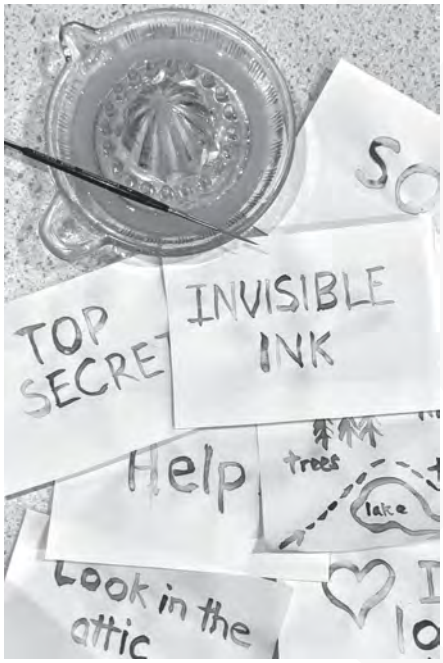
WALT

- Investigate the concept of invisible ink.
- Explore how heat can be used to reveal hidden messages.
- Use scientific tools and processes to detect things we can't see with our eyes.

What you will need:
(per group)

- ✯ *White paper.*
- ✯ *Lemon juice (freshly squeezed, or bottled).*

- ✯ *Small paintbrushes or cotton wool buds.*
- ✯ *Heat source (hot air gun — Care! Adult use only!).*



Invisible ink revealed using ink.

Extension

Can you think of situations where invisible ink could be helpful for leaving secret messages? Brainstorm your ideas with others.

Engage
Explore
Explain
Elaborate
Evaluate

What to do

Basic steps

1. **Prepare your secret message:** Dip the paintbrush or cotton wool bud in lemon juice and use it to write a message on the white paper. The message will be nearly invisible when dry.
2. Let the message dry completely. It might take an hour or more depending on the amount of lemon juice used. Once dry, note if it is totally invisible.
3. **Reveal the hidden message:** Gently hold the paper near a heat source like a hot air gun (***Care!*** Adult use only!). You should see your secret message appear!
4. **Reactivate the message:** The message may fade over time. You can 'recharge' it by reheating the paper with the heat source.

Going further

5. Try diluting the lemon juice to make it more 'invisible'. And, try different 'invisible inks' like diluted milk or vinegar (with adult supervision) and see if they work the same way. Do different types of paper make the messages more invisible?
6. Create a secret code using symbols or drawings made with invisible ink.
7. Research other types of invisible ink and how they work (e.g. ultraviolet light-sensitive ink).

Questions

1. Why can't we see the message at first?
2. How does heat reveal the message?

Discussion

1. This experiment demonstrates the concept of invisible ink, a tool used for secret communication throughout history. What other methods or devices can we use to 'see' things that our naked eyes cannot?

CHALLENGE

The great race ramp!

WALT

- Find how forces like gravity and friction affect speed and distance of travel of a toy car.
- Design and build a ramp to maximise the car's speed and distance travelled.

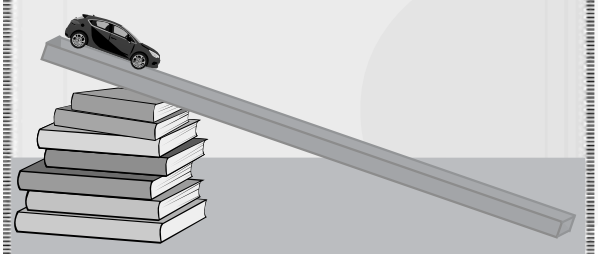
What you will need:
(per group)

- ✭ *Thick books to prop up your ramp.*
- ✭ *Cardboard for cutting into long lengths (or lengths of thin board).*
- ✭ *Small toy car, e.g. a matchbox car.*
- ✭ *Measuring tape.*

Basic method

We'll build ramps and experiment with different angles and materials to see which ones make a toy car travel the fastest and furthest!

1. ***Create a ramp** by placing some thick books on the floor and leaning a piece of cardboard on them to create a ramp. Measure and record the highest point of the ramp and its total length.*



2. *Mark the point where the end of the ramp touches the ground. Measure all distances travelled from this point.*
3. *Explore ideas to see how far and fast your car goes.*

Challenge 1

Perform tests on the ramp height

*Prop your ramp up at different **heights**. Which height makes your car go fastest and furthest? Remember to measure distances travelled from the **end** of the ramp!*

Think like a scientist

What should you do to make sure these trials are fair tests? How many test runs should you do at each height?

Record your results.

Challenge 2

Change the ramp length

*Find out which **length** of ramp makes your car go fastest and furthest?*

Think like a scientist

How did you make sure you were doing fair tests this time?

Record your results.

Challenge 3

The Ultimate Racetrack

Imagine you're designing a real racetrack! Build a multi-part racetrack that includes your ramp and different flat surfaces. Use your understanding of gravity and friction to create a track that maximises the car's speed throughout.

CHALLENGE

Best bird feeder

WALT

- Observe how bird behaviour patterns can help us design feeders that attract specific birds.
- Use data collection and analysis to solve a practical problem.

What you will need:

(per group)

- ✭ *Several different types of bird feeders, e.g. tube feeder, platform feeder, suet or dripping (meat fat) feeder.*
- ✭ *Bird seed (e.g. sunflower seeds, millet, wheat).*
- ✭ *Window with a clear view of the feeders.*

Challenge 1

Different foods — a feeding frenzy

Set up feeders with different types of food in them. Observe over several days which types of food attract the most birds.

Think like a scientist

***How** will you observe the birds? **How** will you record data?*

Do certain types of birds prefer certain types of food?

Do birds fight for their food?

The basic method

We'll welcome birds by setting up different types of feeders and observing which bird species visit each one. This will help us design the 'perfect' feeder to attract a particular bird!

1. *Choose a place for your feeder where you can easily see it from a window (at home or school).*
2. *Make sure the feeder is out of reach of cats and dogs. Cats will try and catch the birds, while dogs may try and eat the food!*

Challenge 2

Seeing patterns

Find ways to identify the different bird species. Choose one species, e.g. sparrows, and look for patterns in its feeding behaviour:

1. *Does it prefer some foods over others?*
2. *What evidence do you have for this?*
3. *Compare with other species.*

Challenge 3

Best bird feeder

Perform fair tests and observe patterns of behaviour to find out which type of bird feeder attracts the most birds. Why do you think this is so?

Is one bird feeder better for certain types of birds? How do you know? What aspects of its design make that bird feeder 'best'?

INVESTIGATION

The great straw skyscraper

WALT

- *Identify structural elements like beams, columns, and diagonals that make a building strong and stable.*
- *Design and build the tallest and most stable skyscraper using only straws and tape.*

What you will need:
(per group)

- ✯ *Craft or paper straws (multiple packs).*
- ✯ *Masking tape.*
- ✯ *Ruler (optional).*
- ✯ *Scissors.*
- ✯ *Selection of weights (books, blocks).*
- ✯ *Video camera set on 'slow motion'.*

Empire State Building, a skyscraper in Manhattan, New York, USA.

Extension

Build a skyscraper that can withstand a small gust of wind (use a fan) while still maintaining its height and stability.

Engage

Explore

Explain

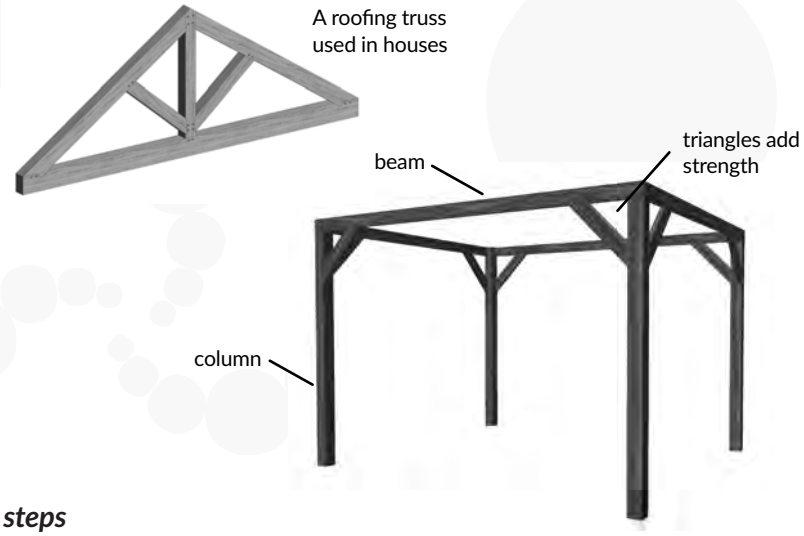
Elaborate

Evaluate

What to do

Setting the scene

Beams, columns, and diagonals are key structural elements in buildings. Beams give horizontal support, columns give vertical support, and diagonal struts between them create triangular-shaped 'trusses' that are very strong rigid structures.



The steps

1. **Skyscraper sketching:** Get creative! Sketch designs for a straw skyscraper, focusing on the beams, columns, and diagonal struts, that will give maximum height and stability.
2. **Building:** Use straws and tape to construct your skyscraper using the design you have created. The goal is to build the tallest structure that will also support a weight placed on top of it.
3. **Testing time:** The winning tower is the tallest one that survives after placing a small weight on top.
4. **Test to destruction:** Start videoing using a slow motion setting. Test your tower till it collapses by gradually adding more weights one at a time. Observe how the structure reacts to the weight and analyse what happens. Which part gave way first and why?

Questions and discussion

1. How would using beams, columns, and diagonal struts improve the stability and strength of your skyscraper compared to a simple straw tower?
2. What are some large real-world structures that use beams, columns, and diagonals in their design?
3. Share what you found out about the weak parts of your design.

CHALLENGE

Trees versus temperature

WALT

- *Investigate how trees can affect air temperature and shade.*
- *Design an experiment to investigate the cooling effect of trees on a hot, sunny day.*

What you will need:

(per group)

- ✭ *Two thermometers (with at least a 0° to 50°C range).*
- ✭ *String.*
- ✭ *During summer: a hot sunny location (school, park or backyard) that also has an area with shade from a large tree.*
- ✭ *Journal and pen for recording observations.*

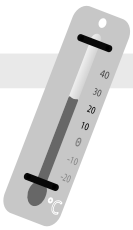
Setting the scene

We'll become junior climate scientists by setting up thermometers in sunny and shady locations to see if trees provide a cooling effect!

Basic method

1. *Choose a day that is fully sunny.*
2. *Carefully hang one thermometer in a sunny location away from trees and buildings.*
3. *Hang the other thermometer under the shade of a large tree canopy. Make sure it is only shade from the tree and not nearby buildings.*
4. *Record temperatures at set times.*

Challenge 1



Temperature tracking

1. *Decide on how often you will need to record the temperatures and how many recordings you will need.*
2. *Record your results in a table.*
3. *Record how each location's temperature felt to you when you were standing there.*

Challenge 2

Temperature patterns

Compare the temperature readings from both locations. Was there a consistent difference in temperature between the sunny and shady locations? By how much did the temperature differ on average?

Graphing your results

Make it easier to understand your results by graphing them.

Challenge 3

The big question

Using your findings, explain how trees might be helpful in reducing heat stress on hot summer days.

Bonus challenge

Do certain types of trees with denser foliage create more shade and better cooling?

SCIENCE UNIT PLAN

Trees, trees, trees / He Rākau, he rākau, he rākau

Curriculum level:
Science L3 and L4

Contexts/Strands:
Living World, Planet Earth and Beyond

Science Concepts

Key concepts:

- A tree is a living thing with roots, trunk, branches, leaves and fruits.
- What trees need to grow.
- How trees make more trees.
- There are many different types of trees and they all grow differently and to different ages!
- We obtain many different types of useful products from trees.
- Trees are homes to many animals and other plants.
- Tree roots help soil stay put and retain moisture.
- Trees clean the air we breathe, so a healthy world needs trees.
- Trees are culturally important.
- How we can become tree protectors.

Cross-curriculum studies and Mātauranga Māori

Approach:
This unit reflects how a cross-curriculum approach is the process of experiencing and understanding connections and, because of this, seeing things as a whole.

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

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

Mātauranga Māori is fundamental to a holistic approach and could indeed be a useful focus for the unit. What traditional Māori knowledge, wisdom, understanding and traditions might contribute to kaitiakitanga (guardianship and stewardship) and a sustainable 'tree-filled' future?

Key aims

To investigate trees as living things which are essential in the environment, but also for their resources. This involves students:

- Exploring, investigating and modelling the biology of trees.
- Understanding how trees can help humans.
- Understanding how trees are an essential part of our communities, the environment and for the health of the planet.

ICT & Resources

Websites and YouTube clips as outlined in specific activities.

General resources:
House of Science Kits: *Plants, Pests & Produce / Ngā Tipu, Ngā Kīrearea me Ngā Hua, Plants, Petals & Pollination / Ngā Tipu Ngā Raupua me te Ruingahae.*
Building Science Concepts: Bk 35 *Is This a Plant?* L1–2, Bk 26 *Making New Plants* L3–4.

Achievement Objectives

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

Contextual
Living World, L3–4:
Life processes: *Recognise that there are life processes common to all living things and that these occur in different ways.*
Ecology: *Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.*
Planet Earth & Beyond, L3–4:
Earth systems: *Appreciate that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources.*

Localised curriculum

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

- Investigate trees that are planted in the school ground.
- Visit a local park or reserve to investigate the trees found there.
- Find out about any locally important trees, such as commemorative trees, particularly large specimens, or unique collections.
- Find out about local tree planting initiatives and get involved in them.
- Invite an arborist in to talk about tree care.
- Find out about local tree industries like forestry, timber mills, or building.
- Have a local carver demonstrate some of their carving skills.
- Investigate ways people are protecting and promoting trees locally.

Answers and teacher guidance for pages 20–24

Tree stump detective p20: ***Challenge 2.*** A light, wider growth ring forms in spring, and a darker, narrower one in summer. (Little growth occurs the rest of the year.) So each pair of light-dark rings represents a year of growth and by counting them you can tell the tree's age. If you can't count all the rings you can estimate how many are missing from the size of those that are visible and estimate an age range, e.g. 15–18 years old. Generally the thicker and rougher the bark, the older the tree (when comparing trees of the same species). ***Challenge 3.*** Multiple small holes bored in the trunk may indicate invasion by damaging beetle grubs; soft spongy wood indicate fungus is breaking down the wood, splits might indicate the tree has been blown over or struck by lightning, and large holes might also indicate rot due to fungal attacks. You might infer that any of these have led to the death of the tree, or, a clean straight cut across the trunk would infer 'death by chainsaw'!

Measuring girths p21: **Q1.** Yes, and they are even different for trees of the same type planted at the same time. **Q2.** In general, the bigger the girth the older the tree (for a given species). Also, it is the healthy trees that attain the greatest girths. **Q3.** Yes, but this will be an estimate, as tree trunks are rarely exactly circular in cross section. (They may be quite oval or have 'in-and-out creases'.) **Q5.** Discussion ideas: oxygen production, carbon dioxide absorption, stabilising soil, habitat for animals and other plants, cooling of the land, rain formation, etc. Data collection helps us to monitor trends.

Cracking the code of tree shapes p22: ***Challenges 1 & 2.*** Answers will vary. This challenge emphasises observations and grouping skills. Is there consensus? ***Challenge 3.*** Other group shapes that could be discussed include 'spreading and open', 'weeping', (both recognised shapes by scientists), and 'bent-by-wind', 'spindly', etc. that are made up according to what is observed (these being shapes that are likely influenced by the environment — legitimate in this context, but not accepted by scientists.

Measure tree heights p23: **Example of a calculation:** Tree shadow length is 28m, your height is 1.5m and your shadow is 3m long.

Tree height = 28m x 1.5m ÷ 3 = 14m

Q1: The two triangles are similar because a) you and the tree are both standing vertically, b) the ground is horizontal in both cases, and c) the angle of the sun is at the same angle in both cases. **Going further:** Factors that might affect accuracy include: difficulty finding the exact end-point of shadows; if the sun is very high in the sky, shadows will be short which magnifies any measurement inaccuracies; where you measure your shadow length from — the tip of your toes or the middle of your foot (versus measuring the tree's shadow from the front or middle of the trunk).

Speedy sprouters p24: **Q1.** Yes, you might see tiny white bumps forming on the submerged nodes of the twigs. These are the beginnings of roots! **Q2.** Willows are generally known to root much faster from cuttings than poplars. **Q3.** Trees like willows and poplars have a special ability to regenerate roots from stem tissue (cuttings). This allows them to grow into new plants quickly and easily. Other trees might require seeds for germination because they have different hormonal balances or require special conditions for root development. **The big question:** The very rapid growth and ease of propagation from chunks of stem make willows 'weedy' in nature. They can grow very quickly and spread easily along riverbanks. While they provide shade and habitat for some animals, dense willow growth can clog waterways and disrupt the natural flow of rivers. Since willows can root from even small twig fragments that break off and float downstream, they can establish themselves in new areas very easily, causing problems in ecosystems where they are not native.

Specific learning intentions and activities

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

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

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

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

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

Specific Learning Intentions

Foundational Science Capabilities/NoS
These capabilities are embedded throughout the unit, in both the content and the way it is taught. The aim is to help students develop a well-rounded set of scientific skills and attitudes, and not just learn scientific facts.

Gather and interpret data
Students will develop this capability through activities such as measuring tree heights and girths, comparing temperatures in full sun versus shade, observing and recording different tree shapes.

Use evidence
Students will strengthen this capability when they use observations and data as evidence to make inferences about their findings, to make robust claims, and draw conclusions from an investigation such as in the activity *Tree stump detective*.

Critique
Students will develop this capability as they learn to question and evaluate the sources of information they use, such as when researching ideas about trees as 'carbon sinks', and when interpreting their own and others' data from experiments.

Interpret representations
Students will develop this capability as they learn to interpret different ways that information about trees and forests is represented, such as in diagrams of photosynthesis, graphs of tree growth over time, and stylised leaf shape diagrams.

Engaging in science
This unit, with its focus on trees and the environment, provides many opportunities for students to connect with how science relates to their lives, their community, and global issues. They can engage with science though hands on experiences, by discussing ethical and societal issues related to trees and ecosystems, by finding solutions to boosting local biodiversity, and by communicating their ideas and findings.

Learning Activities through 5Es model

ENGAGE to ignite interest:

Feel the Flow: Roll up a paper towel and place one end in a glass of coloured water to observe how water moves up a tree trunk.

Leafy Lab: Collect different leaves. How are their shapes and sizes different? Press leaves and make leaf rubbings.

Seed Detectives: Crack open fruits and seeds from trees. Can you find the baby plant hiding inside? Draw and label. How do they disperse?

Sunlight Savvy: Measure sunlight's intensity below a tree canopy versus in direct sun to show how much light a tree captures.

Tree Height Hero: Use the 'stick method' to estimate tree heights like a scientist! (Google the instructions.)

Reaching the sky: Investigate the world's tallest trees, like the Coastal Redwoods, and explore their adaptations for reaching such heights.

Tree Bingo: Go on a nature walk and see how many different tree types you can find.

Tree Timeline: Research the age of Tane Mahuta. Create a timeline to show its age alongside important historical events.

Tree Talk: Interview a local gardener or park ranger about the importance of trees in the community.

Sloganeering for Trees: Create catchy slogans to promote the importance of protecting trees.

Trees in Māori and European cultures: Learn how they were used for food, medicine, tools, fire-making, weapons, building and other products.

Busy Tree: Conduct a 'bioblitz' around a tree to identify the amazing variety of organisms that call it home (insects, spiders, birds, lichens, fungi, etc).

Forest to furniture: Research the many ways we use wood today (construction, paper, cardboard, tools, bow and arrows, furniture, firewood, flooring, timber framing, etc).

Tāne Mahuta, A Guardian Giant: Uncover the cultural significance of Tane Mahuta, a giant kauri tree revered by Māori as forest guardian.

Tree detectives: Choose a tree in your schoolyard, study everything you can about it, and create a presentation to share your findings.

EXPLORE in detail:

Trees versus temperature **Challenge p15:** Investigate if trees have an impact on temperature. How might this benefit us and the planet?

Tree stump detective **Challenge p20:** Like a forensic scientist, find out about the life and death of a tree using clues from a tree stump.

Measuring tree girths **Investigation p21:** Use girth measurements to gauge the size of a tree. What if you don't have a tape measure? There are alternatives. Compare different species, and, trees of the same species.

Cracking the code of tree shapes **Challenge p 22:** Use observation and pattern seeking skills to group trees according to their general shapes. Can you develop extra shape categories? Why do trees have different shapes?

Measure tree heights **Investigation p23:** A tree's height can be estimated by using your height, your own shadow length and the tree's shadow length, and a tape measure. The trick is to use the principle of 'similar triangles' and a simple calculation.

Speedy sprouters **Investigation p24:** Propagate willows and poplars from cuttings. Observe the process. Which species sprouts more easily? Why are willows often considered weeds, while poplars are not?

SCIENCE UNIT PLAN

Specific learning intentions and activities

Specific Learning Intentions	Learning Activities through 5Es model
Learning intentions for this unit Students will: **1. Trees as living things:** Understand and investigate the basic biology of trees, including their structures. **2. Nutrition:** Describe how trees obtain water and nutrients and how they make food by photosynthesis. **3. Reproduction:** Explore how trees reproduce and can be propagated, examples of tree seeds, and, how the seeds are dispersed. **4. Types of trees:** Appreciate the range of tree types, their sizes, shapes and natural habitats. **5. Uses of trees:** Research and investigate the ways we benefit from trees and their products. **6. Trees and the environment:** Understand the positive roles they play in the environment including how they stabilise the soil, reduce flooding dangers, cool our cities and help to reduce carbon dioxide in the atmosphere. **7. Becoming a tree protector:** Explore and put into action tree planting and protection measures. *Other Investigations and Challenges on p15 and pp 20–24 list their own specific WALTS.* **[Theory notes titled *Trees, trees, trees: theory notes*, see over page.]** **Vocabulary:** Trunk Branch Leaves Roots Photosynthesis, Deciduous Evergreen Bark Cambium Canopy Fruit Seed Germination Pollination Cone Angiosperm Gymnosperm Hardwood Softwood Annual ring Deciduous Forest Coniferous Forest Deforestation Conservation Habitat Endangered Adapt Oxygen Carbon dioxide Sustainable	**EXPLAIN** **During or after the exploration activities:** **What is a tree?** Gather student ideas. Or, have students draw a diagram of a tree labelling the parts and explain their functions to a partner. Discuss plants in the school environment and decide which are trees and which are not. How are trees different from shrubs? **How trees feed:** Explain how water and nutrients are absorbed by the roots, while food is made in the leaves using carbon dioxide (CO_2), water (H_2O) and sunlight, with oxygen (O_2) released as *waste*. The food helps the tree grow and stay alive, while some is made into wood. Create a chart with pictures or symbols representing sunlight, water, air, and soil, then explain why each is important for tree growth. **Trees reproduce by making seeds:** Collect and group different seed types. Gather ideas and discuss. When a tree's flowers or cones are pollinated, they make seeds. They can be all sorts of shapes and sizes and have cunning ways of dispersing away from the parent tree. **How do trees vary?** Discuss things like: overall shape/form and branching pattern; bark colour and texture, evergreen v's deciduous; leaf shapes, sizes, colours. **Rank the importance of tree products in students' lives:** Research and find out about tree products and how they impact students. Rank their importance to students. Students can research different tree types and create a presentation highlighting their appearance, leaf type, and a product we might obtain from them. **Trees are important in the environment:** Organise discussion panels where groups of students are assigned to research and explain different aspects of how trees are important in the environment. Examples: Food and habitats for animals like insects, birds, mammals (including humans), and other plants like lichens and mistletoes; reduction of carbon dioxide in the atmosphere; flood protection through binding soil and acting like a sponge; cooling the environment through shading and moisture release; beauty/ aesthetics. **Trees are homes to many animals (birds, insects, etc.) and other plants:** Students can draw a picture of a tree and label the different areas where animals or plants might live. They can explain how each part of the tree provides a home for different creatures. **Become a tree protector:** Discuss why we might want to protect trees. Brainstorm ways to save trees at home, school, and in the community. Create posters or presentations promoting tree protection initiatives. **ELABORATE** Examples of investigations that could extend students' understanding of trees: **1. Understand cultural importance of trees:** Research a culture's uses of, and the values it places on trees. Are particular tree species or individual trees sacred and/or revered, or do they feature in stories, traditions, or celebrations? Do some species stand for particular principles or ideals? Example cultures: Māori; Celts/Druids/ English/Irish; Norse; Shinto, Hindus; Filipino and Australian Aboriginal. **2. Become a tree detective:** Specialise in an aspect of a tree and how to investigate it scientifically. Ask questions and design experiments in an attempt to answer these. **EVALUATE** Teachers should be able to evaluate the success of their teaching so as to make adjustments and refinements to approaches throughout the unit of work. Are students learning? How do we know? Can we measure this? Students should also be evaluating their own understanding and success throughout the unit.

Trees, trees, trees: theory notes

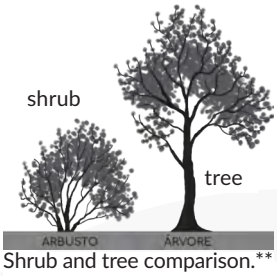
Adjust language and content to suit student level and ability.

Overview

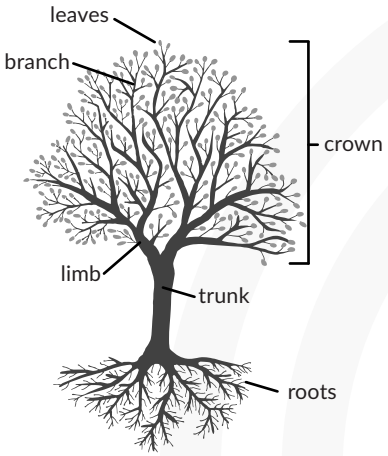
Trees are fascinating living things that play a vital role in our environment and the planet's future.

What are trees?

A **tree** is a plant that can grow to more than 6 metres high and has a single woody trunk. By comparison a **shrub** is shorter than this and has several woody stems growing from its base.



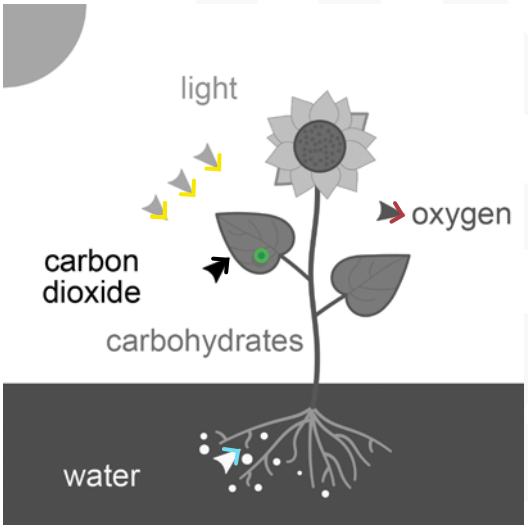
Shrub and tree comparison.**



The main parts of a tree are: [students draw and label].

Trees are living things: They grow, reproduce, and respond to their environment. They need sunlight for energy, water to 'drink', air to 'breathe', and nutrients from the soil to grow.

Leaves are like food factories: They come in a variety of shapes and sizes, helping trees capture sunlight energy to produce food (a process called photosynthesis).



Photosynthesis: Plant takes in water and carbon dioxide, and using the sun's energy, makes carbohydrates (food) and releases oxygen as a waste product. Author: At09kg CC BY-SA https://commons.wikimedia.org/wiki/File:Photosynthesis.gif

Fruits and seeds: Tree flowers produce pollen that is carried by wind or insects to other flowers. This pollen helps create seeds which are tiny baby plants waiting to grow.

Ways of seeds dispersing from the parent tree: wind, water, mammals, birds, ballistic and gravity. [Students describe in their own words examples of each.]

Trees come in many shapes and sizes: These differences are adaptations to their surroundings, e.g. fir trees living in cold climates are shaped with downward pointing branches to shed snow so they don't break.


Fir tree

Two main groupings of trees: 'Deciduous' trees lose all their leaves once a year *during autumn* while evergreen trees, including fir trees and pines, lose their oldest leaves *throughout the year.*

Another way of grouping trees: 'Fir trees' (gymnosperms) have needles, catkins, cones and 'softwood', whereas 'flowering trees' (angiosperms) have leaves, flowers, fruits and 'hardwood'.

Trees can be identified using: general shape, leaves, bark, flowers and cones.

Tree stump secrets: Stumps can tell us about a tree and its death. Examples include [students list]: girth, age, seasonal variation in growth, sapwood and heartwood, possible cause of death, whether it has been exposed to fire or insect attack, etc.

Tree champions of the world


General Sherman tree with person at base.*

Biggest tree (by volume of wood:) [**Ans**. Giant redwood (*Sequoiadendron giganteum*) named General Sherman, USA.]

Students research other champions:

Greatest height: [**Ans.** Coastal redwood (*Sequoia sempervirens*) named 'Hyperion', 115.92 m, (which is greater than the length of a rugby field), USA.]

Greatest girth: [**Ans.** Bald Cypress (*Taxodium mucronatum*) named Árbol del Tule, 42 m, Mexico.]

Greatest age: [**Ans**. Great Basin Bristlecone Pine (*Pinus longaeva*) named Methuselah, 4852 years, USA.]

NZ native tree champions [Student list after researching]

Tallest: kahikatea (49.2m) from West coast.

Largest: kauri (45.2m tall) named Tāne Mahuta, Northland.

Champion Tree (NZ Tree Register): kauri named Te Matua Ngahere, Northland.

Importance of trees

Trees provide homes for many creatures: Animals use trees for food, shelter, and raising young. Other plants use trees as a perch, for absorbing nutrients, and for their micro-habitats.

Trees play a vital role in our environment: They provide shade, clean air, help to cool cities, bind soil, retain air moisture and absorb and trap greenhouse carbon within their wood.

Uses of trees

Trees are a valuable resource: We use wood and other products from trees for many things. Examples include: [Students list.] But it's important to use them responsibly!

Protecting trees

How we can all help protect trees [students create their own lists, examples follow]: plant a tree, propagate trees and give them away, learn about native trees, promote tree planting, recycle paper, organise fundraising events, volunteer to plant trees, write letters to support tree planting policies, get involved in community clean-ups around trees, and, share knowledge about trees.

* Credit: Shrub and tree Author: MarceloTeles, CC-BY-SA-4.0 https://commons.wikimedia.org/wiki/File:Formas-de-vida.png

** CC BY-SA 2.0, Neal Parish, Oakland, CA - IMG_0794 https://commons.wikimedia.org/w/index.php?curid=6750149

CHALLENGE

Tree stump detective

WALT

- *Analyse the physical features of a tree stump to gather clues about the tree's life and death.*
- *Develop observation and critical thinking skills to solve a scientific mystery.*

What you will need:
(per group)

- ⋆ *Tape measure and/or ruler.*
- ⋆ *A clipboard, pencils and paper.*
- ⋆ *Camera.*

Setting the scene

We'll become tree detectives by closely examining a tree stump and its surroundings to gather evidence about the tree's past. Look for clues in the stump's size, rings, bark texture, and any visible damage.

A tree stump like this can reveal all sorts of mysteries that need solving.

Challenge 1

The size story

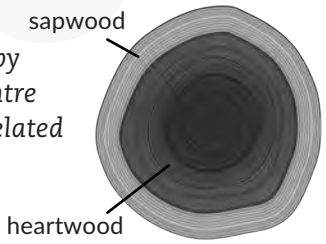
What clues can you gather about the size of the tree? Take measurements. Draw a labelled diagram of the stump and add your measurements.

Measuring the girth (circumference), just one of many measurements that can be done.

Challenge 2

Ringing in the clues

Find clues about the tree's age by counting tree rings from the centre outwards. Why are tree rings related to the tree's age?



Can you find the sapwood which is a lighter colour and towards the outside, and the heartwood which is towards the centre?

Incomplete tree rings

If you can't count all the tree rings, can you come up with an age range for your tree?

Tree bark

Does the bark thickness or texture give any clues about the age of the tree? How so?

Challenge 3

Forensics

What other information can you gather from the tree stump about the life and death of the tree? Look hard for evidence and make inferences.

Clues: Look for holes, soft spongy wood, splits, blackened bark, hollows in the trunk, etc.

INVESTIGATION

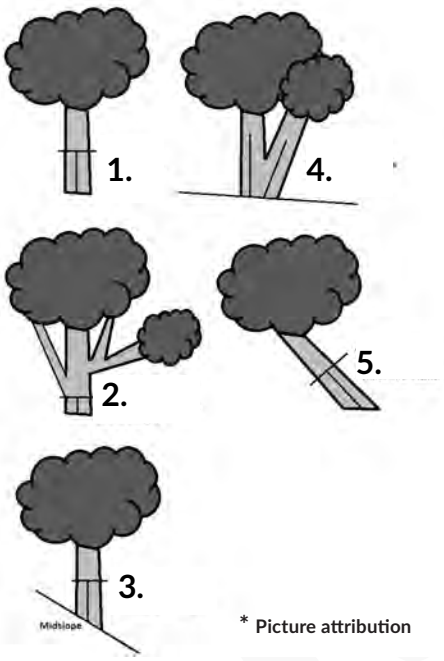
Measuring tree girths

WALT

- Understand the concept of tree girth.
- Use estimation, maths and simple tools to measure the girth of trees and compare their sizes.

What you will need:
(per group)

- ✭ *String (at least 10 metres long).*
- ✭ *Tape measure.*
- ✭ *Calculator (optional).*
- ✭ *Pencils and paper.*
- ✭ *Clipboards (optional).*
- ✭ *List of local tree species (optional).*



* Picture attribution

*** Measuring girths of different shaped trees:** 1. Measured 1.4m above ground level, 2. Measure below low branch, and note height, 3. Measure at mid-slope, 4. Measure at 1.4m and note two trunks, 5. Measure at 1.4m along side of trunk from centre.

Extension

Research the girth of some of the biggest trees on Earth, including New Zealand's biggest. Compare these with the trees you measured.

What to do

Engage

1. **Tree hunt:** Head outdoors to the school grounds, a park, a nature trail, or even your backyard where there are different types of trees.

Explore

2. **String detectives:** Work in pairs to measure the girth of a chosen tree. Wrap the string (or tape measure) around the trunk of the tree, at 1.4 metres above ground level. Mark the spot where the string meets itself.

Explain

3. **Maths mission:** Carefully remove the string and lay it flat along the ground. Use a tape measure (if available) to measure the length of string (in centimetres) that circled the tree trunk. This is the tree's girth!
4. **Estimation station:** If you don't have a tape measure, don't worry! Use your estimation skills. Compare the length of the string to your own arm span, hand width, or a familiar object like a pen. Record your estimated measurement.

Elaborate

5. **Treasure chest of data:** Using the same method of measurement, repeat steps 2–4 for several different trees in your chosen area. Record the type of tree (if you can identify it) and its measured or estimated girth on a data sheet.

Questions and discussion

Evaluate

1. Did you notice any differences in the girth of the trees you measured?
2. How do you think tree girth might be related to a tree's age or health?
3. Can you estimate the **diameter** of the tree trunk by using the girth measurement (diameter = girth ÷ π)? (π, or pi, is a mathematical constant roughly equal to 3.14).
4. Combine your tree data with some other groups and create a bar graph comparing the girths of different trees.
5. Discuss the role of trees in the environment and the importance of data collection.

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CHALLENGE

Cracking the code of tree shapes

WALT

- *Classify trees based on their shapes.*
- *Develop observation skills and learn about different tree growth habits.*

What you will need:
(per group)

- ✭ *Pencils and paper.*
- ✭ *Sheet showing examples of tree shapes.*
- ✭ *Camera.*

Setting the scene

We'll become junior tree detectives! To do this we'll explore a park or green area and observe the different shapes of trees. Imagine these shapes are like clues that help us group and classify the trees.

Bushy-topped

Sky-pointer

Cup-shaped (branches grow upwards)

Palm-like

The scientific name for the overall shape of a tree is called its '**habit**'. This describes the overall growth pattern of a tree including the shape of its crown, branching pattern and trunk form.

Challenge 1

Bushy-topped

Look for trees with crowns that look like big, fluffy balls. The branches spread out in all directions. Draw the ***outline*** *shape of any you find. Record their shapes as bushy-topped. Take photos.*

Sky-pointers

Find trees with crowns that rise up to a single point, like a tall triangle. These are 'sky-pointers', trees with narrow, pointed tops that reach towards the sky. Again, draw the ***outline*** *shape of any you find and label. Take photos.*

Challenge 2

Cup-shaped

See if you can spot a tree with an upright shape because all its branches grown upwards parallel to the trunk. Draw, label and take photos.

Palm-like

Look for trees and tree ferns with single, tall trunks and leaves or fronds clustered at the very top, a bit like a giant fan or palm tree. Draw, label and take photos.

Challenge 3

Mixed match mayhem

Can you find any trees that don't seem to fit into the four groups? These might be young trees still developing their shape, or tree types known for their unique shapes. Create new groups with fun names to classify these unique trees!

The big question

After classifying trees into groups, can you explain ***why*** *they might have different shapes? Research might be needed!*

INVESTIGATION

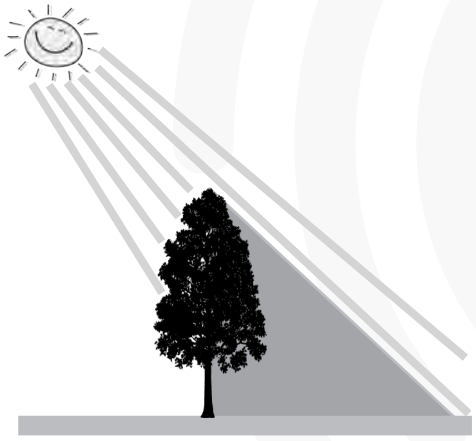
Measure tree heights

WALT

- Use simple tools and shadows to work out the heights of trees.
- Develop problem-solving and critical thinking skills.

What you will need:
(per group)

- ✭ *Metre ruler or tape measure.*
- ✭ *Pencils and paper.*
- ✭ *A calculator.*
- ✭ *Clipboards (optional).*
- ✭ *A sunny day! Examples of best times of the day are 9–10am or 2–3pm when shadows are longer.*



Triangle of shadow due to the tree blocking the sunlight.

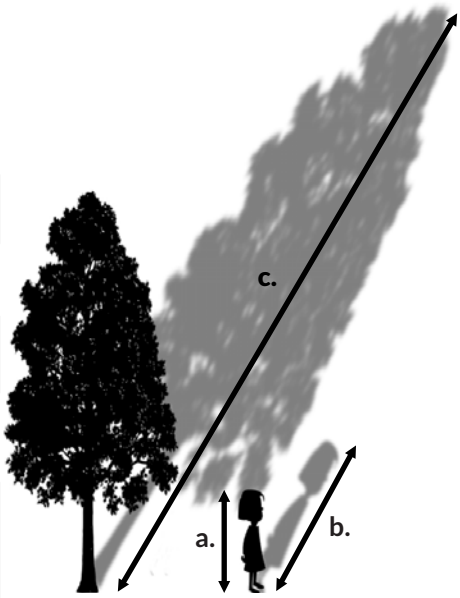
What to do

Engage

1. **Shadow seekers:** Head outdoors on a sunny day to an area with trees of varying heights.

Explore

2. **Standing tall:** Choose a tree to measure. It's easiest if the tree is standing alone, not close to other trees or buildings. Stand upright next to the tree, making sure you are both in full sunlight.
3. **Shadow show:** Have someone use the metre ruler to measure your height from head to toe. Record. Then, measure the length of the shadow cast by your body (from foot to head) on the ground. Record.



Three measurements are needed: a) your height, b) your shadow length, and c) the tree shadow length.

4. **The big tree measure (without climbing!):** Now, measure the length of the shadow made by the tree. Record.

Questions and discussion

Explain

1. Imagine the tree and its shadow form a giant triangle (diagram to left). Your body and your shadow also form a similar but smaller triangle! Discuss why the two triangles are similar.
2. Can you use the concept of similar triangles to figure out the height of the tree? Here's the trick:

   Write down the following proportion:

$$\frac{\text{Tree height}}{\text{Tree shadow length}} = \frac{\text{Your height}}{\text{Your shadow length}}$$

   The unknown value is tree height, so:

$$\text{Tree height} = \frac{\text{Tree shadow length x Your height}}{\text{Your shadow length}}$$

Elaborate

Find the tree height by plugging values into the formula. Repeat for other trees.

Going further

Work out the heights of several different trees using the same method. Compare their results and discuss what factors might affect the accuracy of the measurements (uneven ground, time of day, etc).

Evaluate

Extension

Research the use of clinometers, which are specialised tools for measuring angles and heights. Discuss how they work and compare them to the shadow method.

INVESTIGATION

Speedy sprouters

WALT

- Investigate how some trees, like willows and poplars, grow easily from cuttings.
- Observe root formation in different tree types.
- Explore the concept of invasive plants and their effect on the environment.

What you will need:
(per group)

- ✭ *Two drinking glasses or jars (transparent).*
- ✭ *Scissors or pruning shears (use with adult supervision).*
- ✭ *Fresh willow twigs (about 15 cm long). Here is an example of one collected in winter:*

- ✭ *Fresh poplar twigs (about 15 cm long).*
- ✭ *Water.*

Extension

Look up information on invasive plant species in your region. What are they like and what do they do?

Resource: Building Science Concepts: Bk 26 *Making New Plants* L3–4.

Engage Explore Explain Elaborate Evaluate

What to do

1. **Snip snip:** With adult supervision, carefully use scissors or pruning secateurs to cut a few willow twigs and a few poplar twigs from healthy trees. Choose twigs that are about the thickness of a pencil and have several nodes (little bumps where leaves grow).
2. **Label**: Label your jars or glasses with 'Willow' and 'Poplar'.
3. **Water:** Fill each jar or glass to about halfway with clean water.
4. **Into water:** Carefully insert the cut ends of the willow and poplar twigs into the water, making sure at least one node is submerged in each jar. The part closest to the original end of each stem needs to be facing upwards.
5. **Give it light:** Place your jars or glasses in a well-lit spot, but not in direct sunlight. Replace water every few days.

Willow cuttings after three weeks, showing root formation.

Going further
Once the cuttings have formed roots about 5cm long, try transplanting them into small pots with soil to see if they continue to grow.

Questions

1. After a week or two, do you see any changes to the bottom ends of the twigs?
2. Which type of twig, willow or poplar, seems to sprout roots faster? State your evidence.
3. Why do you think some trees, like willows and poplars, can grow easily from cuttings, while others might require seeds?

The big question

Why are many types of willows considered to be weeds in New Zealand?

Assessment rubric

Example assessment rubric

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

Rubric relating to: 'Observations'

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

In a nutshell

"Assessment measures learning"

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

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

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

EXHIBITS AND SHOWS

Exhibit Themes

Each year we have on display six different themed collections of exhibits available during your 70 minute programme. For 2025 these themes are shown below. To assist you in preparing for your visit, we've also developed a unit plan called *Trees, trees, trees / He Rākau, he rākau, he rākau* — found earlier in this booklet — that complements the *Trees and environment / Ngā rākau me te taiao* theme and the *Planet Earth / Whakaaturanga Papatūānuku* show. Past units on other themes can be found within pdf downloads of Resource Books at: https://scienceroadshow.nz/resources/ (click on *Resource Book Archive)*.

Applied science — Te pūtaiao whaipainga

Exhibit learning intentions relate to: scientific ideas that can be applied to practical situations and in solving real world challenges and problems.

Contexts — Applied science, Problem solving, Challenges.
Localised curriculum ideas — Local professionals where science is applied to their work, such as electricians, arborists and foresters, medical (doctors, nurses, surgeons, radiographers), engineers. Physics of playground equipment.

Detecting — Te tautohu

Exhibit learning intentions relate to: how instruments can be used to collect data and how they can detect things beyond our own senses and with greater accuracy than we can simply estimate.

Contexts — All science contexts.
Localised curriculum ideas — Related local professions: the Trades (e.g. builders using laser levels), recent earthquakes, local weather stations, flood detection on local rivers.

Forces — Ngā tōpana

Exhibit learning intentions relate to: forces and motion, gravity, friction, pressure, circular forces, electrostatic forces, venturi effect.

Contexts — Forces and Motion, Pushes and Pulls.
Resources — Building Science Concepts: BK 42 Marbles L3–4.
House of Science kit(s): May the Force be With You.
Localised curriculum ideas— Forces involved in sports, such as collision impacts (e.g. in rugby). Local structures designed to resist wind, water or earthquakes. Forces associated with a playground flying fox or other playground equipment.

Patterns — He tauira

Exhibit learning intentions relating to patterns seen in different phenomena: a beating heart, symmetry, earthquakes, reflection, waves, the seasons and more.

Contexts — All science contexts.
Localised curriculum ideas — Where we see patterns in nature, such as the tides, weather, temperature. Who monitors and predicts patterns and trends in our local community, e.g. fishermen, forecasters, farmers.

Structures — He hanganga

Exhibit learning intentions relate to: structural components, creating structural stability, form and function, forces within structures, design.

Contexts — Forces, Gravity, Problem solving
Localised curriculum ideas — Structural elements used in local buildings, bridges, dams, towers, stadiums. Talks from builders or structural engineers. Interesting house designs.

Trees and environment — Ngā rākau me te taiao

Exhibit learning intentions relate to: tree age, height and growth, great trees, photosynthesis and carbon absorption, sea life, seasons, pollution and the environment.

Contexts — A sustainable environment, Environment and pollution, Trees and the environment.
Resource: House of Science Kit — Climate Change / Huringa Āhuarangi.
Localised curriculum ideas — Finding significant local trees, caring for trees in the school ground, cleaning up a local reserve, measuring and documenting local trees, learning about local habitats, talks from DOC rangers.

Shows

While being exciting and entertaining, our shows provide a great opportunity to enhance student knowledge and understanding in two science areas each year. The shows for 2025 are as follows.

Planet Earth show — Whakaaturanga Papatūānuku

This show demonstrates how matter cycles through Earth's systems, while energy flows, with specific learning outcomes relating to the following:

- the nature of matter and the energy it possesses.
- how water and carbon both cycle around, passing from place to place and organism to organism
- how the carbon dioxide from burning fossil fuels impacts on Earth's atmosphere, causing global warming and extreme and weather patterns
- how energy flows from place to place and through organisms, finally ending up as heat that passes into space
- how trees, soil, wetlands and oceans can trap carbon thereby reducing the amount of carbon dioxide in the atmosphere.

Balloons and Bernoulli — Ngā puangi me Bernoulli

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

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

Shows — Learning Outcomes

After attending shows students will have increased:

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

Key References for Exhibit Themes and Shows

Science kits: House of Science https://houseofscience.nz/science-kits
School Journal and Connected series: https://journalsurf.co.nz/

Answers to pages 4–15

Applied science word scramble *page 4*

Unscrambled words: medicine, computer, telescope, satellite, plastic, refrigerator, telephone, microscope, battery, hospital, spaceship, submarine, photography. Applied science uses science ideas for real uses.

Detecting things *page 5*

Answers and examples of practical uses: 1) Microscope — already given, 2) Infrared thermometer — measure temperature of disc brakes in a car, 3) Night vision goggles — find a missing person in the dark, 4) Telescope — view the moon's surface, 5) Metal detector, — find lost coins in beach sand, 6) Ultrasound machine — view a developing baby in the womb, 7) X-ray machine — locate decay in teeth, 8) Satellite — track a hurricane's movement, 9) Stethoscope — listen to a patient's heart beat, 10) Mass spectrometer — find what chemicals are present in an unknown drug.

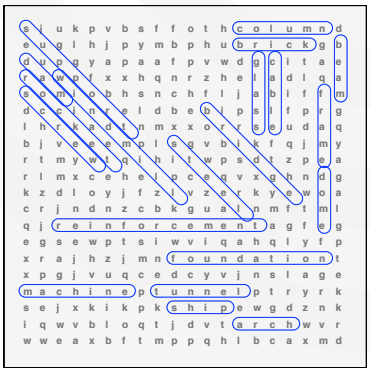
Forces: brain teasers *page 6*

Bike: Friction between the brake pads and the wheels creates a force that opposes your forward movement. **Swing:** Gravity pulling you down and the tension in the swing chains pulling you upwards in an arc. **Balloon:** As the air rushes out of the balloon, it creates an equal and opposite force that pushes the balloon in the other direction. **Tug-of-war:** The rope stays still because the forces cancel each other out. **Book:** The force from the table pushes up against the books, counteracting gravity which pulls them down. **Bouncy ball:** gravity. **Magnetic:** The closer magnets are, the stronger the pull.

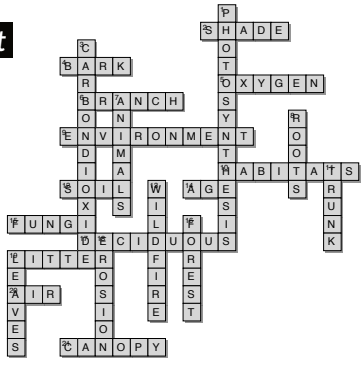
Number pattern puzzlers *page 7*

The plant problem: 1) add all the heights and divide by the number of sprouts: so, 2.5 cm divided by 5 = 0.5 cm. 2) 60 cm divided by 5 = 12.0 cm. Yes, most sprouts grew to around 12.0 cm, with some slight variations. 3) Examples: 'Does the number of beans planted affect their growth rate?', or, 'How much do bean sprouts typically grow after their third week?' **Bouncy ball challenge:** 1) Ball A: 28 cm, Ball B: 43 cm, Ball C: 18 cm, Ball D: 21 cm). 2) Yes, each ball loses a little height with each bounce, and, the loss of height is at a steady rate. 3) The ball's hardness, softness and/or elasticity.

Structures: word search *page 8*



Trees and the environment *page 9*



The dancing peas mystery *page 10*

Q1. They likely sank towards the bottom. **Q2.** They floated higher up in the solution. **Q3.** The sugary water is heavier (more dense), so the lighter peas float upwards. **Discussion: Density** is how much mass (stuff) is packed into a certain volume (space). Sugary water is denser than plain water because it has more 'stuff' (sugar) packed into the same amount of space. **Buoyancy** is the ability of an object to float in a liquid. Less dense objects tend to float in denser liquids, while denser objects sink in less dense liquids. **Density is important:** Ships can float safely because they are designed to be less dense than water. Hot air balloons rise because the heated air inside is less dense than the cooler air outside. Oil spills are less dense than water and float on top, making them spread in all directions.

Invisible ink mystery! *page 11*

Q1. Lemon juice is clear and dries clear, leaving no visible mark on the paper. **Q2.** The heat causes the organic compounds in the lemon juice, like sugars and acids, to react with oxygen in the air. This reaction, called oxidation, turns those compounds brown. **Discussion: 1.** A telescope magnifies far away objects, a microscope magnifies close-up objects, night scopes allow us to see people and animals at night when it is almost completely dark.

The great ramp race! *page 12*

Challenge 1. It will be an intermediate height — too steep and the car will smack into the ground and bounce or flip, but too low and the car won't pick up much speed. **Fair tests:** Keep everything the same (the car, the length of ramp, the floor surface, etc.) and to make comparisons only change the steepness of the ramp. Best to perform (say) 3–10 test runs at each steepness setting, and find the averages. **Challenge 2.** Similarly, it will be an intermediate length. Too short and the ramp will be too steep. Too long and there will be a lot of friction against the ramp surface so the car won't speed up much. **Challenge 3.** Ideas and outcomes will vary.

Best bird feeder *page 13*

Challenge 1. Observe carefully. Record numbers of birds at set time intervals, e.g. every 15 minutes. Record in data tables showing numbers of birds at a given feeder at each time interval. On average, are there more of one type of bird at a given feeder? Use 'slow mo' on a camera to observe fights. **Challenge 2.** Hint: Set up three identical feeders with different foods in them. Count the sparrows at each feeder (say) every 15 minutes. **Challenge 3.** Hint: Use three different types of feeders, each with the same types of food. Answers and reasoning will vary.

The great straw skyscraper *page 14*

Q1. The tower would be much stronger and more stable. Horizontal beams form platforms that achieve width (which make it harder to tip over), vertical ones form pillars that achieve height, while adding diagonal struts form triangular structures that are very strong and rigid, thus making it possible to achieve greater height and load-bearing capabilities. **Q2.** Eiffel Tower, Auckland Harbour Bridge, power pylons.

Trees versus temperature *page 15*

Challenge 2. On average it can be 2–5 degrees cooler under trees than in the open. **Challenge 3.** A tree canopy blocks a lot of the heat from sun rays, so your skin is cooler. Also the ground and other objects under the tree are cooler resulting in less reflected heat. If there is a patch of trees, the moisture they release can have an additional cooling effect.

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- Learn how to target all types of learners by developing practical investigations that will stimulate all the senses.
- Introduce more science to other areas of your teaching.
- Unit selection and planning.
- Investigate the cultural differences in learning styles and how teaching can be adapted to meet the needs of all learners.
- Discover that you don't need to be an expert in science to teach science well.
- Being a Science Champion within your school or area and inspiring science learning in all classrooms.

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