SCIENCE ROADSHOW 26

RESOURCE BOOK

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Te Tāhuhu o te Mātauranga
Ministry of Education

Science ROADSHOW

CONTENTS

This resource contains language-based puzzles and hands-on activities that relate to the exhibit themes in the Science Roadshow's 2026 programme.

For answers and possible outcomes to all puzzles, investigations, and challenges — see pages 23 and 24.

PUZZLES:

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.

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.

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.

Local Curriculum

Suggestions have 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 Learning Hub- Pokapū Akoranga Pūtaiao

Makes New Zealand science, technology and engineering more visible and accessible. It has over 11,500 resources showcasing cutting edge science and demonstrates how the stories of science can be used to enrich school teaching and learning, making it more relevant, engaging and meaningful. They have put together a collection of resources to support this year's Science Roadshow at https://www.sciencelearn.org.nz/

Science kits to support science education

House of Science has a range of hands-on science kits available for science teaching. 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/.

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.

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FOR THE TEACHER

Abbreviations used throughout this booklet:

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

WILF = What I'm Looking For

TIB = This is Because

Investigation	Engagement activities ("hooks")	WILFs and TIBs	Resources
Hand-eye Co-ordination	Discuss why sight is important. How do we measure how good our sight is? Why is it important to be able to distinguish two different types of food, e.g. fruits?	**WILF:** An appreciation of the importance of developing eye-hand coordination for daily tasks, academic success, sports... PLUS improved motor skills, reaction time and problem solving abilities. **TIB:** the body must learn/practice the synchronisation of visual and motor skills.	See page 6
Fair Test – hot water solar heater	Bill comparison between home with water solar heater and another without. Different colours of clothing from around the world, especially dark vs light colours.	**WILF:** A construction that will allow water to circulate from the bottle and through the solar heater creating a comparative temperature difference. Recognition of things that must be done to have a fair test. **TIB**: The tubes heat up transferring heat energy to the water inside, setting up a convection current so the reservoir gets progressively warmer.	HoS What do you think? / He aha ō whakaaro? HoS Hot Stuff / Te Wera Hoki
Phases of the Moon	Display luna and tidal charts. https://lovelearningtpt.org/how-to-teach-moon-phases/	**WILF:** An appreciation of a model that allows an exploration of observable phenomena (Moon phase) and the effect on Earth. Patterns and predictions. **TIB:** The Moon reflects light; it is always half lit by the sun and as it orbits the Earth our view of the sunlit and dark sides changes (phases).	HoS: Spaced Out / Ki Tuarangi
Circular-winged glider	Watch You tube clips of gliding objects from nature and human made.	**WILF:** A construction that will be stable and smooth in flight. This success will enable measurements to be more easily made and reinforce basic ideas of motion. **TIB:** Unbalanced forces result in a change in motion (overcoming inertia)	See page 15
Pūrerehua	Discussion on how to create sound in musical instruments, cultural uses.	**WILF:** The building of a functioning pūrerehura and a series of student observations that that leads to a determination of how it works/makes a sound. **TIB:** The movement downwards and upwards as it is swung around the head creates the sound. The cord winds and unwinds and the blade spins. Faster swinging the louder the sound...	See page 16
How good is your eyesight?	Watch a YouTube video on human eyesight or that of another animal(s)	**WILF:** 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? **TIB:** Parts of our eyes register objects differently (eye structure)	HoS: Super Sense / Nongo Nui
Ames window	Viewing a range of optical illusions. Discuss how the brain receives and processes information from the eyes (and other senses); it learns patterns and makes assumptions (and or misinterpretations) when faced with conflicting data – hence a perception that doesn't match reality (the illusion).	**WILF:** Creation of an Ames window and the illusion it creates. **TIBs:** This is an optical illusion where a trapezoid object appears to be a rectangular when oscillating back and forth. The illusion exploits the brain's strong assumption that windows are rectangular.	See page 19
Measuring Density	Place different objects in water and see if they float or sink. Discuss buoyancy	**WILF:** Students will discover that the difference in density between the object and water will determine if the object sinks. **TIB:** Gravity pulls things down more strongly on denser objects causing them to sink and displace water upwards.	HoS: Float my Boat / Te Whakamānu i Taku Poti

THEMES & SHOWS

Exhibit Themes
Each year we have on display six different themed collections of exhibits available during your 70 minute programme. For 2026 these themes are:

Human Performance

Exhibit learning intentions relate to: muscle strength; sense of hearing, smell and balance; hand-eye coordination; reaction speed.

Contexts: Human performance, My body, The human body.

Localised curriculum ideas: being aware of our immediate environment.

Fair tests

Exhibit learning intentions relate to: careful observations, comparisons, controls and objectivity that are required to conduct a fair test.

Contexts: All science contexts.

Localised curriculum ideas: e.g. Cooking and baking, plant growth, fertiliser types and application.

Astronomy

Exhibit learning intentions relate to: space; stars and constellations; the moon and sun; seasons; weather.

Contexts: Astronomy, Space, Weather, Seasons Online searching — use terms listed herein.

Localised curriculum ideas: Local weather patterns, horticulture microclimates, ides at local beach, local stories about constellations, planetarium visit, historical storms, school weather station, seasonal changes in the garden.

Movement

Exhibit learning intentions relate to: forces; rockets; rotation; friction; magnetic forces; the behaviour of pendula; balance; speed and movement; and, types of wheels.

Contexts: Forces and motion.

Localised curriculum ideas: different forms of motion seen in sports eg. Sprinters, javelin throwers, swimmers... Flight of birds and planes, different types of wheels on cars.

Sight and Illusion

Exhibit learning intentions relate to: visual learning behaviour; binocular vision; blind spot detection; visual illusions and tricks; virtual images; the brain's interpretation of visual messages; 3-D perception; and, persistence of vision.

Contexts: Our senses.

Localised curriculum ideas: clarity and design of road signs, black ice, mirages.

Using Numbers

Exhibit learning intentions relate to: calculating and quantifying observations to enable comparisons.

Contexts: All science contexts. House of Science Kit — Measurement Matters / Te Whakahirahira o te Inenga.

Localised curriculum ideas: situations where calculation allows comparisons weather, weights and measures, paying for what you get.

Shows
While being exciting and entertaining, our shows provide a great opportunity to enhance student knowledge in two science areas each year. The shows for 2026 are as follows.

Kitchen Chemistry — Te pūtaiao ā-kihini

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

- density of liquids
- the refractive index of liquids
- acid–base indicator substances
- how bleaches destroy pigments
- acid–base neutralisation
- coagulation of proteins
- molecular weight and viscosity
- CO^2 release in reactions.

Related science kits: House of Science* *Sweet & Sour, Food for Thought, Float my Boat.*
Key School Journal References: *Grow your own crystals* Article 5 1982 Pt 01 No. 4 Pgs 28-29 SOUTHGATE, Brent; *Hokey-pokey* Article 1998 Pt CN No. 3 Pg 28 YOCUM, Eva; *Tricky science* Article 5 1997 Pt 01 No. 3 Pgs 18-20 ANDERSON, K. E.; *Windows made of water* Article 4 1982 Pt 01 No. 2 Pgs 24-25 SOUTHGATE, Brent. *Fast rust*, WALL, Bronwen, Article Year 5, Connected No. 03, 2013, pp14-17.
Key 'Building Science Concepts' references: Book 14 *Making porridge: Conducting Heat and Cooking Food.* Book 23 *Fresh food: How food keeps and loses its freshness.* Book 24 *Preserving food: Processes in food storage.* Book 56 *Bread: The chemistry of breadmaking.* Book 57 *Eggs: Mixing, beating, crushing and heating.* Book 58 *Ice: Melting and freezing.*

Am I Living? — Kei te Ora Ahau?

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.

Key School Journal References: *Bendy bones* Article 2000 Pt CN No. 3 Pgs 20-21, VAUGHAN, Marcia. *Blood in the bank* Article 6 1987 Pt 04 No. 1 Pgs 20-24, KEIR, Bill. *Bones on the mend* Article 3 2001 Pt JJ No. 23 Pgs 6-12, GOULD, Margaret. *Filling a tooth* Article 4 1983 Pt 02 No. 3 Pgs 9-15, THOMSON, Jane. *Mighty muscles* Article 5 2011 Pt 01 No. 2 26-31, GIBBISON, Sue. *Sleep tight* Article 4 2001 Pt 02 No. 1 Pgs 20-23, HILL, David. Small Article 4 1996 Pt 03 No. 3 Pgs 24-27, BUXTON, Jane. *What do you see?* Article 1998 Pt CN No. 1 Pgs 12-13, BOWES, Clare.
Key 'Building Science Concepts' references: Book 4 *Animal Life Histories: Reproduction, Growth, and Change* L1-4. Book 3 *Birds: Structure, Function, and Adaptation* L1-4. Book 51 *Standing Up: Skeletons and Frameworks* L1-2. Book 39 *Is This an Animal?: Introducing the Animal Kingdom* L1-4. Book 55 *Mammals: Investigating a Group of Animals* L3-4. Book 45 *Slugs and Snails: Investigating Small Animals* L1-4. Book 6 *Soil Animals: Diversity beneath* Our Feet L3-4.

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.

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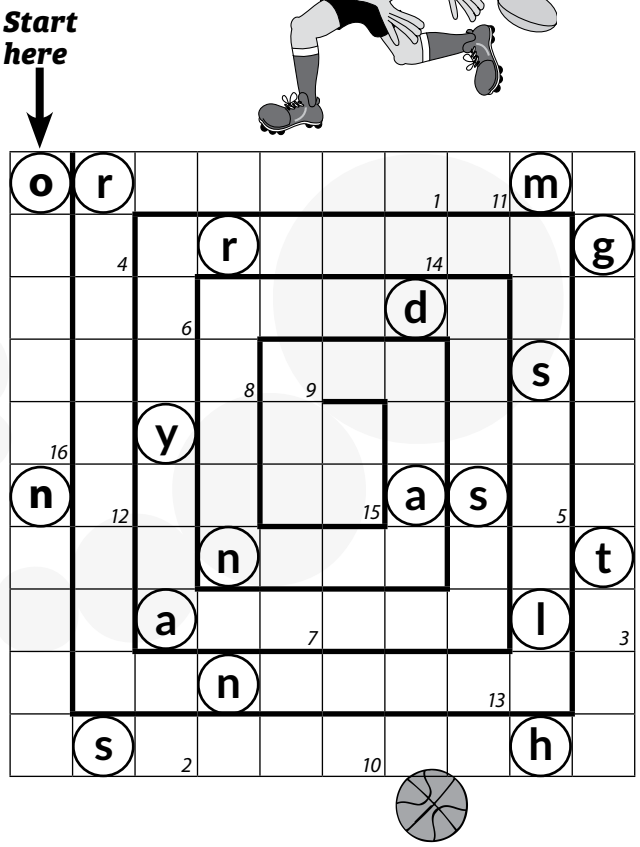
SCIENCE VOCABULARY PUZZLE

Fitness wins!

Find your way to the centre of the maze by filling in the answers to the clues. Every answer uses the last letter of the previous word as its first letter, so the words form a chain. The *circled* letters are the start and finish letters of words.
Once complete, the *numbered* squares are clues for spelling out two mystery words that describe what you gain when you become physically fit. One letter clue is given.

Clues

- We breathe this in.
- These pass messages to our brain.
- Muscle builders train to build _____.
- Pumps blood around our body.
- With exercise we build muscle t....n....g.
- Where we might go to exercise.
- When a person has large muscles they are said to be m.....r.
- Breathing in and out.
- A popular winter sport played mainly by females.
- Used to collect oxygen from the air.
- In athletics, a very faster runner.
- A popular winter sport played mainly by males.
- An activity that improves flexibility, breath control and posture.
- These carry blood away from the heart.
- Sprinters need this. The same as velocity.
- A race involving two events, such as running and cycling.
- A person skilled in ninjutsu.
- The sport of competing in track and field events.



Mystery words:

When you become fit, you gain...

1	2	3	4	5	6	7	8

and

9	10	d	11	12	13	14	15	16

Key School Journal References:
Don't Sit if You Want to Keep Fit, PITCHES, Neale, Article, CN, L4, 2015.
Why Do Our Muscles Get Tired, ARMSTRONG, Dave, Article, CN, L2 2015.

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INVESTIGATION

Hand-eye co-ordination

What you will need:
(per group)

- *A ping-pong ball.*
- *Access to a flat, hard floor.*

WALT

- *Explore how factors like practice, illumination, age, and object size affect eye-hand coordination.*

What to do

1. Stand on a hard, flat floor. Now bounce the ping–pong ball from your writing hand, catching it in your non-writing hand. Repeat 100 times, counting the number of times it is dropped.
2. Repeat step 1. above, but reverse the direction, bouncing the ball to your writing hand.
3. Repeat step 1. above, but with one eye closed.
4. Repeat step 1. above, but in lower light conditions, e.g. with the room's lights off.
5. Investigate some other factors that might affect the outcome, e.g. the age of the person, the sex of the person, catching the ball in only three fingers (thumb, index and middle fingers).
6. Show your results in a bar graph.

Person bouncing a ball and catching it with other hand.

Questions

1. Why do you think this activity is called an example of hand–eye co-ordination?
2. Which hand is best at catching? Why?
3. Is it easier to catch the ball when using one or two eyes? Why?
4. How do low light conditions affect the outcome? Why?
5. Describe the other factors you investigated and what you found.

Extension

Describe the steps your body must take in order to catch a ball. (Hint: use terms like eyes, brain, nerves, muscles, move, distance, judge, etc.)

Key School Journal References:
Goal shooting TAUMAUNU, Waimarama Article 9.5-10.5 04 No. 1 1990, *Jiani* TRAFFORD, Jan Article 8-9 02 No. 3 2000, *Mighty muscles* GIBBISON, Sue Article 9-10 01 No. 2 2011.

CHALLENGE

Smell testing

WALT

- *Make observations and inferences relating to smell.*

What you will need:
(per group)

- ✭ *Small non-see-through containers. Film canisters like this are ideal.*
- ✭ *Aluminium foil.*
- ✭ *Rubber bands.*
- ✭ *Substances to smell, e.g. orange peel, cotton wool soaked in perfume, banana, pine needles, chocolate, coffee, soil, cotton wool soaked in vanilla essence, garlic, malt vinegar, rose petals, manuka sawdust, ginger, peppermint, pencil shavings, potato chips, Brussels sprouts. Warning, **not peanuts!***

Setting the scene

Our sense of smell is important for our survival. It helps us to detect things that will help us, e.g. what is safe to eat like fresh fruit; and what things might harm us, e.g. decaying fish.

Place a substance to smell in a container then place aluminium foil over the top and hold it in place with a rubber band. Make some small holes in the foil. Or, if your containers have lids that you can't see through, make holes directly in them.

Ask someone to smell the top of the container. Can they ***describe*** the smell? Can they ***name*** what they are smelling?

Challenge 1

Make a collection of smells

*Place five or six 'smelly' substances in different containers and cover each with foil held in place with rubber bands. **Warning**: Make sure you only use safe substances and because of allergies, do NOT use peanuts. How will you keep track of what is in each container?*

Test your own smelling ability

Mix the containers up so you can't tell what is inside each. Smell each container and record what you think is inside. Don't check them till you have completed the lot. Find a way of marking (or rating) yourself on your ability to name the smells correctly.

Challenge 2

Testing another person

Test other people with the same collection of smells you used above, again starting with them mixed up. Don't even tell them the selection of smells they are being tested on. Mark or rate them using the same method you used above. Also record the smells they like and dislike.

Making sure it's a fair test

*Before you test other people with your set of smells, how are you going to make sure your test is **fair**? That is, how do you ensure the only thing that changes from one test to the next is the person being tested?*

Challenge 3

How many smells can we recognise?

Make a bigger smell collection and find a way of testing how many different smells a person can detect correctly. Collect data from lots of people to get an average.

Dogs favour their sense of smell. Why?

About smell

Find out about how we smell things. Also, find out about how the human sense of smell compares with other animals like dogs, cats and budgies.

Key School Journal References:
Super Senses COMESKEY, Matt Article 4 Connected L2 2014. *Mahina-arangi's perfume* PIRIPI, Rawiri Story Connected 3 2002. *Mmm, That's Tasty!* GARDNER, Neville Article 6 Level 3 Jun 2012.

SCIENCE VOCABULARY **PUZZLE**

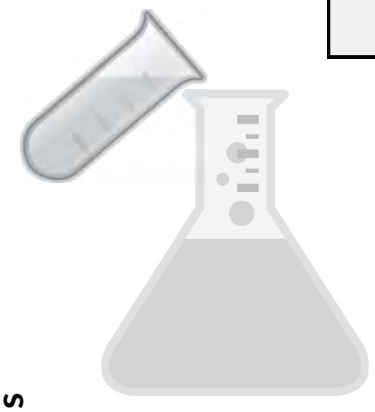
Fair testing

There are 22 hidden words in the grid below, but 24 are given in the word list. Can you identify the two ***extra*** words? Words in the grid can be found diagonally, vertically and horizontally, and some words may be reversed.

Word list

COMMUNICATION
METHOD
DEPENDENT
MEASUREMENT
TENTATIVE
CREATIVE
OBSERVATION
TEST
DATUM
CRITIQUING
CONTROL
INDEPENDENT
VARIABLE
CONCLUSION
PREDICTION
INVESTIGATION
PROCEDURE
ABSTRACT
REPLICATE
INTERPRET
RESEARCH
HYPOTHESIS
EXPERIMENTATION
THEORY

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



Extra words _____

_____

Extension

Here are some extra words about 'fair testing'. Can you create your own word search using all these words? HINTS: 1) Use graph paper and a pencil. 2) Try and overlap the words.

INVESTIGATE, MEASURE, EXPERIMENT, COMPARISON, DATA, PREDICT, QUESTION, FAIR, TEST, AIM, TRIALS, OBSERVE, RESULTS, CRITIQUE, EVIDENCE.

INVESTIGATION

Fair test — water solar heater

What you will need:
(per group)

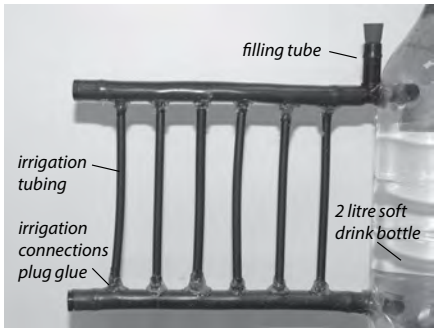
- ✭ *Two 2 litre soft drink bottles or similar. They must be the same.*
- ✭ *1 metre of plastic tubing (about 5–10 mm in diameter). A good type is used for home irrigation systems. This has fittings that help when connecting everything up.*
- ✭ *Hot glue gun.*
- ✭ *A drill or sharp point.*
- ✭ *Thermometer.*
- ✭ *Water.*

WALT

- *Build and test a solar water heater.*
- *Understand how fair testing allows comparison.*

What to do

1. Make one hole near the top and one hole near the bottom of a 2 litre soft drink bottle.
2. Make up your solar panel by measuring, cutting and gluing tubes (or use bought connectors) together as shown to the right. Notice the filling tube at the top. This allows you to fill the tubes up with water so there will be no air-locks.



3. Glue the solar heater to your bottle.
4. Fill the bottle and solar heater with water, making sure there are not air bubbles in the solar panel tubes.
5. Fill up the other bottle to the same level, and place both in the sun (see lower picture).

6. Measure the temperature of the water in each bottle, pushing the thermometer into the water to the same level in each case, then put the lids on.
7. Measure the water temperature every half hour over two or three hours of strong sunshine.

Questions

1. Graph the water temperature in each bottle against time.
2. Which bottle increased in temperature the most?
3. Draw a picture to show how the solar heater worked. Add arrows to show the direction of water flow.
4. What is the water flow in the solar heater called?
5. List at least three things you did or used to make sure you were doing a fair test.

Extension

6. Investigate solar water heaters on the Internet. How effective are they in New Zealand? How much do they save on power bills?

Key resources from Learning Media: Building Science Concepts Book 29, *Solar Energy,* L2-4. Book 36, *Heat on the Move,* L3-4.

Key School Journal References: Power for Pukapuka, Maureen Goodwin, Article, Part CN, No. 1, 2000

CHALLENGE

Paper towels — how absorbent?

WALT

- *Gather an interpret data on paper towel absorbency.*
- *Use evidence to support which paper towel is the most absorbent.*

What you will need:

(per group)

- ✭ *Two different brands of paper towels (2–3 sheets of each).*
- ✭ *A small funnel.*
- ✭ *Two test tubes or small containers.*
- ✭ *A measuring cylinder (optional).*

Setting the scene

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

Paper towel.

Also, a better buy might be one that has more sheets per roll or costs less for the amount of water it holds. Science can help us to make decisions about all these things.

Challenge 1

How do we collect data?

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

Squeezing the water from a paper towel into a funnel that feeds into a test tube.

Challenge 2

Which brand is best?

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

Using evidence

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

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

Challenge 3

Comparing with other types of paper

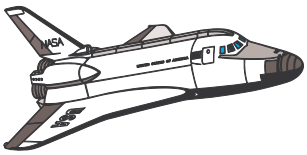
Find a way of ***comparing*** *how good toilet paper and paper towels are at soaking up water. Try other types of paper too.*

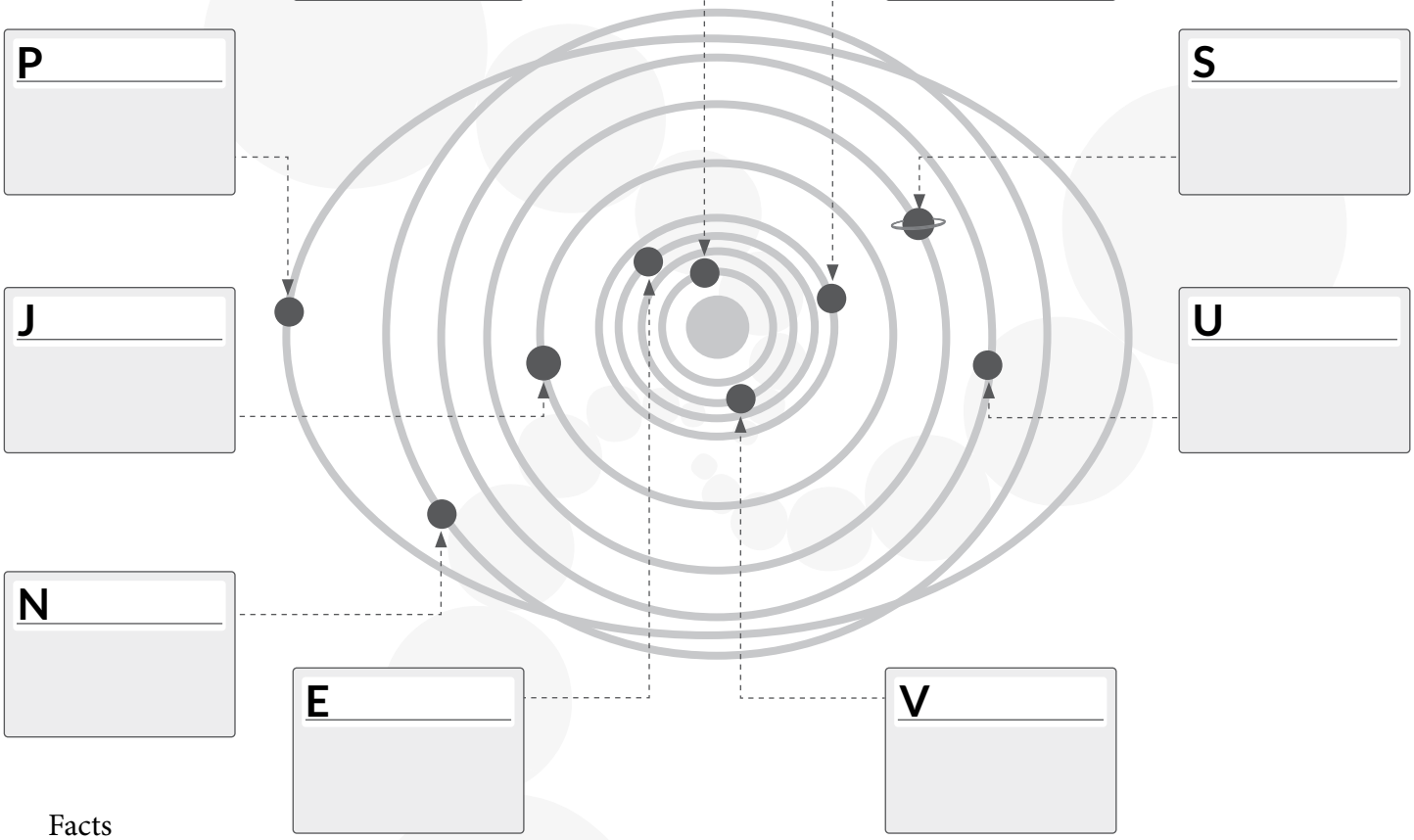
In what ways do paper towels and toilet paper need to be different? Can you find evidence for them looking and behaving differently? Share your ideas with others.

Key School Journal References:
Investigating Insulation, HINCHCO, Selena, Article, Connected, 01, 2010.
Pseudoscience, FERN, Sophie, Article, CN, L3, 2015.

Solar system puzzle

Use your research skills to: (a) label the planets and (b) add each of the facts below to the correct planet.





Facts

1. Closest to Sun.
2. Biggest planet.
3. Smallest planet.
4. Hottest planet.
5. Coldest planet.
6. Least dense planet.
7. Planet with strongest gravity.
8. Planet with longest ‘day’.
9. Planet with shortest ‘day’.
10. Planet with temperature closest to Earth’s temperature.

Key School Journal References:
No Sun, BROWN, James, Poem, L3, May, 2016.
The Problem with Pluto, HILL, David, Article, L3, Feb, 2012.
Becoming a Martian, KNIGHTON, Clare, Article, L3, May, 2017.

INVESTIGATION

Phases of the moon

What you will need:
(per group)

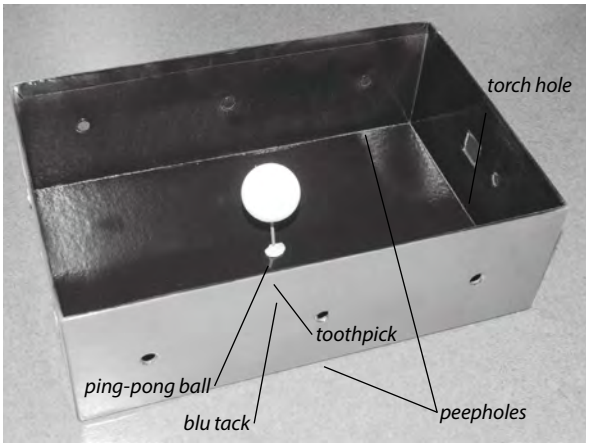
- A shoebox.
- Black paint.
- Scissors or craft knife.
- A torch.
- A small ball, e.g. a ping-pong or golf ball.
- A toothpick.
- Blu tack.

WALT

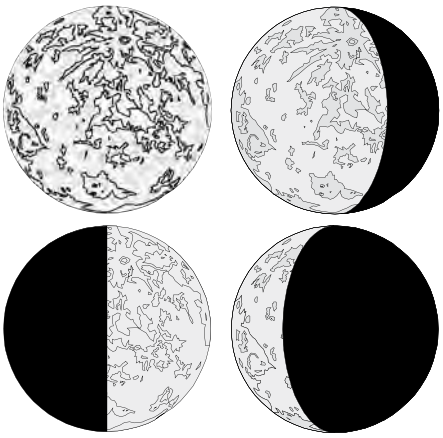
- *Build a model to investigate phases of the moon and why these occur.*

What to do

1. Paint the inside of the shoebox black.
2. Cut small peepholes through the sides of the shoebox as shown to the right. Also, cut a hole in one end of the box and position the torch so it can shine the length of the box.
3. Mount the ball in the middle of the box on a toothpick using blu-tack (see diagram). Place the lid on the box.
4. Look at the small ball (representing the moon) through one of the peepholes. Draw the part of the ball that is lit up by the torchlight. (A compass or a bottle lid may help you to draw neat circles.) Repeat for each of the holes.



Shoebox set-up. Note, there are three peepholes along each long side of the box, and one in each end.



Questions

1. What does the ball inside the box represent?
2. What does the torch represent?
3. When you are looking through the peepholes, where are you 'looking from'?
4. From which direction do you see: a full moon; a half moon; a new moon; a crescent moon; and, a gibbous moon? (Hint, you may need to Google these names to find out what they mean.)
5. Find out about how the phases of the moon affect the tides on Earth. What are 'spring tides' and what are 'neap tides'?

Extension

Find out about 'Earth tides' What causes them?

Key resources from Learning Media:
Building Science Concepts, Book 8, *The Moon,* L3-4.
Book 20, *Our Star, Our Sun,* L1-2.
Book 28, *Night Sky,* L3-4.

Key School Journal References:
The Moon Illusion, KEIR, Bill, Article CN No. 3 1999.
Night Light, HILL, David, Article, L2, May 2016
Why is the Moon Upside Down? PUHARICH, Trish, Article, Connected, 03, 2013.

CHALLENGE

Astroblaster

WALT

- *Gather and interpret data from a collision.*

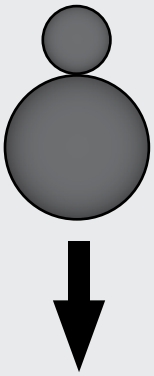
What you will need:
(per group)

- ✯ *Several different types and sizes of round balls — soccer, rubber, plastic, ping pong, super balls, etc.*
- ✯ *A 1 meter ruler.*

Setting the scene

Try this:

Hold two balls so they are touching, one above the other. The top ball should be smaller than the lower one. Let them fall together onto concrete or a hard floor from about one metre. This needs practice. What happens to them when they hit the ground?



Two balls falling together, one on top of the other.

Practice this so you get the larger ball hitting the ground with the smaller one 'piggy-backing' it. Something quite unexpected happens.....! This could be like an asteroid hitting a planet and breaking apart on impact....!

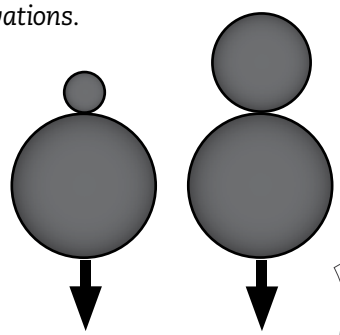
Challenge 1

Make close observations

If the balls successfully hit the ground one on top of the other, what happens from the moment they are dropped to when they stop? Use all your senses to make your observations.

What happens with different combinations of ball sizes (see to right)?

What happens if the top one is slightly to one side when they reach the ground?



Challenge 2

Gather data

Chose one combination of balls. How high does the top ball rebound upwards? Decide on a way to measure this. Does it always rebound the same distance? Can you find an average?

If the same two balls are dropped one at a time, how high do they each bounce? Can you find an average for each?

Challenge 3

Use your data as evidence

Where did all the energy go to from the two balls falling to the ground?

Use your evidence as a model for a real situation

Imagine if the two balls were in fact ONE asteroid that hit a planet and broke up to form two chunks (= the two separate balls). Use your evidence to describe what might happen as a result of a collision between an asteroid and a planet.

Key 'Building Science Concepts' references:
Book 27 *Exploring space: Discovering our place in the universe* L3-4.

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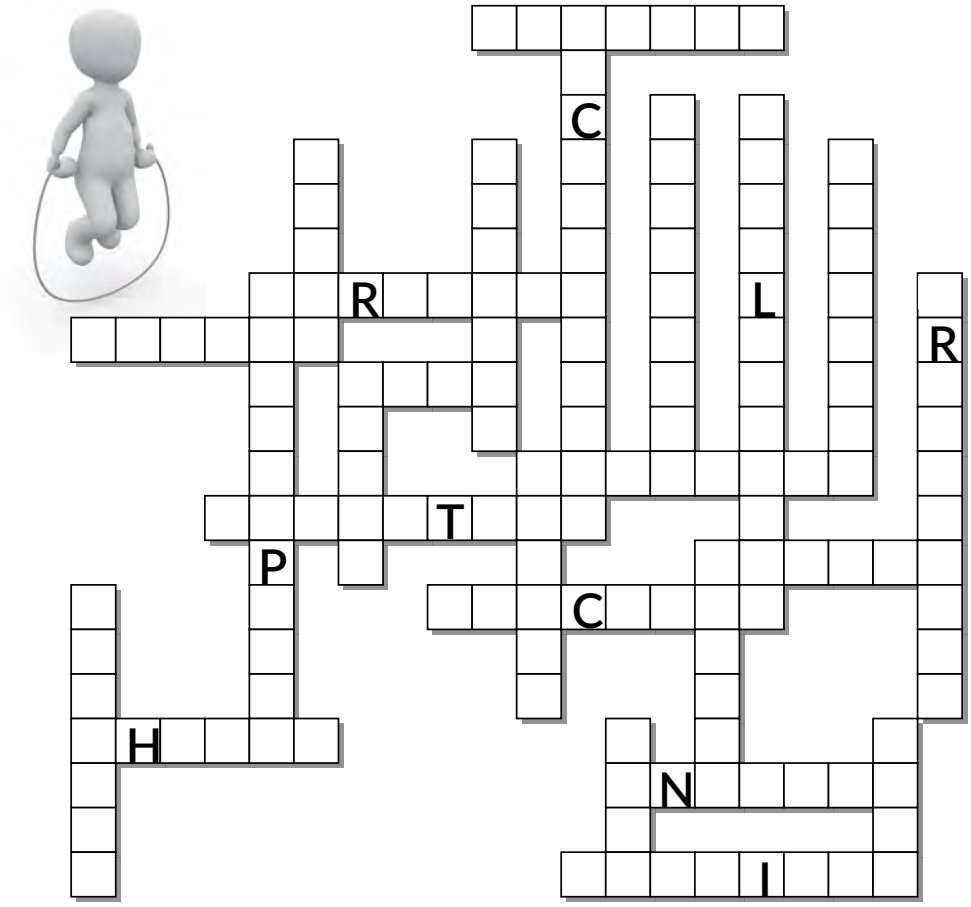
SCIENCE VOCABULARY PUZZLE

Let's move!

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

Word list

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



Statements about movement

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

Key School Journal References:
Speed Freaks, HILL, David, Article, Connected, 03, 2009.
Sky High, TU'AKOI, Feana and HILL, David, Article, School Journal Story Library, 03, 2012.
Heat Thieves, BENN, Ken, Article, Connected, 01,2010.

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INVESTIGATION

Circular-winged glider

What you will need:
(per person)

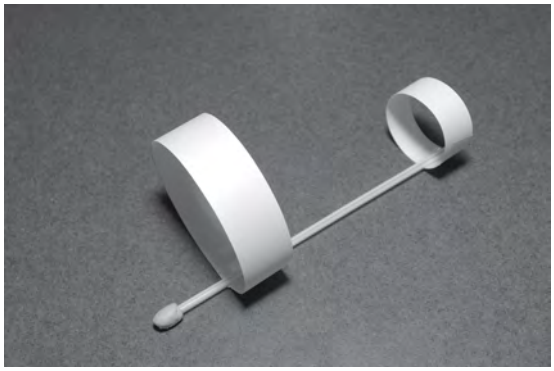
- A plastic drinking straw.
- An A4 sheet of paper.
- A ruler and scissors.
- Sellotape.
- Blu tack or plasticine.
- A watch with a timer.

WALT

- *Build a circular -winged glider.*
- *Improve on the design so it will glide at a steady speed.*
- *Calculate its average speed.*

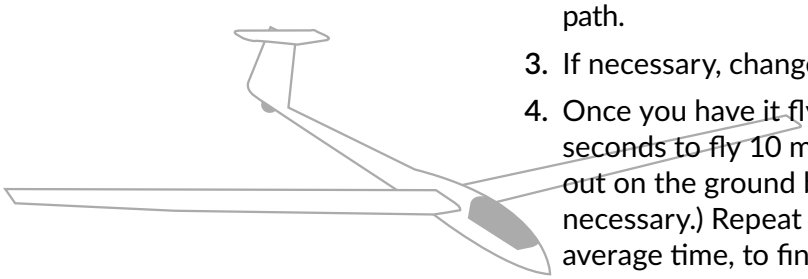
What to do

1. Measure and cut a piece of paper 3 cm x 30 cm in size and another one 2 cm x 18 cm in size. Make each of them into a loop and sellotape them to the straw as shown in the picture. Add some weight to the front of your glider using blu-tack or plasticine.



Glider made from paper and drinking straw.

2. Fly your glider to test how well it goes into the wind, with the wind and across the wind. Make adjustments to the weight and position of the wings to see if you can get it to glide in a long, straight, steady path.
3. If necessary, change the size and position of the circular wings.
4. Once you have it flying in a straight line, time how long it takes in seconds to fly 10 metres. You will need to measure this distance out on the ground before you start. (Use a smaller distance if necessary.) Repeat this 10 times. Divide the distance (10 m) by the average time, to find the average speed in metres per second.



Questions

1. Draw your final best design and label all the measurements so you could make exactly the same model again.
2. Could you get your glider to fly straight ahead at a steady speed?
3. Draw a picture with arrows to show the forces acting on your glider.
4. What was your glider's average speed in metres per second?

Extension

5. Find out about real glider design. How do they stay in the air?

Key resources from Learning Media:
Building Science Concepts, Book 17, *Flight, L1-4.*
Book 34, *Parachutes, L3-4.*

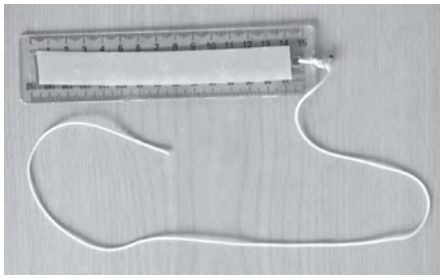
Key School Journal References:
A long glide north, Jane Thomson, Article, Part 04, No. 1, 1981; *The winner loses,* Alan Bagnall, Story, Part 03, No. 1, 1994

INVESTIGATION

Pūrerehua

What you will need:
(per group)

- A small plastic ruler (about 15 cm long) with a hole in one end.
- String (it is best to use curtain cord or types of fully braided cord that will not unravel).
- Coloured tape or stickers.
- Access to an open area where students cannot do damage to each other or property.



50 cm of string attached to a small plastic ruler that has different coloured tape stuck to both sides.

Hints:
1) Always record your findings and do many repeats to confirm them. 2) Time how long it takes before buzzing begins, then change the string length and repeat. 3) Use tape to colour each side of the ruler differently so you can see which way it is spinning. 4) Suddenly stop the pūrerehua to see which way it unravels. Does it always unravel in the same direction?

Key School Journal Reference:
Make a pūrerehua Article 4 2001 Pt 01 No. 1 Pgs 11-13 KAA, Oho.

WALT

- *Build a working pūrerehua and investigate how it works.*

What to do

Build a basic pūrerehua

Tie 50 cm of string to the ruler, using the hole in the ruler (see picture to the left). Go outside well away from other people and spin the pūrerehua around your head. Try spinning it in both a horizontal circle and a vertical circle.

Using a pūrerehua.

Investigate how a pūrerehua works

Carefully observe other people using their pūrerehua and try to figure out how it works. Try to explain these observations: a) it makes a buzzing sound b) it takes a few spins before it starts making its buzzing sound, c) it repeatedly buzzes—stops—buzzes, and d) it appears to rise and fall as it rotates around your head. (Also, see hints in the box to the left.)

Write-up

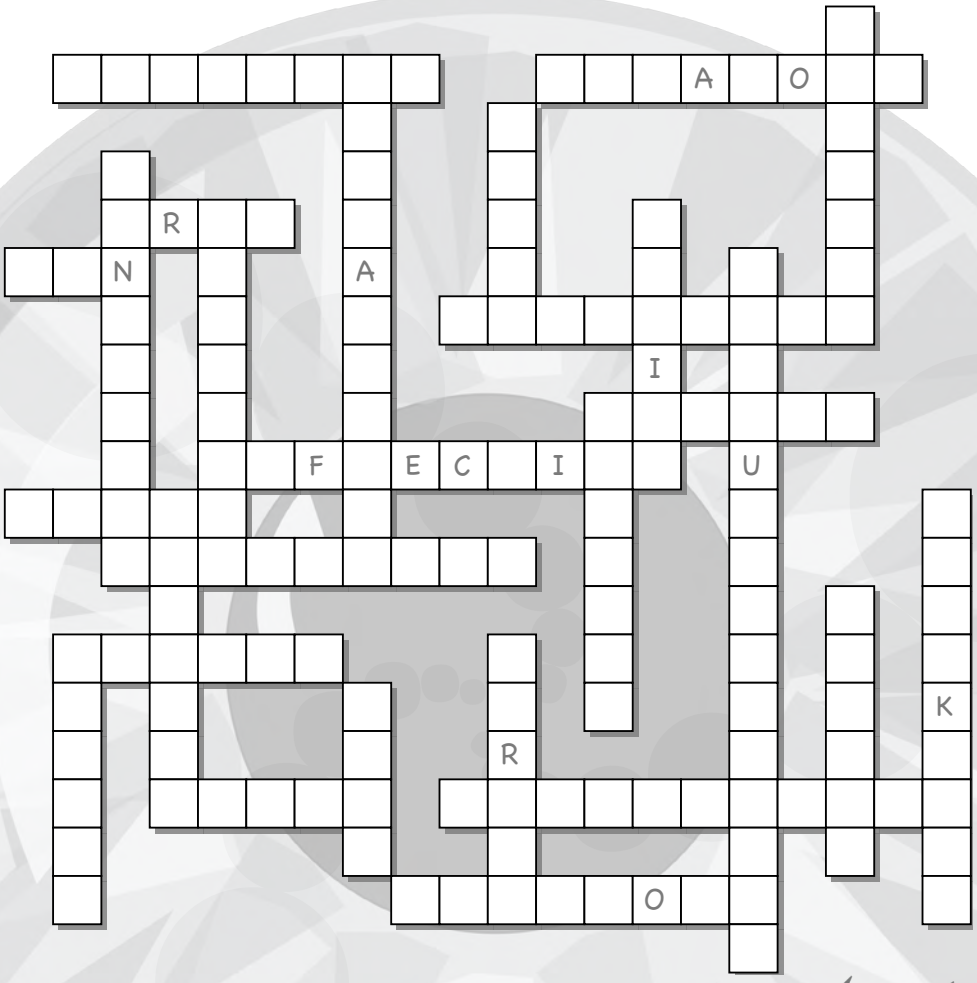
In a paragraph, use your findings to describe how a pūrerehua works by explaining the reason for each of the observations a) to d) above. In what ways is it similar to some musical instruments?

Extension
Research into which cultures historically used the pūrerehua (or bullroarer) and why.

SCIENCE VOCABULARY PUZZLE

Light and sight

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 light and sight.



Word list

Eyebrows
Radiation
Colour
Blackness
Spectrum
Iris
Binocular
Convex
White
Compoundeye
Rainbow
Polaroid
Opaque
Eyes
Cornea
Vision
Colourblindness
Concave
Mirages
Brain
Ultraviolet
Pupil
Infrared
Sun
Illusions
Lashes
Glare
Reflection
Strobe

Statements about light and sight

1. ***The eyes cannot work without the*** _____ .

2. ***An*** _____ ***object does not let light through.***

INVESTIGATION

How good is your eyesight?

What you will need:
(per group or as a demonstration)

- *Felt pens or coloured pencils.*
- *Light weight cardboard.*
- *Long measuring tape.*

House sparrow. Photo by Dawn Beattie. http://www.flickr.com/photos/pics4dawn/8685039858/.

Mouse. Photo by Peter E Smith.

Showing others:
There are many ways of showing or telling others what you have done and found. Ideas include: write a poem, story or song; create a poster; write a newspaper article; do a demo or show, with each person in your

Key School Journal References:
Hunting the hunters, SUTHERLAND, Mary, Article 5 2000 Pt 04 No. 3 Pgs 7-9.
Your marvellous sense of touch, BIRCHALL, Brian, Article 4 1994 Pt 01 No. 3 Pgs 8-9.

WALT

- *Research, make observations, and measurements, and fair tests, and link to our everyday world.*

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.

Doing it yourself

6. Decide on your own questions to investigate about eyesight. Decide on how you will investigate these questions, then do some fair tests to find answers. Hints: Does a cloudy or sunny day change the results? Is movement easier to see? Are certain colours or shapes easier to see than others?

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.

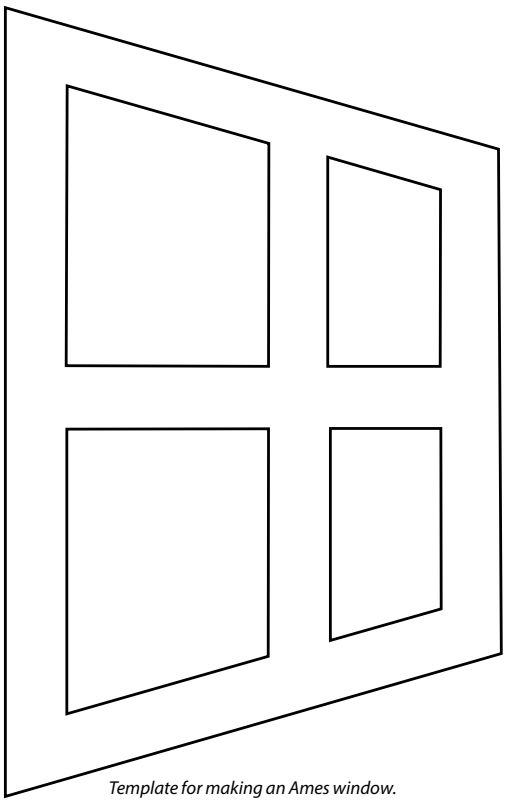
Find out about how good the eyesight of a hawk or eagle is compared with humans. Also, how good is a dog's sense of smell compared with ours?

INVESTIGATION

Ames window

What you will need:
(per group)

- ✯ *Thick cardboard or foam board (an A5 sized piece) that is the same colour on both sides.*
- ✯ *A kebab stick.*
- ✯ *Sellotape.*



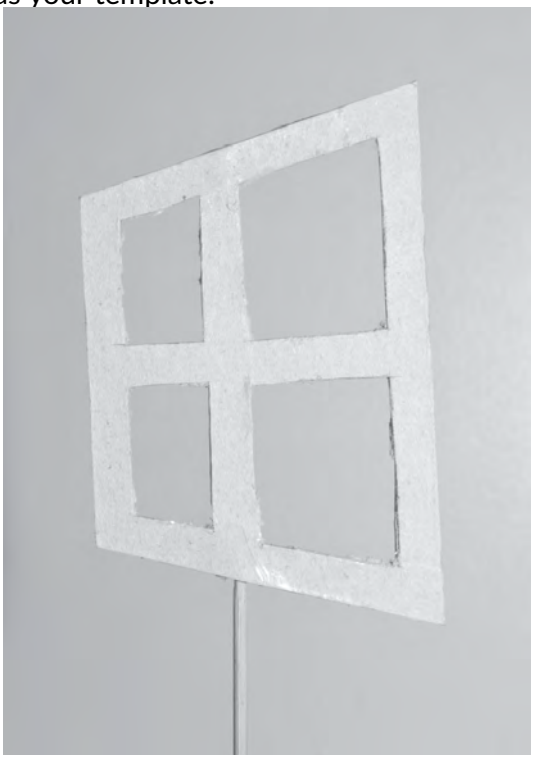
Template for making an Ames window.

WALT

- *Explore how optical illusions like the Ames window show that our brain can interpret visual information differently from what is actually happening.*

What to do

1. Use the image to the left as your template.
2. Sellotape this on top of your cardboard, then use a craft knife to cut along the lines to create a 'window'.
3. Push the pointed end of the kebab stick into your window in the position shown to the right.
4. Holding it at arms length and closing one eye, steadily spin the window with your fingers and watch as instead of spinning, it appears to do something else.
5. Take steps to improve the illusion.



Questions

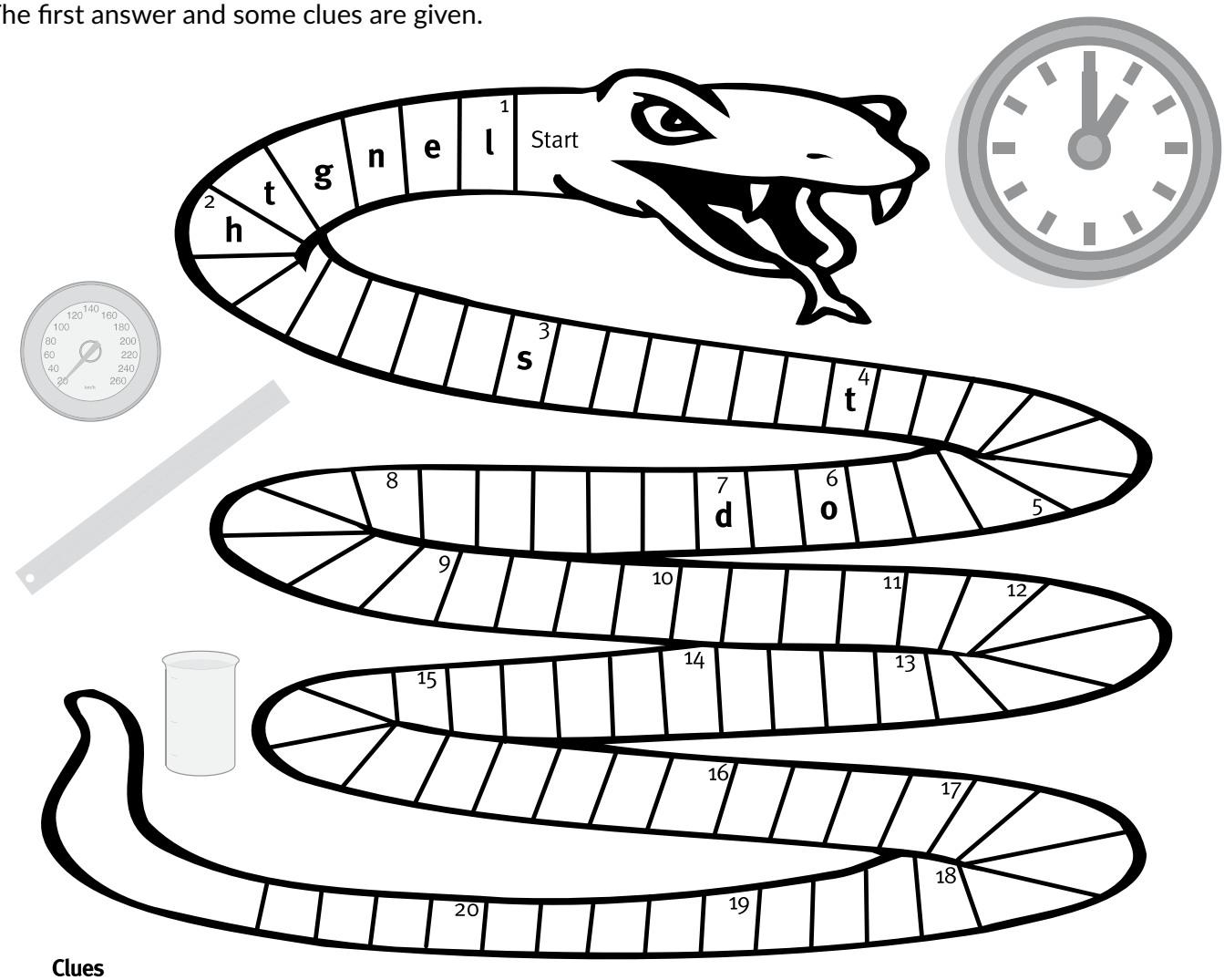
1. What is the window *actually* doing when you spin it in your fingers? What does it *appear* to be doing?
2. How did you improve on your illusion?
3. Look at video clips of Ames window, e.g. on YouTube. By what other means can you 'improve' on the effect? Try it out.

Key School Journal References:
What do you see?, BOWES, Clare, Article, Connected, 1, 1998.

SCIENCE VOCABULARY **PUZZLE**

Measurement madness

This puzzle uses the last letter of each answer as the first letter of the next answer.
The first answer and some clues are given.



Clues

1. From nose to tail is its **length** (like 'long')
2. His property is five_____ in area.
3. The opposite to 'add'.
4. A thousand times bigger than a billion.
5. One thousand times smaller than 'micro'.
6. The numbers 3, 7, and 9 are ____ (not even).
7. The numbering system using 10s, not binary.
8. We measure petrol volume in _____.
9. How fast something moves (like velocity).
10. The first ____ in the number twenty is '2'.
11. New Zealand's currency system is based on the number ___ , not twelve.
12. The smallest _____ is zero.
13. A circle is _____, not square.
14. Opposite to multiply.
15. Taking a guess based on rough values.
16. A picture that shows data, e.g. a histogram.
17. Greater, bigger. Not lower.
18. Used to measure distance.
19. Over and over.
20. Measured in hours minutes and seconds.

Key School Journal References:
Calculator Riddles, BONALLACK, John, Article, 04, 1, 1994.
Sensing Data, Article, Connected, L4, 2017.
How Much Does One Cat Eat?, BAGNALL, Allan, Article, 03, 2, 1997.

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INVESTIGATION

Measuring density

What you will need:
(per group)

- ✭ *Felt pens or coloured pencils.*
- ✭ *A spring balance or an electronic balance (either needs to measure in grams)*
- ✭ *A measuring cylinder*
- ✭ *Some cotton thread*
- ✭ *Water*
- ✭ *A calculator*
- ✭ *Some solid objects that will fit into the measuring cylinder and that do not float in water, e.g. bolts, a piece of aluminium, plastic, different types of rock, a lead fishing sinker.*

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Extension

What is specific gravity? What is the specific gravity of water, a mineral such as granite, and gold?

How does the Plimsoll line or Load Line of a ship help with ship sailing safety?

Key resources from Learning Media:
Building Science Concepts Book 37 *Floating and Sinking*, L3-4.

Key School Journal References:
The Float Test, HETHERINGTON, Alison, Article, 03, 3 1992.
Will They Float?, TU'AKOI, Feana, Ready to Read, RR, Big Books, 2016.

WALT

- *Investigate density.*
- *Find out the density of various substances.*
- *Observe how density affects buoyancy.*

What to do

1. Tie a 20cm length of cotton to one of the objects.
2. Use the scales to measure the weight (actual mass) of the object in grams.
3. Add water to the measuring cylinder so it is about 2/3 full. There must be enough water to cover the object chosen above.

4. Record the volume of water in the cylinder, then gently lower the object into the cylinder. Again, record the volume. Subtract the first value from the second to work out the object's volume in millilitres.
5. Record your data in a table like the one below. Calculate the density (last column) by dividing the object's mass by its volume.

Object	Substance object is made of	Mass in grams (g)	Volume in millilitres (mL)	Density (in g/mL)
bolt	steel			

Questions

1. Which object had the greatest density? What substance was it made of?
2. Is rock material more dense than steel?
3. What is density?
4. How could you use this technique to tell the difference between gold and fool's gold, or between one mineral and another?

CHALLENGE

How hard can you squeeze?

WALT

- *Measure the strength of hand and forearm.*
- *Compare and calculate forces.*

What you will need:
(per group)

- *Bathroom scales.*

Setting the scene

Imagine you are training for a body building competition. Each day you work on improving your strength, but how do you know that it **is** improving?

One thing you can measure is your hand and forearm strength using bathroom scales.

To measure your strength, hold the scales and squeeze as hard as you can for two seconds. Record the 'weight' you squeezed (in kilograms).

Squeezing bathroom scales with both hands.

Challenge 1

Compare forces

How can you compare the strength of each of your hands? Perform a fair test to find the answer. Do repeats to ensure accuracy and record your results. Which hand was stronger and why?

Repeat using both hands at once. Record.

Do both hands squeeze with double the force of one hand alone?

Can you squeeze your body weight?

Compare your squeeze strength with your friends.

Challenge 2

Calculate the forces

The standard measure of force is the 'Newton' (N).

Convert the 'weight' values you found to Newtons of force by using this formula:

Force = weight squeezed (kg) x 10 N/kg

For example, if you squeezed 35 kg, then the force you created was:

Force = 35 kg x 10 N/kg
Force = 350 N

For left, right and both hands, find the average (mean) squeeze strength for the class.

Challenge 3

Measure and calculate the strength of other muscles

Devise a way of measuring the strength of other muscles in your body, such as your thigh muscles and record your answer in Newtons.

Key School Journal References:
In training, Vivienne Joseph, Story, Part 01, No. 1, 1992; *Strongest woman in the world,* Cynthia Todd Maquire, Article, Part 04, No. 3, 1995

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ANSWERS

HUMAN PERFORMANCE

Fitness wins *page 5*

1) Oxygenervestrengtheartoningymusclarespirationetballung-sprinterugbyogarteriespeeduathloninjathletics.

2) Strength. 3) Endurance.

Hand–eye co-ordination *page 6*

1. Our eyes and hands must work together to catch the ball.
2. Usually the 'writing' hand. It is more practised at hand–eye type activities like catching a ball.
3. Two eyes usually, because they can judge distances better than one eye.
4. It is more difficult to catch the ball. Less light makes it harder to judge distances.
5. Examples: Very young people are not as good at catching the ball. It is harder to catch the ball using three fingers than using the whole hand.

Extension: The eyes see the ball and tell the brain where it is and how fast it is moving. The brain uses this information to pass messages to the arm and hand instructing it to move and grasp at the ball.

Smell testing *page 7*

Challenge 2: For a fair test, students will need to change only one thing between each test. For this investigation the thing being changed will be the person being tested. Every other aspect of the test must be kept the same, including things like: keeping the contents of the 'smell bottles' secret (no listening in other people's guesses); using the same set of smell bottles, presenting the smells in the same order; determining a set time between each smell test, e.g. 20 seconds (or the person being tested might be asked to breathe in and out through their nose 5 times between each smell test); always keeping their noses the same distance from the bottle; always sniffing the same number of times; keeping to the same rules about how exact their guesses have to be; etc. Challenge 3: In fact humans can detect many thousands of distinct smells. So, the more smells tested, the greater the number of smells that will be detected correctly.

MOVEMENT

Let's move! *page 14*

Solution: force, distance.

Circular Winged Glider *page 15*

1. Diagram drawn by child.
2. Yes, this is usually possible.
3. During forward steady speed flight, the forward arrow (thrust) should be of equal length to the backwards arrow (air friction). But, the upwards arrow (lift) should be smaller than the downwards arrow (gravity), since the glider accelerates downwards.
4. It will be somewhere in the range of 2–4 metres per second (approx.).

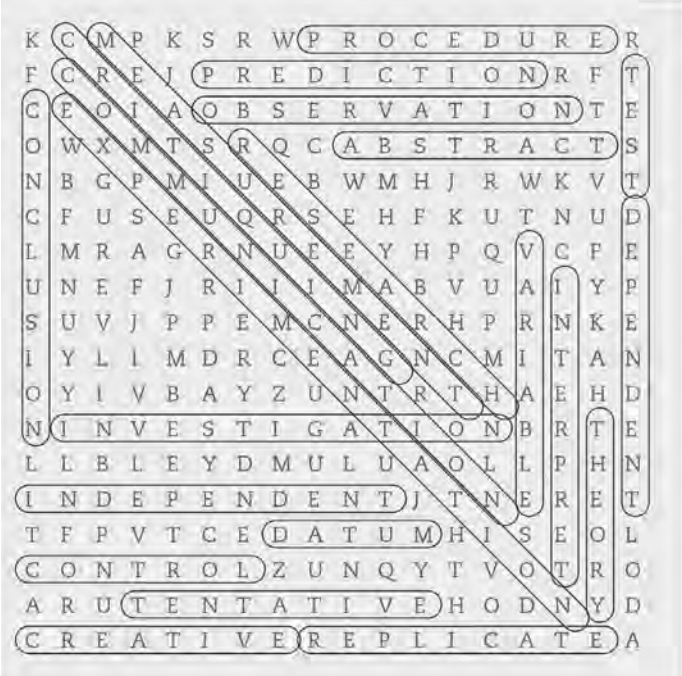
Pūrerehua *page 16*

Write-up key ideas: The spinning ruler causes the air to vibrate, which is the sound we hear. The string must first wind up tight one way before is suddenly unravels to make the sound. It winds up again in the opposite direction, then unravels quickly, causing the buzz–stop–buzz effect. The ruler spins one way, giving it 'top spin' (like a tennis ball), causing it to fall, then when it reverses it has 'bottom spin' (like a 'cut' or 'chop' shot in tennis) causing it to rise.

FAIR TESTS

Fair tests puzzle *page 8*

Extra words: METHOD, HYPOTHESIS.



Fair test — Solar water heater *page 9*

1. Graph
2. The bottle with the solar panel attached
3. Drawing should show water flowing in a circular manner (upwards through the solar panel pipes, across the top of the bottle, downwards inside the bottle, then into the bottom of the solar panel)
4. A convection current
5. Same size bottles; water levels the same; inserting the thermometer the same distance when recording the temperature; amount of sunlight each bottle receives is the same...

Paper towels — how absorbent? *page 10*

Challenge 1. Things to keep the same: The time the paper is soaked, the time it hangs, the amount of effort used to squeeze out the water; how the water is collected. **Challenge 2.** For a fair test, all parts of the method would have had to be the same except the brand of paper towel. The larger the volume of water squeezed out, the better the towel. Students should have done more than one trial for each brand of towel. The best value for money overall would be the brand that soaks up the most water per roll, for the amount of money spent on that roll. **Challenge 3.** Compare how much water is absorbed for a given area of towel. Toilet paper is softer and breaks down into little bits more easily. Perform softness and strength tests. Look at fibres microscopically.

ANSWERS

ASTRONOMY

Solar System puzzle page 11

1. Mercury, 2. Jupiter, 3. Pluto, 4. Venus (453 degrees C), 5. Pluto (-236 degrees C), 6. Saturn, 7. Jupiter, 8. Venus (243 Earth days), 9. Jupiter (9.8 Earth hours), 10. Mars.

Phases of the moon page 12

1. The moon.
2. The sun.
3. The Earth.
4. A full moon is seen when looking from the same direction as the sun (the torch); a half moon is seen when looking side on to the moon; a new moon is seen when observing the moon from the opposite side to the moon to the sun ; a crescent moon is seen when looking from slightly behind the moon; and, a gibbous moon is seen when looking from an angle slightly forward of the moon.
5. A full moon and a new moon create extreme high and low tides (called spring tides). Half moons create the least extreme tides (called neap tides).

Extension: Earth tides occur when the Earth's crust shifts in response to the moon and sun's gravitational pull (as well as other influences).

Astroblaster page 13

Challenge 1: The balls fall together and when they hit the ground the bottom one only bounces a little, while the top one shoots upwards at high speed, etc. The smaller the top ball in comparison to the bottom ball, the higher it shoots away. If it is slightly to one side, the top ball shoots off at an angle. **Challenge 2:** Use a ruler or a scale on a wall to measure the height on many repeat trials. When they fall separately, the larger ball bounces higher and the smaller one bounces lower than when they land together. **Challenge 3:** Most of the energy from the two balls falling is transferred to the smaller ball making it rebound higher than 'expected'. When an asteroid collides the impact might cause smaller chunks to 'rebound' into space at very high speeds.

USING NUMBERS

Measurement Madness page 20

Length, hectares, subtract, trillion, nano, odd, decimal, litres, speed, digit, ten, number, round, divide, estimating, graph, higher, ruler, repeat, time.

Measuring density page 21

1. Fishing sinker, led (if this was available to test).
2. No, steel is more dense.
3 Density is how much matter there is packed in a given amount of space.
4. Gold will be more dense than fool's gold. Every different mineral has a different density. (More advanced: compare specific gravities with known values for minerals.)

EXTENSION

Specific gravity is the ratio of an object's density to the density of water. For example, gold has a density of 19 g/mL, water's density is 1 g/mL, so gold's specific gravity is 19. The specific gravity of minerals such as granite are in the range of 2.5–4.0.

How hard can you squeeze? page 22

Challenge 1: Compare them by squeezing with one hand only, then swap hands and squeeze with the other. Record and repeat 10 times for each hand. The hand you write with is usually the stronger because it is used more often (resulting in more muscle growth). Usually both hands squeeze with about double the force of one hand alone. (A little less than double compared with the writing hand, a little more than double compared with the non-writing hand. A strong light person can often squeeze their body weight.

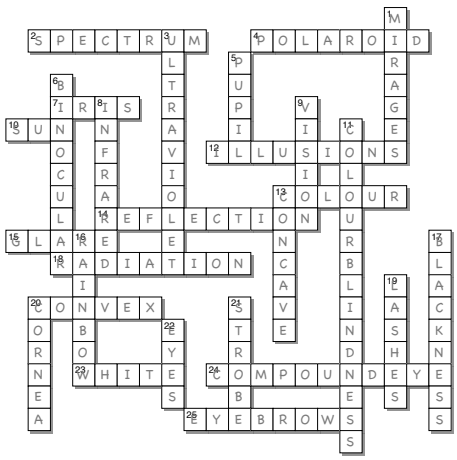
Challenge 2: Answers will vary.

Challenge 3: There are many methods of measuring the strength of muscles. A simple one is by testing the maximum known weight that can be lifted using the muscles concerned, either directly or via a rope and pulley. Use a force meter (in Newtons), or a spring balance, or scales measuring in kilograms, and then multiply your answer by 10 for the answer in Newtons.

SIGHT & ILLUSION

Light and sight page 17

Solution's missing words: 1) brain, 2) opaque.



How good is your eyesight? page 18

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.

Ames window page 19

1. Rotating. It *appears* to be oscillating back and forth (i.e. it appears to spin 180 degrees then reverse and spin 180 degrees back the way it came).
2. Improve the illustration by: ensuring the light is even; ensuring both sides of the window are identical; and spinning the window at a steady rate.
3. Motorise it (e.g. using Lego) so it spins at a perfectly steady rate, and, add a 'rod' that protrudes (see YouTube).

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