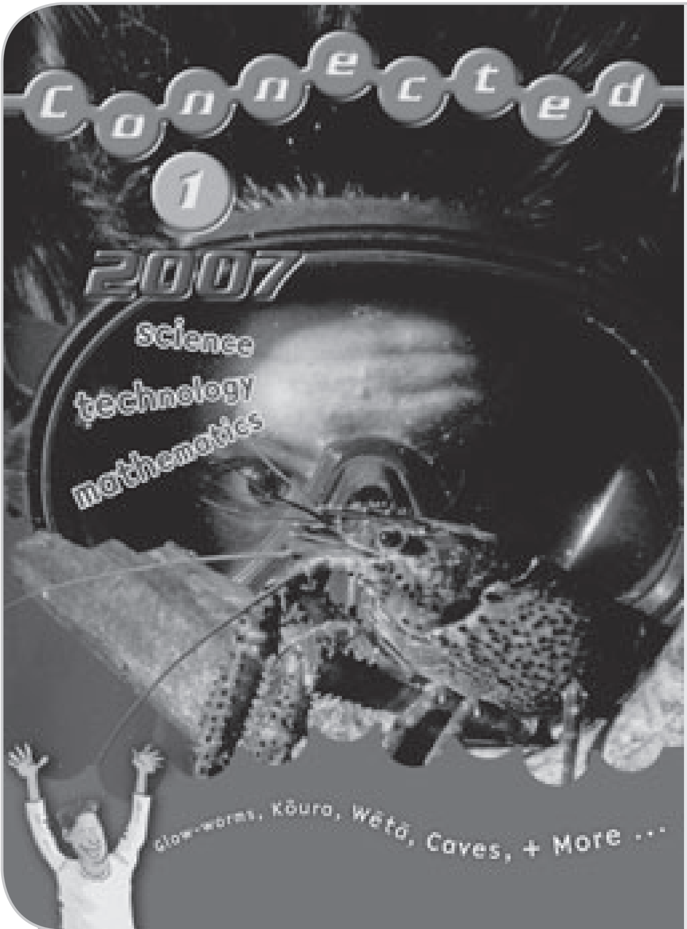
MINISTRY OF EDUCATION
*Te Tāhuhu o te Mātauranga*




# Notes for Teachers

## Connected 1 2007

## Contents and Curriculum Links

# Introduction

Connected is a series designed to show mathematics, science, and technology in the context of students' everyday lives. The stories and articles are intended to stimulate discussion and to provide starting points for further investigations by individuals, groups, or a whole class. A **shared or guided reading approach** to using these texts will support students in their understanding of the concepts and the technical vocabulary.

Connected 1 is designed to appeal to **year 3 and 4** students who are working at **levels 1 and 2**.

## *General Themes in* Connected *1 2007*

1. Limestone cave formation, with a focus on erosion processes in which solids dissolve in water and form solutions
2. Stalactite and stalagmite formation, with a focus on substances dissolved in water recrystallising to form solids
3. The adaptations of cave-dwelling animals
4. The use of traditional Māori fishing technology in modern-day scientific research
5. Number in our everyday world, with a focus on using multiple strategies to solve number problems

# "A Trip to Nīkau Cave" and "The Secret Underground"

## Possible Achievement Objectives

### Science

**Living World**

- 1.1: Share their experiences relating to the living world and group the living world according to some of its attributes.
- 1.2: Observe and identify parts of common animals and plants.
- 2.1: Use differences and similarities in external characteristics to distinguish broad groups of living things.
- 2.2: Investigate and understand the general function of the main parts of animals and plants.
- 2.4: Investigate the responses of plants and animals, including people, to environmental changes in their habitats.

**Developing Scientific Skills and Attitudes**

- 1/2: Identify trends and relationships in recorded observations and measurements by suggesting links between these. (Processing and Interpreting)

### *New Zealand Curriculum: Draft for Consultation, 2006*

**Living World**

- 1/2: Recognise that living things are suited to their particular habitat. (Ecology)
- 1/2: Recognise that there are lots of different living things in the world and that they can be grouped in different ways. (Evolution)

**Nature of Science**

- 1/2: Students will extend their experiences and personal explanations of the natural world through exploration, play, and asking questions. (Investigating in Science)

### The Specific Learning Intentions

The students will be able to:

- describe the specific conditions that characterise a cave environment;
- describe how the physical adaptations observed in cave-dwelling animals help them to survive in a challenging underground habitat;
- compare the anatomy of a cave-adapted animal with the anatomy of a closely related species that lives above the ground.

### The Key Ideas

- Living things depend on one another and on the non-living environment in which they live.
- Caves provide both challenges and opportunities for the animals that live in them.
- Animals that live in caves have physical features that help them to overcome the challenges and take advantage of the opportunities.

## Developing the Ideas

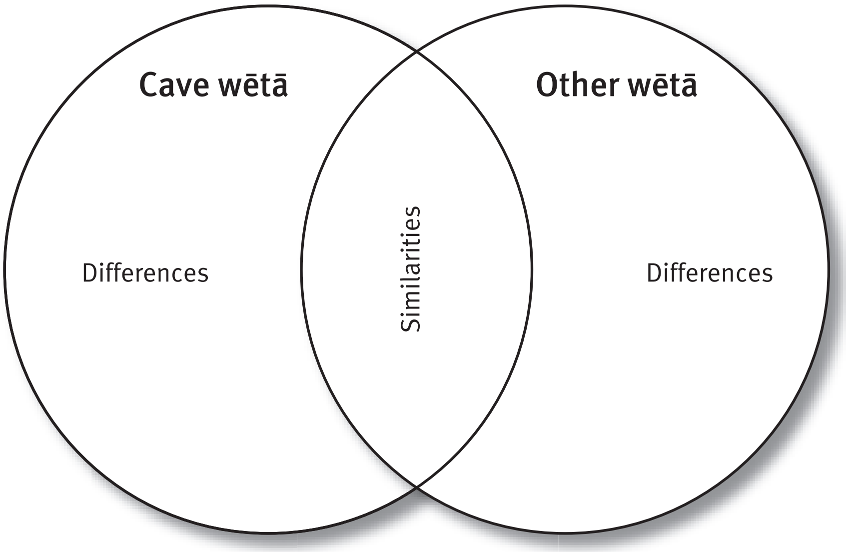
Living things usually exist in communities and directly interact with their environment. You could introduce these ideas to the students by talking about their school community and school environment.

- Who is part of the school community?
  - students;
  - teachers;
  - parents;
  - caretakers;
  - office staff;
  - neighbours;
  - the school dental therapist;
  - school bus drivers;
  - cleaners.
- How do we know these people are part of the school community?
  - We see them often in the local area doing particular things.
  - They might be identifiable as school community members because they wear a uniform, carry particular equipment, and wear clothes for particular parts of the school environment, for example, a sunhat if they work mainly outdoors.
- What jobs or daily tasks do the community members do?
- What do members of the school community need in order to do their jobs well and comfortably?
  - shelter that's dry and warm;
  - access to food and drink;
  - learning tools, such as computers, maths and science equipment, books, and stationery;
  - other tools and equipment, such as lawn mowers, cleaning equipment, ladders, telephones, and fax machines.

Tell the class that you're about to read with them an article about a community of plants and animals that live in a very unusual place. After a shared reading of "The Secret Underground", repeat the activity above to identify who lives in a cave community. Focus discussion on the fact that caves are special environments where there are opportunities – but only for those animals that can deal with the physical and biological challenges.

Some of the animals that are found in caves can live in other places as well. Rats are a good example. Some animals, however, have special features that enable them to survive particularly well in caves. These animals are less often found outside their unusual cave world. Cave wētā are a good example.

The class could help you to complete a Venn diagram to explore the differences and similarities between cave wētā and other wētā species.




The students could then research another group of animals in which there are species adapted for very different habitats, for example, desert snakes and sea snakes or garden slugs and sea slugs. If choosing slugs, the students could begin by reading "Snailville – a Great Place to Visit?" in *Connected* 1 2005.

## *Further References*

### NZCER's Assessment Resource Bank (ARB)

This large and varied resource includes material that supports students' learning about classification. The following steps will allow free access to the ARB.

- **http://arb.nzcer.org.nz/nzcer3/nzcer.htm**
- Search the Banks: Science
- User name: arb
- Password: guide
- Specific tasks can be looked up by number through the "free-text search" function.

Scientists classify living things and group them together according to their shared features. Some features are readily observed, whereas others can only be observed by using scientific equipment such as a microscope. At levels 1 and 2, it's appropriate to focus on the readily observable features. ARB tasks LW0063, LW0067, LW0068, LW0069, and LW0060 all focus on classifying living things according to their observable features.

Task LW0637 describes a way of identifying the parts of an animal that help it to survive. By downloading and saving tasks LW0637 and LW0067 as Word documents you can personalise a task to meet your students' learning needs. Task LW0637 can be changed by using an image from the cards for task LW0067.

### Ministry of Education Resources

The relationships among communities of living organisms and their environment are further explored in *Making Better Sense of the Living World* (Learning Media, 2001). See especially Science Focus: Relationships among Living Organisms and Their Environment, page 98.

Similar themes in a different context are explored in *Life between the Tides*, book 21 in the Building Science Concepts series (Learning Media, 2002).

# Further Activities

## Activity: Design Your Own Animal

This activity helps students to explore links between organisms' physical features and the environment in which they live.

### What You Need

- Paper
- Pens
- Modelling materials, such as clay or cardboard, paper, fabric scraps, sticky tape, and scissors.

### What You Do

- Suggest, or ask the students to think of, an unusual and possibly inhospitable environment for an animal to live in, for example, inside a school bag, in a drain that's sometimes dry and sometimes flooded, or on a busy footpath.
- Have them design and draw an animal that could live in this environment.
- You could give them focus questions to think about when designing their animal.
  - What will it eat?
  - Will it be safe in its environment? Will it need special body parts for defence?
  - Will it need to attach itself to something to be safe from danger?
  - What colour and pattern will it need to have?
  - What would its outside covering be made of?
  - What other problems will the animal have in its unusual home? How will it solve them?
- Each student could make labelled diagrams of their animal or else use modelling materials to make a 3-D version. They should then write a story about how their animal survives in its special environment.

### What You Look For

- Do the students suggest a variety of environmental challenges without prompting?
- Do they present well-reasoned strategies that will help their animal to find food, breathe, keep warm, move around, and sense its environment?
- Can they explain how particular physical features help their animal to respond to specific environmental challenges?

For assessment advice, based on a similar activity, see Long Haul Birds, a level 2/3, Living World exemplar that focuses on a student's diagram that shows the adaptations of a migratory bird. See **www.tki.org.nz/r/assessment/exemplars/sci/living/lw_2a_e.php**

# How to Make a Limestone Cave

## Possible Achievement Objectives

### Science

**Planet Earth and Beyond**

- 1.1/4: Share their ideas about some easily observable features and patterns that occur in their physical environment and how some of these features may be protected.
- 1.2: Suggest ways that their immediate physical environment was different in the past.
- 2.1/4: Investigate easily observable physical features and patterns and consider how the features are affected by people.

**Material World**

- 2.3: Investigate and describe everyday changes to common substances.

**Developing Scientific Skills and Attitudes**

- 1/2: Share what they did and what they found out in their investigations in whole class situations or in groups. (Reporting)

**Nature of Science and its Relationship to Technology**

- 1.1: Share and compare their emerging science ideas.
- 2.1: Use a variety of methods to investigate different ideas about the same object or event.

### New Zealand Curriculum: Draft for Consultation, 2006

**Planet Earth and Beyond**

- 1/2: Observe and describe local natural features and how they can change. (Earth cycles)

**Material World**

- 1/2: Observe and describe temporary (physical) and permanent (chemical) changes to familiar materials. (Chemical reactions)

**Nature of Science**

- 1/2: Students will build their language and develop their understandings of the many ways the natural world can be represented. (Communicating in science)

### The Specific Learning Intentions

The students will be able to:

- use models to explore the way in which salt and sugar dissolve and recrystallise in a reversible process;
- demonstrate and describe how the process of dissolving limestone rock is linked to the formation of caves;
- recognise that dissolved sugar recrystallises into a solid and link the associated ideas with the formation of stalactites and stalagmites from dissolved limestone.

### The Key Ideas

- A physical change in which a solid dissolves in a liquid to form a solution is reversible.
  - o Limestone rock (calcium carbonate) is dissolved by rainwater seeping through cracks in the ground.
  - o Over time, caves form in the rock as the limestone is slowly but continuously dissolved and washed away.
  - o The resulting solution of limestone and rainwater travels further underground. When water evaporates from the solution, tiny crystals of limestone are left behind on the surface over which the solution is travelling. Over long periods, this recrystallised rock forms stalactites and stalagmites.
- We can use models to help us understand scientific processes.

## Developing the Ideas

Before the first reading, you could carry out a simple demonstration to bring out the students' previous experiences and their existing ideas about the process of dissolving. Add a teaspoon of salt to a glass of cold water and allow it to settle on the bottom. Ask the students what they think will happen if you stir it vigorously. If they suggest the salt will dissolve, ask whether they think it will happen instantly or gradually. They can then watch carefully as you demonstrate.

With cold water, the salt will take a little time to dissolve completely. After about 20 seconds, the crystals will no longer be clearly visible, but the water will look cloudy white because of all the small, semi-dissolved crystals swirling around. After another 20 seconds of stirring, the water will be much clearer. (If you use hot water, the salt will completely dissolve much more quickly. However, demonstrating with hot water may lead students to the misconception that things only dissolve in hot liquids – especially if they already have associations of watching adults stir sugar into hot drinks.)

Lead a discussion to explore the idea that, although we can't see the salt crystals any more, we know that the salt is still there because:

- We can taste it. (Make sure the students understand that we don't taste things during science activities unless the teacher specifically indicates that it is safe to do so.)
- We can smell it faintly.
- We may be able to see it slightly. (Although the cloudy whiteness will clear when the salt has dissolved, the salty water will have a slightly different visual quality when compared with pure water. Although transparent, salty water can appear slightly "blurry".)

Explain that scientists observe what is happening to substances by using their senses to detect changes in, for example, smell, taste, colour or clarity, and feel. (Solutions such as sea water and dissolved drinks may feel slightly sticky, especially as they dry.) Then pose some questions:

- Why do you think we can't see the salt crystals any more?
- Can we get the salt crystals back?

Check that the students understand that the salt is no longer visible because, once dissolved, the individual particles are so small we can't see them – but the salt is all still there. In terms of getting the crystals back, you could leave the glass to stand in a cool place while you read "How to Make a Limestone Cave" with the class and carry out some follow-up activities. During the reading, allow pauses for questions and discussion. Because the cave context will be unfamiliar to many students, the previous and following activities are designed to make links with everyday experiences. The suggested activities also incorporate the use of models to demonstrate the key processes using familiar materials.

# Further Activities

## Role-play Activity: Dissolving the Class

This game demonstrates the concept that solid substances are present in solutions but are not visible because they have broken up into very tiny particles and mixed evenly through the liquid. The activity is a type of scientific model in that it mirrors reality in order to clarify concepts.

### What You Need

- Chairs
- Blue headbands or headband-mounted placards
- White headbands or headband-mounted placards

### What You Do

- Arrange the chairs into the shape of a glass.
- Ask about fifteen students to wear blue headbands. These students are particles of water.
- Ask about ten other students to wear white headbands. These students are particles of salt.
- "Pour" in the water by asking the water particles to move into the bottom of the glass and spread around to fill about two-thirds of the available space.
- Now "pour" in four particles of the salt. These particles are in solid form, so ask those students to hold hands until they break apart when moving in between the water particles. Make sure that the salt particles evenly space themselves through the water particles at all times.
- Explain that the salt particles will join up again into solid bits (that is, hold hands again) if they're right next to each other. They must move randomly, though, so they'll have to resist the temptation to edge closer intentionally.
    - Ask the students what they think they will observe if more salt particles move into the glass.
    - Ask the remaining salt particles to join the glass and mix evenly through it. Some will be close enough to join hands. These particles will be heavy so they should move to the bottom of the glass and stay there. (You may need to direct the students' movements at this point.)
- Discuss what will happen to the remaining dissolved salt crystals if half of the water particles evaporate away from the glass. Ask the students to demonstrate this. Now even more salt particles will come side by side and join hands.
- Retrieve the glass of salty water that's been resting since your first demonstration. Some of the dissolved salt will probably have recrystallised and sunk to the bottom of the glass. (It may take a few hours for this to happen.)
    - Ask the students to comment on the recrystallised salt in the bottom of the glass.
    - What part of the role play demonstrated this process?
    - You could remix the solution and heat it in a pan to evaporate the water and the students could observe the resulting crystals.
    - What part of the role play demonstrated this process?

### What You Look For

- Can the students make accurate links between their role play and what's happened in the glass of salty water at various stages?

- Do they understand that dissolving is the opposite of crystallising?
- Do they understand that dissolving and crystallising are reversible processes?
- Do they use the correct terms, such as dissolving, evaporating, and crystallising to describe what's happening in the demonstration and the role play?

## *Activity: Making a Sugar Cave*

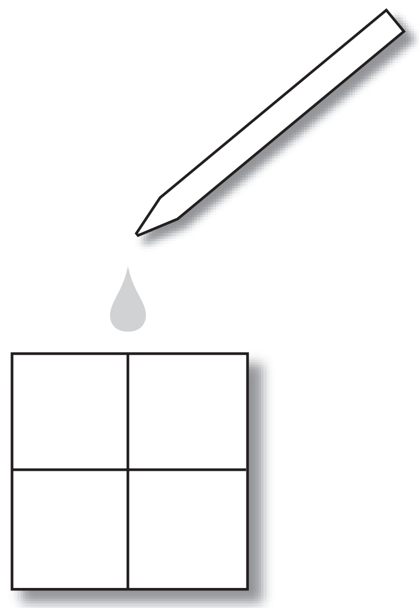
This activity moves the students from a general consideration of dissolving and crystallising back to the original context of cave formation. The activity models the way in which water can dissolve part of a solid structure and form hollows or caves.

### What You Need

8 or more sugar cubes
Tap water
An eye-dropper, plastic pipette, or straw
A dinner plate

### What You Do

- At the edge of a dinner plate, build a large block of sugar by stacking together 8 individual cubes.
- Angle the plate slightly by resting one end on something that's about a centimetre high. The block of sugar should be on this raised end.
- Use the eye-dropper, plastic pipette, or straw to drip water onto the centre top of the block where the cubes intercept.



- Keep dripping water until a clear liquid runs out from under the block.
  - o Discuss possible reasons for the time delay before the runnel of liquid appears.
  - o Observe carefully what happens to the sugar cube structure.
  - o Ask what the students think the out-flowing liquid will taste like.
- Either leave the angled plate undisturbed in a warm place for a day or two or collect some of the liquid and heat it gently in a pan.
  - o Ask the students to predict what will happen when the water evaporates from the solution.

- Discuss the reversible process of dissolving and crystallising and help the students to make links between the demonstration and the formation of limestone caves.
  - Discuss the analogy between the sugar dissolving and the dissolving of limestone by rainwater.
  - Discuss the analogy between the sugar recrystallising and the growth of limestone stalactites and stalagmites. Because water runs downwards, stalactites and stalagmites are long, tapering structures.
- The students could finish up by carrying out an art activity that involves growing decorative crystals. See "Grow Your Own Crystals" in *Connected* 1 2000.

### What You Look For

- Can the students make accurate links between the modelling activity and the formation of limestone caves?
- Can they relate the sugar dissolving and leaving a hollow to rainwater dissolving limestone and forming a cave?
- Can they relate the sugar recrystallising to the formation and growth of stalactites and stalagmites?
- Are they aware that the sugar structure is being used as a model to help them to understand the formation of caves?

Models are an extremely useful strategy to help students understand the different principles and processes taking place within a limestone cave system. However, it is important to discuss the idea that the glass of water role play and the sugary water activity do not exactly replicate the processes being explored.

To sum up, you could work with the class to construct a large, labelled flow diagram that shows the processes of cave formation. Include arrows to show the addition and removal of water from the process and to show limestone dissolving and recrystallising.

## *Further References*

You could access a variety of resources if your students require further explorations within this topic.

### NZCER's Assessment Resource Bank (ARB)

This large and varied resource includes material that supports students' learning about classification. The following steps will allow free access to the ARB.

- **http://arb.nzcer.org.nz/nzcer3/nzcer.htm**
- Search the Banks: Science
- User name: arb
- Password: guide
- Specific tasks can be looked up by number through the "free-text search" function.

Task MW6319 focuses on level 2 objectives covering physical change and dissolving. The skill focus is observation. The teachers' notes also link to more information about student misconceptions.

The concepts of dissolving and evaporation are explored in depth in the Ministry of Education's *Making Better Sense of the Material World* (Learning Media, 1998), especially the chapter Science Focus: Drinks. *Sand, Salt, and Jelly Crystals* (book 16 in the Ministry of Education's Building Science Concepts series [Learning Media, 2001]) also includes student activities and comprehensive teachers' notes that explore dissolving as a special kind of mixing.

# Counting Kōura

## *Possible Achievement Objectives* (NZ Curriculum: Draft for Consultation, 2006)

**Nature of Technology**

- Characteristics of technology (L1, 2)
- Characteristics of technological outcomes (L1, 2)

**Technological Knowledge**

- Technological products (L1, 2)

### *Possible Technological Areas* (TechiNZC)

**Materials Technology**

**Structures and Mechanisms**

### *The Specific Learning Intentions*

Students will be able to:

- identify and describe the attributes that animal traps need in order to be successful. (Nature of Technology – Characteristics of technological outcomes L1, 2)
- identify the materials used in traps and understand the performance properties of these materials. (Technological Knowledge – Technological products L1, 2)
- understand that people develop traps for specific purposes and that traps enhance people's ability to control living things. (Nature of Technology – Characteristics of technology L1, 2)
- describe and understand the relationship between the physical and functional attributes of traps. (Nature of Technology – Characteristics of technological outcomes L1, 2)

### *The Key Ideas*

**Nature of Technology**

- The scientists tried many ways to count the kōura before finding a solution that worked.
- As the scientists developed their solution, key attributes became important. For example, the method had to be economical and usable in rough and muddy water. It was also important that the traps did not get tangled with weeds and that the traps caught kōura of all sizes.
- The tau kōura was developed by Māori as a way to collect and store kōura alive – by enticement rather than physical capture. In this way, they could control the kōura and harvest them when needed.
- The tau kōura had crucial physical attributes. They looked like twisted roots and were made of ferns tied into bundles. The tau kōura were similar to the places where kōura hide in their natural environment. The matted fern also trapped food for the kōura to eat.

**Technological Knowledge**

- The purpose of the tau kōura was to collect and store kōura. The properties of the natural materials used to construct the traps improved the performance of the trap.

# Developing the Ideas

The following web pages provide further information about the way in which existing technology was trialled and new outcomes were developed during the kōura study.
**www.niwascience.co.nz/maori/research/monitoring_koura/**
**www.niwascience.co.nz/maori/research/monitoring_koura/background**
**www.niwascience.co.nz/maori/research/monitoring_koura/protocol**

The following website provides information about the technology and animal husbandry techniques used for farming kōura.
**www.clearwatercrayfish.co.nz/koura.html#5**

# Further Activities

The activities below are designed to help students to discuss and practically investigate key ideas about the technology of traps.

## Activity: All Sorts of Traps

### What You Need

Examples of or print/internet photographs/illustrations of various traps, for example, a crayfish pot, possum cage, mousetrap, Venus flytrap, pitcher plant, snail trap, fly paper, whitebait net, minnow trap, butterfly net, roach hotel

### What You Do

- Show the collection of photographs or devices to the students.
  - Ask them to tell you which of the traps are not an example of technology. (The Venus flytrap and pitcher plant are both traps but are not technology because they haven't been designed by people. Their characteristics are, however, similar to those of traps made by people.)
  - Ask them to help you describe the physical attributes of the traps.
  - Record their observations on the board under the following headings: materials, size, and shape.
- Discuss the possible purpose of each trap.
  - For each example, ask the students to make a reasoned prediction about the sort(s) of animal it might be designed for.
- Confirm or correct the students' predictions about the target animals and lead a discussion about how each trap might work.
  - In particular, ask the students to comment on links between the physical attributes of each trap and the way it functions. For example, the pitcher plant's tube is lined with downwardly angled hairs and some eel traps have barbs angled inwards along their entry tube. Both features allow the target animal to enter but prevent it from leaving. (These features will probably not be visible in illustrations, so you could mention them at the beginning as an example.)
  - Classify the traps in terms of how they operate to either trap and kill or trap and store the target animal.
  - This could lead into a discussion about how each trap fulfils a human or social need, for example, to provide food (in the case of the whitebait trap), to protect the environment (in the case of the possum trap), or to learn about nature (in the case of the tau kōura used in the article).

### What You Look For

- Do the students realise that a trap is a technological outcome because it is developed and made by people?
- Can the students describe the physical attributes of the traps?
- Can they relate those physical attributes to the way in which each trap functions?

## *Activity: Making a Trap to Count Slaters*

This activity could be integrated with a simple science unit. However, the learning experiences below emphasise the characteristics of technology and of technological outcomes. The key attributes of slaters and their preferred environments need to be established before beginning the activity. For ideas that establish a scientific context, see *Soil Animals*, book 6 in the Ministry of Education's Building Science Concepts series.

### What You Need

Potatoes
Rubber bands
Tools for hollowing out potatoes

### What You Do

- Establish the need. For example, "As part of our study on mini-beasts, we need to work out where slaters like to live. We'll need some technology to help with our science study, so we're going to make some traps to capture slaters in various places. This will give us an idea of where they like to live."
- Spend a little time discussing the purpose of the traps they're about to make.
  - The purpose is to capture and hold the slaters alive. This will allow the students to count the slaters (in order to answer the scientific question) and then release the animals.
  - You could reiterate some of the alternative purposes for traps.
- The students should then make their potato traps by following these steps:
  - Cut the potato in half.
  - Hollow it out and make a hole in one end through which slaters can enter.
  - Put the halves back together and fasten them with rubber bands.
  - Locate the traps in different positions around the school grounds.
  - Return to the traps after a day or two, count the number of slaters inside, and release them in a dark, damp place.
- Lead a discussion in which the students comment on the way in which the slater traps were designed to catch particular animals and hold them without harming them.

### What You Look For

- Can the students accurately describe the physical attributes of the potato trap?
- Can they relate those physical attributes to the trap's function?
- Do they describe how the potato trap works in terms of the relationship between a slater's habitat and the physical attributes of the potato trap?

# Finding Friday

## Possible Achievement Objectives

### Mathematics

**Number**

- Recall the basic addition and subtraction facts (Exploring computation and estimation, level 2).
- Mentally perform calculations involving addition and subtraction (Exploring computation and estimation, level 2).
- Write and solve story problems which involve whole numbers, using addition, subtraction, multiplication, or division (Exploring computation and estimation, level 2).

**Mathematical Processes**

- Record, in an organised way, and talk about the results of mathematical exploration (Communicating mathematical ideas, level 2).

### Links to the Number Framework

**Strategies**

**Stage Five: Early Additive Part–whole**

- Early addition and subtraction
  - o The student uses a limited range of mental strategies to estimate answers and solve addition or subtraction problems.
- Multiplication by repeated addition
  - o On multiplication tasks, the student uses a combination of known multiplication facts and repeated addition.

**Knowledge**

**Stage Five: Early Additive**

- Number sequence and order
  - o The student says the skip-counting sequences, forwards and backwards, in the range 0–100 for twos, threes, fives, and tens.
- Grouping and place value
  - o The student knows groupings within 100 of twos, fives, and tens.
- Basic facts
  - o The student recalls addition facts to 20 and subtraction facts to 10. Multiplication facts for the 2, 5, and 10 times tables.
- Written recording
  - o The student records the results of addition and subtraction calculations using equations and diagrams, for example, an empty number line.

# Developing the Ideas

## The Importance of Written Recording

"Finding Friday" presents a good context for reinforcing the usefulness of written recording in mathematics. As students are learning to verbalise their strategies, informal teacher jottings, and then later student jottings, are invaluable. These informal jottings are a step on the way to the compact written methods that follow mathematical conventions. After a first reading of the story, you could discuss with your students why it was useful for the students in the story to formally and informally record their ideas. Important reasons include:

- To communicate with others:
    - o to record answers (making them available for later scrutiny or discussion);
    - o to describe or explain methods;
    - o to present information or data for themselves or others to interpret or use.
- To clarify their own thinking or ideas or to keep track of their own work:
    - o to help work out a calculation by recording interim steps;
    - o to help organise information so that it is easy to interpret;
    - o to help find a solution with the aid of a diagram;
    - o to help remember key facts or ideas.
- So that the teacher can understand how they are processing the ideas. This puts the teacher in a position:
    - o to challenge students to justify their solutions (instead of maybe settling for a guess);
    - o to discover and help resolve areas of mathematical misunderstanding;
    - o to provide further challenges or next steps.

## A second reading

The story includes four distinct mathematical episodes: (i) the paintbrushes, (ii) the crayons, (iii) the multi-link cubes, and (iv) Mr Rainbow's 19 + 19 challenge. During the second reading of the story, focus on the mathematics in each of these episodes:

(i) This problem can be used to reinforce the idea that, when adding more than two numbers, it doesn't matter how we pair them up (the *associative* principle). The numbers of paintbrushes can easily be varied for practice and to increase complexity.

(ii) How can the original problem (the difference between 17 and 26) be written, using numbers and symbols or a diagram? Have your students discuss the kind of strategy used by Ayesha. (She has used 20 as a tidy number.) For further practice at finding the difference between pairs of numbers, students could use a pair of dice labelled, for example, {13, 14, 16, 19, 24, 29} and {27, 28, 30, 33, 37, 42}. Working in small groups, they take turns at rolling the two dice and calculating the difference between them, using a tidy number strategy or an alternative and naming it.

(iii) This problem is described only in words and numbers, as well as being beautifully illustrated. You could challenge your students to find a way or ways of representing it symbolically.

(iv) The fourth problem is already represented symbolically and could be used as a model for a similar challenge problem, such as 28 + 25. Can small groups come up with at least three solution strategies each? Can they represent them symbolically or with the help of a number line or another diagram?

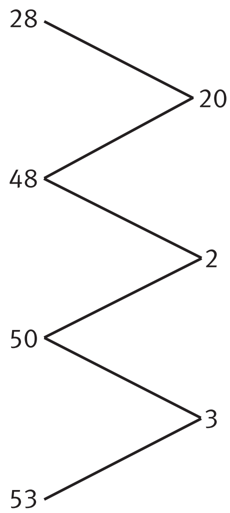
### *Number lines and diagrams*

Example (from above): 28 + 25

Number lines and other kinds of diagrammatic representations are very important ways of giving expression to mathematical ideas. Give your students copies of number lines to use and make sure that they have blank paper. Some will benefit from a structured transition in which they progress from a full number line to one with decades only and finally to an empty number line (ENL). (For Numeracy Project Material Masters 5–12, see **www.nzmaths.co.nz/numeracy/materialmasters.aspx**)

Here is a partitioning strategy represented on a number line (28 + 25 = 28 + [20 + 2 + 3]):


Here is the same strategy represented vertically as a series of "gaps":




## *Further Activities*

1. Have the students vary one of the numbers in Mr Rainbow's challenge problem by 2 or by 3. Can they adapt the strategies used by Ayesha's group so that they work with the new pair of numbers? If not, why not? Can they suggest another strategy that will work?
2. Working in groups, have the students devise their own challenge problems. After they have tested their problems to check that they can solve them using at least three different strategies, their problems can be swapped with those of another group.
3. In pairs or groups, have the students devise "Finding Friday" problems of their own. These could be "two box" or "three box" problems. For example, if one box contains 12 big and 11 small paintbrushes and one box contains 5 big and 3 small paintbrushes, how many of each are there? Or, there are 16 pegs in one box, 9 in a second, and 14 in a third. There should be 50 altogether. How many, if any, are missing?
4. Hold a "Finding Friday" competition with your class, using real examples or cards with information on them that require the students to use addition and subtraction strategies:

- Three boxes of Figure It Out books contain 10, 7, and 6 copies. There should be 30 in all. How many are missing?
- Group A has 12 large paintbrushes, 8 medium, and 9 small. Group B has 8 large, 11 medium, and 10 small. Group C has 9 large, 11 medium, and 7 small. There should be a total of 35 large, 40 medium, and 30 small. How many of each size are missing? How many are missing altogether?

The students could gain points for each strategy used.

5. Challenge your students to come up with a different, non-classroom context in which similar problems and strategies can be explored. Small groups could develop examples and try them out on each other. As always, encourage them to name the strategies they're using. By naming the strategies, they come to recognise them as tools and learn the circumstances in which each is useful.

## *Useful References*

Numeracy Project *Book 1: The Number Framework*
Numeracy Project *Book 4: Teaching Number Knowledge*
Numeracy Project Book 5: *Teaching Addition, Subtraction, and Place Value*
Numeracy Project *Book 6: Teaching Multiplication and Division*
Figure It Out: Levels 2–3, *Number*, Books 1 and 2 (students' books and teachers' notes)
Figure It Out: Levels 2–3, *Number Sense and Algebraic Thinking*, Books 1 and 2 (students' books and teachers' notes)

**www.nzmaths.co.nz** Click on the Number jigsaw piece and choose appropriate activities from Number Facts and Operating with Numbers.

## *Acknowledgments*

Learning Media and the Ministry of Education thank Mary Loveless, Faculty of Education, The University of Waikato, for writing the notes for "A Trip to Nīkau Caves", "How to Make a Limestone Cave", and "The Secret Underground", Angela Compton, Faculty of Education, The University of Auckland, for writing the notes for "Counting Kōura", and Dale Hendry, freelance consultant, for writing the notes for "Finding Friday". Thanks also to Barbara Benson, Dunedin College of Education, for reviewing the science notes; Dr Vicki Compton, Faculty of Education, The University of Auckland, for reviewing the technology notes; and Lynn Tozer, Dunedin College of Education, for reviewing the mathematics notes.

Series Editor: Rupert Alchin
Maths Editor: Ian Reid

Published for the Ministry of Education by
Learning Media Limited, Box 3293, Wellington, New Zealand.
www.learningmedia.co.nz





ISBN 978 0 7903 1979 7
Item number 31979
Students' book: item number 31978