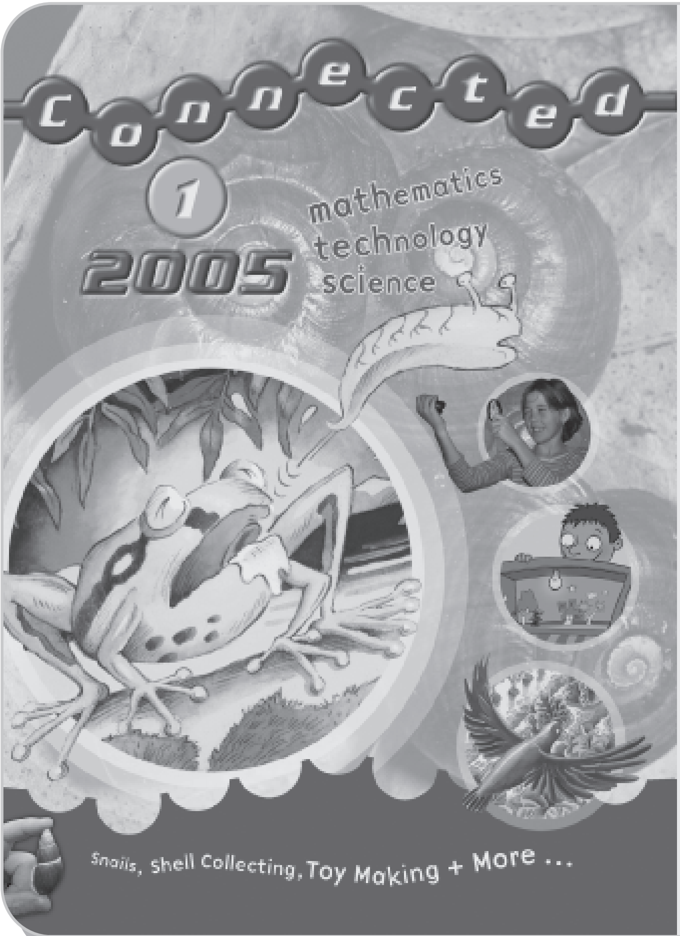
MINISTRY OF EDUCATION

Te Tāhuhu o te Mātauranga



Notes for Teachers

Connected 1 2005

Contents and Curriculum Links

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Introduction

Connected is a series designed to show mathematics, science, and technology in the context of students' everyday lives. The stories and articles provide starting points for further investigations by individuals, groups, or a whole class. Connected 1 is designed to appeal to years 3 and 4 students, working at levels 1 and 2, by reflecting their interests and experiences, expanding their knowledge and understanding, and engaging their imaginations.

General Themes in *Connected 1 2005*

The main themes in *Connected 1 2005* are snails, stage performances, and electronic toys.

1. Snails

The four items about snails explore the Living World, the Nature of Science, and Investigative Skills and Attitudes. Through their reading and follow-up activities, the students will develop an awareness of the great variety of slug and snail types and of the distinguishing characteristics that they all share. The students will consider the environmental conditions that particular species need, and they will explore ways in which scientists use this type of knowledge to develop strategies for protecting endangered species.

2. Stage Performances

"Centre Stage" is an amusing story about the problems that arise when backstage technicians have to crank handles to turn a circular stage. Because they cannot see the stage from where they are, they need to develop mathematical strategies for correctly positioning the stage and the singers and dancers who are attempting to perform on it. You could use this story to initiate student activities that explore number, ratios, and geometry.

3. Electronic Toys

"Super Toy Makers" provides a context in which students can explore possibilities for developing their own electronic toys or other automated devices with moving parts. Even young students find such activities stimulating and achievable if they are provided with the right supports. The teachers' notes offer advice about helping very young students to plan and carry out their technology projects.

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Snailville – a Great Place to Visit?

Possible Achievement Objectives

Science

Living World

- 2.1: Use differences and similarities in external characteristics to distinguish broad groups of living things (snails and slugs).

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.

The Specific Learning Intentions

The students will be able to:

- recognise a variety of slugs and snails by the distinguishing features they share;
- describe the physical characteristics of a variety of slug and snail habitats;
- present the results of a slug and snail investigation in mural form and talk about the diversity depicted.

The Key Ideas

- There are many different types of snails and slugs.
- Each type lives in a habitat that has distinct physical features.
- The lifestyle of each snail or slug is suited to the physical features of its particular habitat.

Developing the Ideas

There are many different types of snails and slugs. They have a wide variety of body shapes and forms, and they live in diverse habitats. Despite the differences between slugs and snails, young children can recognise them quite easily by looking for a combination of features. After the first reading, you could ask your students how Sigourney knew who to invite. The students could help you to draw up a list of defining characteristics of slugs and snails, which might include:

- a protective shell with a distinctive coiled shape (in the case of snails);
- an outer coating of slime on the soft body parts;
- a prominent muscular foot that is used for movement. (Most snails and slugs appear to glide over surfaces, but there are exceptions. For example, one deep-sea snail hops and many marine slugs can swim in an undulating fashion.)

Some of the items in *Connected 1 2005* focus on the impact of other *living things* on snail populations, especially predators and plants for food and shelter. The following activity takes a different perspective by making strong links between the diversity of *physical settings* and diversity of snail types.

Further Activity

A Slug and Snail Habitat Mural

What You Need

- Materials for a mural
- Images of a wide variety of slugs and snails

What You Do

- When assembling the collection of images, you could rely on books, but the Internet is also a quick and easy source. Make sure that you collect images of species that live in a wide variety of habitats. (Some students may prefer to carry out their own image searches and draw a variety of slugs and snails.)
- If you wish to emphasise classification, you could include pictures of other small invertebrates, such as worms and slaters, and make the first task an elimination exercise.
  - Ask the students to identify all the slugs and snails.
  - Ask them how they identified each example. Encourage them to talk about the defining features.
  - You could also ask them to explain how each of the eliminated examples failed to conform to the defining characteristics.
- Ask the students to reflect on the story and think about all the different sorts of places where slugs and snails live. (Freshwater habitats are not mentioned in the story, and you may wish to add them to the list.) Lead a discussion in which you draw out their ideas about the physical features of such habitats.
  - Are there a lot of plants?
  - Is there a lot of exposed rock, mud, sand, or soil?
  - Is the terrain flat, sloping, or steep?
  - Within the habitat, do the slugs and snails seek out areas that are light, shady, or dark?
  - Do they seek out areas that are warm or cool?
  - Do they seek out areas that are damp or dry?
  - Do some slugs and snails live in water rather than on land?
  - If so, is the water salty/fresh, shallow/deep, still/flowing…?
- Draw all the ideas together to begin a mural of the many possible habitats. (This activity could be adapted for other presentation formats, such as big books, posters, digital data shows, or concertina books.) Write the habitats on separate pieces of paper and attach them along a wall in a logical sequence, for example:

  The sea—The rocky shore—Damp places on land—Streams—Ponds and lakes
- Display the collection of pictures and ask the students to predict where each species lives. Ask them for clues from the pictures to back up their ideas.
- Help them to find out where each species actually does live and place each picture on the mural in its appropriate physical environment. Talk about how the slugs' and snails' physical features help them to stay alive in these very different areas.

The following chart lists a useful range of examples.

Type of snail or slug	Where It Lives	Physical Features of its Home
Garden snails	Gardens and other leafy places	On land; flattish areas with some exposed soil (Within its habitat, the garden snail avoids dry places in the open, preferring damp places in the shade.)
Pāua	Rocky seashore – below the tide line	Hard rocks that are always covered by salty water; strong currents and wave action
Limpets	Rocky seashore – in the tidal zone	Hard rocks that are exposed at low tide; hot and dry at low tide; strong wave action
Sea slugs	Sea floor	Soft sea-floor surfaces that are always covered by salty water
Pond snails	Bottom of ponds	Mud on soft pond bottom; always covered by fresh water
Paryphanta (giant native land snails)	Mainly in bush areas to the west of the main ranges on both islands	Under leaf litter (Within bushy habitats, *Paryphanta* species seek out cool, damp, dark places, which suit their physical features and those of their prey – worms. Some species live in South Island tussock country.)
Mud snails	Coastal estuaries	Mud flats at the seashore; very soft and squishy surfaces; salty, flowing water; exposed at low tide
Sea hares	Deep sea	Very cold, dark places that are covered by deep sea water; very high water pressure

What You Look For

- Do the students use appropriate words to describe the key physical features of different slug and snail habitats?
- Can they recognise snails and slugs, and can they identify the key features that even very different species share?

Useful References

- *New Zealand Geographic*, no. 7, July–September 1990, is an excellent source of information about the diversity of New Zealand's native land snails. The issue includes many colour photographs and a land snail poster.
- Library books about the rocky shore often include images of various snails and slugs.

- The physical features of rocky shore environments are described in *Life Between the Tides*, book 21 in the Ministry of Education's Building Science Concepts series (Learning Media, 2002). If your students become interested in what the various snails on the rocky shore eat, you will find background information about this in *Tidal Communities*, book 22 in the Building Science Concepts series (Learning Media, 2002).
- *Soil Animals*, book 6 in the Building Science Concepts series (Learning Media, 2001), has notes about the physical features of the soil habitats, where many native snails are found.
- If you decide to include animals other than slugs and snails in the initial collection of images, the Ministry of Education's *Making Better Sense of the Living World* (Learning Media, 2001) provides background information and activities about grouping and classification. See especially pages 18–19, 22–23, and 35–38.
- The New Zealand Curriculum Exemplars: *Science* (Learning Media, 2003, or **www.tki.org.nz/r/assessment/exemplars/sci/index_e.php**) include Living World case studies that focus on grouping and classification according to external features, for example:
  Level 1, Leaves Sort-up
  Level 3, Trotter's Bush

"The Shell Collector", "A Safe Home for Snails", and "On the Snail Trail"

Possible Achievement Objectives

Living World

- 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.
- 2.4: Investigate the responses of plants or animals, including people, to environmental changes in their habitats.

Nature of Science

- 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.

The Specific Learning Intentions

The students will be able to:

- observe snails to investigate where they commonly live;
- use information sources to identify the needs of different types of snails;
- suggest a plan for meeting the needs of garden snails;
- use information sources to identify the changes in endangered snails' habitats that have affected their ability to survive.

The Key Ideas

- Some snails are native to New Zealand, whereas others have come here from other places.
- All snails need a safe place to live.
- Different types of snail live in different places and eat different things.
- Many animals eat snails.
- If a change in a snail's habitat lasts for a long time, that kind of snail may become endangered or even extinct.
- When scientists are trying to save an endangered species, they have to find out as much as they can about the sorts of places it likes to inhabit, what it likes to eat, what eats it, and what has changed in its environment.

Developing the Ideas

Many students will have watched adults sprinkling pesticides around gardens to rid them of snails and other pests. The idea of protecting snails will be novel for these students. You may need to discuss the idea that there are many species of snail and some of them are very unusual and rare. Also, what may be a "valuable" species in one environment will be a "pest" in another – such labels are context specific. (Another well-known example of this is the possum, which is a destructive immigrant in New Zealand but a protected species in Australia.)

Exploring how scientists work is a Nature of Science activity that also supports the development of students' investigative skills. When scientists are working to increase the numbers of an endangered species, they need to consider a number of scenarios. Often they develop an idea (based on the information they have collected through their observations, their experiences, and other scientists' research), try it out, and then evaluate its success. At any point, they may need to carry out further research – and then try again.

These sorts of process can be summarised and presented as a simplified schema:

- Scientists find out what is already known about the endangered species. For example, they might review research about its preferred environmental conditions, its competitors, what eats it, and, in the case of animals, what it eats.
- They investigate environmental changes that may have impacted on the species, for example:
  - the introduction or immigration of competing species, including humans;
  - the destruction of habitat, which often results from competition with humans;
  - the introduction or immigration of predators or browsers, including humans;
  - a lack of food;
  - disease;
  - climate change;
  - cataclysmic events, including floods, droughts, and volcanic eruptions.
- The scientists form a hypothesis about the conditions that will favour the species' survival.
- They formulate a plan on that basis.
- They carry out the plan under controlled conditions, monitor the results, evaluate the plan, and alter it as necessary.
- They then implement the plan in a less controlled environment, monitor the results, evaluate the plan, and alter it as necessary.

The scientists working with the flax snails follow this model, and Rebecca Moore completes part of the process with her science fair project. The following activity sequence scaffolds students through this sort of investigation as appropriate for levels 1 and 2. You could begin by introducing the three articles in the following way.

- Introduce a garden snail to the students. Identify its main anatomical features. Ask the students for their ideas about where snails live and what they eat. Ask what eats snails. Introduce the idea that there are lots of different types of snail – perhaps by reading "Snailville – a Great Place to Live?".
- Read "The Shell Collector".
- Read "A Safe Home for Snails".
- Before reading "On the Snail Trail", ask the students for their ideas about how the scientists might be able to check up on the snails they release on Matakohe-Limestone Island.
- Read "On the Snail Trail".
- Discuss the Flax Snail Update. Ask your students to suggest reasons for the snail deaths and encourage them to justify their ideas.
- Proceed to the following activity sequence, Modelling How Scientists Work.

Further Activities

Modelling How Scientists Work

Part A: Setting the Scene

- Discuss the fact that it is illegal to keep endangered snails in classrooms.
- Present a scenario in which the garden snail has become an endangered species and the students are scientists who will try to save these snails from extinction.
- Explain that their job is to come up with a plan – but before they can do this, they will need to think about how scientists work.

Part B: Thinking about Using Information

What You Need

- The articles "A Safe Home for Snails" and "On the Snail Trail"
- Sticky labels or pieces of card

What You Do

- Ask the students to revisit the texts and help you to list what the scientists knew about flax snails. Record this information on separate fact cards or sticky labels.

Flax Snail Facts	What the Scientists Did
There are not many flax snails.	They collected some flax snails.
Flax snails have babies.	They built a special home to see if they would have some babies.
Rats, pigs, and thrushes eat lots of flax snails.	They put some snails on an island where there were no pigs or rats.
Flax snails' favourite food is karaka leaves.	They released them under a karaka tree.
Flax snails like damp places.	They put them in a shallow hole and covered them with leaves.
Flax snails are good at hiding.	They put machines on them so that they could find them later.

- Ask them to list what the scientists did with the snails. Record these actions on differently coloured action cards or sticky labels.
- Ask them to match each action card with a fact card. The chart at left summarises the key associations.
- These associations should clarify the key idea that the scientists' plan was based on what they knew about the flax snails. Your students may have other ideas about things they would need to know. Ask "What *didn't* the scientists know about flax snails?"

What You Look For

- Can the students identify relevant information in the texts?
- Can they match the scientists' actions with what they knew about flax snails?
- Can they make less obvious connections? For example, do they understand the link between snails liking rain (in other words, damp conditions) and the scientists covering them with leaves?
- Are they aware that the scientists had to find out a lot about flax snails before they developed their plan?
- Are they aware that the scientists based their plan on known snail facts?

<u>**Part C: Thinking about Planning**</u>

What You Need

- The article "The Shell Collector"

What You Do

- Ask the students to help you list what Rebecca Moore knew about kauri snails at the beginning of her project.
- Make the point that Rebecca investigated only what eats kauri snails. Ask "If you wanted to save the kauri snails from more than just predators, what other sorts of things might you need to think about?" (You may wish to refer back to the schema that summarises how scientists develop recovery plans for endangered species.) Record the students' responses as questions.
- Ask the students to work in small groups and come up with a possible plan for keeping kauri snails safe. Later, each group should present their plan to the others, who critique the plan.

What You Look For

- Do the students use known facts about the kauri snail to construct their plan?
- Do they raise other questions for consideration?
- Are they able to critique other groups' plans, giving reasons why they may or may not work?

<u>**Part D: Planning a Safe Home for Garden Snails**</u>

What You Need

- An area where snails can be observed in their natural environment
- Access to books and Internet sites about garden snails

What You Do

- Ask the students to suggest garden snail questions they will need to explore before they begin their plan.
- Assign questions to different groups or individuals.
- Take the class on a snail hunt. Explain that the main purpose is to find out what sorts of places garden snails like to live in and to look for clues about what they might eat.
- Afterwards, the students could explore reference sources to check their ideas.
  Question cards of the following type could support their planning.

What do they eat?

How will I make sure that they get the right food?

What are their enemies?

How will I protect them?

Where do they like to live?

How will I make their classroom home like their real home?

How warm do they like to be?

How will I make sure that their home is the right temperature?

Do they like to live in damp or dry places?

How will I make sure that their home is damp or dry enough?

Do they like to live in dark or light places?

How will I make sure that there are dark or light places to go to?

- Working in groups, the students then plan how to make a special home that meets the needs of garden snails. They should share their ideas with another group, consider the feedback, adjust their ideas as appropriate, and draw a detailed, labelled plan of their snail home.
- The students could then build the safe homes and keep a number of snails for a short time. Encourage them to carry out snail observations and use these to evaluate whether the snails' needs are being met. Make sure that the students return the snails to their original habitat.

What You Look For

- Do the students ask questions that relate to what they need to find out?
- Do they use observation skills and research skills to answer their own questions?
- Do they apply what they have found out about snails when they plan their snail house?
- Do they consider more than one of the snails' needs?
- Do they handle the snails carefully?

Other Activities

The following activities from *Slugs and Snails*, book 45 in the Ministry of Education's Building Science Concepts series (Learning Media, 2003), could be used to develop understanding of snails' needs:

- Meet a Snail (page 9) can be used to gauge your students' prior knowledge about snail habitats.
- The Senses of Slugs and Snails (page 12) can be used to investigate snails' responses to changes in their environment.
- What Does a Snail's Shell Do? (page 13) explores how a snail's shell provides protection.
- Eating and Being Eaten (page 14) explores food chains.

The list of resources on page 16 suggests books that are suitable for classroom research.

Useful References

- Ministry of Education (1999). *Caring for Animals: A Guide for Teachers, Early Childhood Educators, and Students*. Wellington: Learning Media. This guide, which is available in all schools, is essential reading for anyone wanting to keep animals in the classroom. It addresses ethical issues and provides specific guidelines for the care of common classroom animals.
- "Impacts of Feral Pigs on D'Urville Island's Invertebrates", a recent article in Landcare Research's online journal, *Kararehe Kino*, reports on an investigation funded by the Department of Conservation. The main invertebrate discussed is a species of the native snail genus *Powelliphanta*. The article can be accessed at:

  www.landcareresearch.co.nz/publications/newsletters/possnews/KarareheKino4.pdf

Super Toy Makers

Possible Achievement Objectives

Technological Areas

Electronics and Control Technology

Structures and Mechanisms

(See the Specific Learning Intentions for links to relevant Achievement Objectives.)

Science

Physical World

- 1.4: Describe uses of items of everyday technology, and, in simple terms, suggest how they work.
- 2.1/2: Investigate and describe their ideas about some everyday examples of physical phenomena.

The Specific Learning Intentions

In developing their own electrical devices with moving parts, the students will be able to:

- experiment with wires, a battery, and a motor in order to make a simple circuit by connecting them in sequence (AO 1, 2b, 3);
- explain the concept of visual appeal in relation to toys or puppets (AO 4, 5, 6a, 6c, 7, 8);
- explain the concept of reliable function and strength of construction when designing a device with automatic moving parts (AO 1, 2, 6a–c, 8);
- trial and select appropriate materials and methods of joining and controlling them in order to construct a device with automatic moving parts (AO 1–4, 6a–d);
- communicate the details of the circuit retrospectively through a two-dimensional drawing of the design (AO 4, 6c).

The Key Ideas

The following suggestions for supporting the technological practice of young students can be implemented in a wide range of contexts.

1. Engagement with any teaching and learning task will be enhanced if your students take part in selecting the direction of their own learning.
2. You should negotiate with your students the criteria that guide their practice.
3. Making links between the investigation, planning, and final construction of a technological outcome is challenging for students of all ages. It is important to help your students to keep their end goal in mind as they work through the various stages of their product development.
4. It is important to allow the students plenty of time to discuss, trial, and modify their outcomes so that they are able to achieve a workable solution.
5. Successful technological activity often relies on students actively exploring appropriate knowledge bases, for example, physics, economics, biotechnology, food technology, and the arts.

Developing the Ideas

In order to focus your students' thinking on the key aspects of technological practice exemplified in "Super Toy Makers", you could discuss the following features of the storyline.

1. The students initiated the technological task and helped to drive the overall process.
2. The students were clear about the task and understood the criteria they needed to work to. They understood that the final product needed to be aesthetically pleasing, robust, and reliable.
3. The students were able to make links between the investigation, planning, and final construction of their chosen solution.
4. The opportunities for the students to discuss, trial, and modify constructions were critical to a successful outcome.
5. To complete a successfully functioning product, the students needed opportunities to explore how simple electrical circuits work.

Further Activities

1. and 2. Learning Directions and Criteria for Student Practice

"Super Toy Makers" exemplifies the way in which technology projects often emerge from the hurly burly of the classroom. You can make the best use of such opportunities if you build flexibility into your long-term planning.

From the outset, the students need to be familiar with the topic and able to connect with it. In the contexts of toys and electronics for young students, focusing on everyday objects at an early stage allows them to draw on their existing knowledge of product purpose and functioning. Because the learning sequence is initiated by the exploration of something familiar, the students will be likely to participate willingly, confidently, and enthusiastically. In such situations, they will be better able to develop a workable outcome.

Useful References

- The New Zealand Curriculum Exemplars: *Technology* (Learning Media, 2003, or **www.tki.org.nz/r/assessment/exemplars/tech/index_e.php**)
  Level 1, Cameron's Pterosaur
  Level 1, Personal Posters

Level 1, A Stand or Hanger for a Photoframe
Level 2, Kidzdough

- Louise Milne "Put Your Finger on Your Nose if You Are Proud of Your Technology" in *Set: Research Information for Teachers,* no. 1, 2004.

Focus Questions

The following types of question will help to clarify the students' ideas about key product attributes in a range of contexts.

- What is the product (or system or environment) I need to develop?
- What is the product's purpose?
- Who is going to use the product?
- Does it need to be easy for anyone to use, or will it be used by people with existing skills?
- Where is it going to be used?
- How long will it need to last?
- How many times will it be used?
- How reliable and strong does it need to be?
- Is the way it looks important? If so, how should it look?
- What similar products do we have that would give us some further ideas?

3. Maintaining a Focus on the End Goal

With young students, it can be a challenge to ensure that the purpose and functioning of their final product remains clear in their minds throughout the unit. Young students can easily become distracted, lose track of where they are heading, or focus too much on certain aspects of the brief at the expense of others. For example, they may give more attention to aesthetics than to functionality. Useful prompts include wall charts, pictures, diagrams, and photographs that summarise the work completed and the work yet to be tackled. It is also helpful to consistently recap the previous session and clearly describe upcoming tasks.

Young students sometimes become confused about the various design stages they need to work through. This may make them reluctant to participate. The planning and prototyping stages are a good example. Young students can construct simple 2-dimensional design drawings, but they often find it hard to relate these to a 3-dimensional structure. In addition, they are often unable to visualise the final product with all the possible options of colour, decoration, size, and design. Rather than expecting young students to plan too far in advance, it is often more effective to give them time for hands-on experimentation and then allow them to work through a construction process of trial and improvement. (Older students, given the right support and prompts, can usually work through a more structured, long-term planning and implementation process.)

Useful References

- The New Zealand Curriculum Exemplars: *Technology* (Learning Media, 2003, or **www.tki.org.nz/r/assessment/exemplars/tech/index_e.php)**
  Level 1, Cameron's Pterosaur
  Level 1, Muffins for the Visitors
  Level 1, A Stand or Hanger for a Photoframe
- Judy Moreland "Putting Students at the Centre: Developing Effective Learners in Primary Technology Classrooms" in *Set: Research Information for Teachers*, no. 1, 2004.

Focus Questions

The following types of question will help your students to plan their hands-on time in a range of contexts.

- What tasks do I need to complete in order to plan, construct, and test my design?
- What would be the best sequence in which to tackle these tasks?
- Are there some things I need to find out about?
- Where can I find the information?
- Are there some things I will need help with, and who might help me?
- What sorts of materials should I use?
- How will I know if my design will work?
- Is there a way of checking my design before I make it?
- What do I do if it doesn't work properly?

4. Allowing Time for Trial and Modification

In order to fit technology into an already full programme, it can be tempting to "blitz" some tasks. "Super Toy Makers" exemplifies the importance of focused, exploratory discussions with teachers and classmates. The story also illustrates the time required for generating ideas, planning for practice, and testing, modifying, and retesting possible solutions.

Useful References

- The New Zealand Curriculum Exemplars: *Technology* (Learning Media, 2003, or **www.tki.org.nz/r/assessment/exemplars/tech/index_e.php)**
  Level 1, A Stand or Hanger for a Photoframe
  Level 1, Creative Cards
  Level 2, Kidzdough
  Level 2, Library Environment
- Louise Milne "Put Your Finger on Your Nose if You Are Proud of Your Technology" in *Set: Research Information for Teachers*, no. 1, 2004.

Focus Questions

The following types of question will help your students to reflect on their progress in a range of contexts.

- Does my solution work in the way I expected?
- If not, what changes do I need to make?
- How long will these changes take?
- Can the person using my solution operate it easily?
- If not, how can I make it more user-friendly?
- Do I need to think about instructions for using it?
- Is my design strong enough to last for as long as it needs to?
- If not, how could I make it stronger and longer lasting?
- Does my solution look as it should?
- If not, what changes do I need to make to the way it looks?

5. Exploring Relevant Knowledge Bases

The students' work in "Super Toy Makers" emerged from a science investigation and was supported by science knowledge and skills. In particular, the unit provided an opportunity for students and teachers to think about and experiment with simple electrical circuits. Cross-curricular integration is a feature of many technology case studies, and the New Zealand Curriculum Exemplars also provide examples from strands other than the Physical World, for example, Terrarium Environments, which draws on Living World knowledge and skills.

Although electrical circuits are first mentioned explicitly at level 2 of *Science in the New Zealand Curriculum*, younger students are capable of working in this area. In fact, even pre-schoolers happily experiment with simple circuits. In this experimental work, it is important that the students keep their task and final goal in mind so that their exploration stays focused and useful.

Useful References

- The New Zealand Curriculum Exemplars: *Technology* (Learning Media, 2003, or **www.tki.org.nz/r/assessment/exemplars/tech/index_e.php)**
  Level 1, Cameron's Pterosaur
  Level 1, Terrarium Environments
  Level 1, Speedy Switches

Focus Questions

The following types of question will help the students to explore electrical circuits.

- What components do I need in my circuit to make a light shine?
- What materials are these components mostly made from?
- What happens if I replace the wires with something made of plastic or wood?
- What happens if I turn some of the components around?
- What else can I put into the circuit instead of a light?
- How can I make the light [buzzer, motor, etc.] go on and off?
- Can I put more than one of these components into a single circuit?
- How could I create a moving device using an electrical circuit?

Activities that Explore Electricity and Electrical Circuits

The Ministry of Education's *Making Better Sense of the Physical World* (Learning Media, 1999) includes background information for teachers and a range of student activities that explore electricity and electrical circuits. See Science Focus: Electricity, especially pages 68 to 73.

Centre Stage

Possible Achievement Objectives

Mathematics

Number

- Find, by practical means, one half and one quarter of a shape, and a half of a set of objects (Exploring computation and estimation, level 1).
- Write and solve comparison problems (Exploring number, level 2).
- Write and solve story problems which involve halves, quarters, thirds, and fifths (Exploring number, level 2).

Geometry

- Follow and give a sequence of instructions related to movement and position (Exploring shape and space, level 1).
- Rotate their body and other objects through quarter and half turns (Exploring symmetry and transformations, level 1).
- Make clockwise and anticlockwise turns (Exploring symmetry and transformations, level 2).

Algebra

- Write number sentences, using = , from story contexts (Exploring equations and expressions, level 1).

Developing the Ideas

Few students will have been to a theatre that has a revolving stage, so you may need to begin by connecting the story with what they know. A good starting point could be the pop-idol contests or similar shows screened on television. These typically use very elaborate stages, with complex lighting and sound. Simpler examples are the revolving platforms that some car showrooms use to feature a product, the small revolving platforms that stores sometimes use to display merchandise, or even the "lazy Susan" on the barbecue table. Some students may have been to a restaurant with a revolving floor or a milking shed with a revolving floor for the cows. If so, they may be happy to talk about the experience. Ask your students for their ideas on how these revolving platforms might work.

Revolving stages such as the one in the story have two main functions: to provide an eye-catching special effect and to make it possible for technicians to change the scenery without interrupting the performance.

Discuss with your students the way in which the stage in the story has been divided to accommodate Donna's performance, then Room 9's weather dance. Get the students to model the stage set up for both performances (that is, one with the stage divided into halves and one with it divided into quarters). Paper circles would be ideal for this. Get the students to look at and discuss the two different set-ups and how they relate to each other. By modelling with materials, help them to see that a quarter plus a quarter = one half, that halving a region means dividing it into two equal parts, and that a half of one half = one quarter.

Next, get the students to consider how the stage moves. The gears (or pulleys) that link the handles to the stage in the story are hidden from the observer, but without them, it wouldn't turn.

It will help your students imagine the workings if you do a demonstration using two very differently sized wheels linked with a rubber band. This will suggest how it is that the crank handle in the story has to turn many times just to make the stage turn once.

It is possible that the stage is turned using a system of gear wheels instead of pulleys. Gears and pulleys have a similar function, and if your school has sets of plastic gear wheels, you could demonstrate that there is an exact and predictable relationship between the number of turns that one wheel makes and the number of turns that one meshed with it makes. Explain to the students that they can make predictions based on the number of teeth that the two wheels have: if 12-tooth and 24-tooth wheels are meshed, the smaller wheel will have to turn exactly twice before the big wheel turns once, because 12 x 2 = 24. Alternatively, if the big wheel is turned once, the small wheel will turn twice. This is a simple example of ratio and proportion at work.

With a revolving stage, an enormous weight is moved using a very small gear wheel to turn a much bigger gear wheel. Certainly the little wheel will need to be turned lots of times – but this is not a problem for a stage crew. The stage will turn very slowly – and this is exactly what is needed. No one wants to see the actors or the scenery go flying off into the audience.

Tama and Alice discover that they need to turn the handle 60 times to make the stage turn once. If half this number of turns is made (30), the stage will turn just halfway round. It will therefore take just 15 handle turns to turn the stage one quarter of the way round. The students can find the number of handle turns needed to turn the stage three-quarters of the way around by adding one half-turn and one quarter-turn, giving 30 + 15 = 45 handle turns.

Further Activities

Dividing the Stage Differently

By varying the sectors of the stage, the remaining fractions listed in the Number, level 2 achievement objectives can be introduced in a similar way. For example, the stage could be divided into thirds or fifths.

Approaching the problem as before, the students could ask "How many handle cranks are needed to turn the stage one fifth of a turn?" Reasoning it out, it takes 60 handle turns for 1 turn of the stage: 60 = 12 + 12 + 12 + 12 + 12 (using an Early Additive approach); therefore, the handles must be cranked 12 times.

Links to the Number Framework

Stage Two: Counting from One on Materials (Dividing up the stage.)

Stages Three and Four: Counting from One by Imaging and Advanced Counting (Counting On)
Imaging doubles to 10 and corresponding halves; equal sharing.

Stage Four: Advanced Counting (Counting On) Imaging doubles to 20 and corresponding halves. (Determining the handle turns for a part stage turn.)

Stage Five: Early Additive Part-Whole Finding a fraction of a number by repeated addition or subtraction (for example, $\frac{1}{4}$ of 60).

Fraction Pieces, page 6, *Book 4: Teaching Number Knowledge* and material master 4.19 (Numeracy Project materials) could be used in conjunction with this Connected story.

See also Fun Folding, pages 22–23, and Finding Fractions, page 24 of *Number: Book Two*, Figure It Out, Level 2.