MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

Notes for Teachers

Connected 2 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 2 is designed to appeal to **year 4–6** students who are working at **levels 1–3**.

General Themes in Connected *2 2007*

1. Two technology items in this collection explore rice grains and flour as versatile staples that have a central place in traditional Asian food technology. The grains and other parts of the plant are also widely used as art, packaging, and building materials. "Rice, Rice, Rice" describes the manifold ways in which the Vietnamese make traditional use of all parts of the plant. The companion article, "Room 8's Rice Craze", recounts the way in which a class of innovative New Zealand students become fascinated by all the traditional uses for rice – and decide to develop some new rice products of their own.

2. Microbes are the subject of "The Good, the Bad, and the Ugly", which describes the ubiquitous nature of bacteria, fungi, and viruses, the ecological roles they play, the many ways in which humans take advantage of bacteria and fungi, and microbes' occasional role as pathogens (disease-causing organisms). "The Invasion" expands on the last of those topics by describing a chickenpox infection and its effects on various cells and tissues as the infection progresses. The body's immune responses are also described. These responses lead to full recovery and long-term immunity.

3. Sequential patterns are the subject of "The Finishing Touch". In this story, a mother and daughter are planning to decorate their rumpus room. As part of the planning, they take the guesswork out of design decisions by mathematically appraising all sorts of options for sequences of both patterns and colours.

"Rice, Rice, Rice" and "Room 8's Rice Craze"

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

Technological Practice

- Planning for practice (L 2, 3)
- Brief development (L 2, 3)
- Outcome development and evaluation (L 2, 3)

Nature of Technology

- Characteristics of technology (L 2)
- Characteristics of technological outcomes (L 2, 3)

Technological Knowledge

- Technological modelling (L 2)
- Technological products (L 2, 3)

Possible Technological Areas (TechiNZC)

Food Technology
Materials Technology
Production and Process Technology

The Specific Learning Intentions

Technological Practice

The students will be able to:

- investigate different ways in which edible rice paper is used;
- experiment with techniques for making edible rice paper in order to test and evaluate the product for use with local food items;
- understand the technological principle of fitness for purpose.

Nature of Technology

The students will understand that:

- simple technological products or equipment allow people to extend their capabilities;
- the successful development of new products based on existing ones requires product knowledge and the ability both to follow known techniques and to innovate.

Technological Knowledge

The students will understand that:

- the successful development of a new product requires purpose, clearly defined user groups, and agreed performance properties;
- the trialling of prototypes is an essential phase in the development of a new or improved product;

- knowledge of the material properties of rice flour and rice paper is essential if we wish to use these materials in new or improved products;
- extensive knowledge of the process of constructing rice paper is likely to ensure a successful outcome.

The Key Ideas

- Successful technological practice involves exploring the appropriate knowledge bases. In this case, technological practice is supported by scientific understanding about the ways in which materials change physically and chemically when treated in various ways.
- Fitness for purpose is a key element in most technological developments – the product must serve its purpose and meet the needs of the consumers for whom it is developed.
- Trial and error can be a key feature of technological development. However, this should be tempered by a thorough initial investigation of existing materials and products. This and the use of local expertise in the early stages can reduce the haphazard nature of trial and error, turning it into something that's better described as informed experimentation.
- Serendipitous or accidental discoveries are a well-recognised phenomenon in the world of science and technology. The "decorative humidity meters" are a good example of this.

Developing the Ideas

In the following discussion, rice paper made from milled rice grains is referred to as "edible rice paper". This distinguishes it from other products that are also known as rice paper but are in fact made from rice straw or fibres from other plants, such as hemp and bamboo. These "rice papers" are used for writing and decorative purposes. It would be useful to clarify this distinction with students after the first reading and go on to discuss how the different properties of the various base materials for rice paper affect the properties of the paper. For example, rice paper made from flour is not fibrous and therefore lacks the strength and texture of rice paper made from straw.

In order to focus students' minds on the important aspects of technological practice exemplified in "Rice, Rice, Rice" and "Room 8's Rice Craze", you could discuss the following key ideas after the first reading.

Innovative Practice Is Supported by Knowledge of Existing Practice

The students' successes in "Room 8's Rice Craze" were underpinned by their understanding of traditional technological processes and products. At the outset, they decided to emulate traditional practice in order to gain first-hand experience of rice flour and the various ways in which it can be treated. Their plan was then to build on this structured exploration of base materials by branching out with innovative ideas.

This strategy reflects the reality that most units of classroom technology are built into tight timeframes and budgets. Efficiency of practice is therefore important. To that end, an initial manipulation of materials (in this case, by emulating traditional practice) allows students to gain a feel for what they can do with particular materials or ingredients. This general exploration of materials can bring great benefits later when followed up with the more focused development of mock-ups. Also, it's important to acknowledge that the hands-on, experimental method of design engages many students who experience less success with more abstract approaches.

Serendipitous Discoveries

A chance discovery or insight can be very exciting – and hugely beneficial in a technology project. The decorative humidity meters in "Room 8's Rice Craze" provide an excellent opportunity to introduce this idea. You may wish to augment the discussion with reference to "Fever" and "'Eureka!': Accidental Breakthroughs in Science", both in *Connected* 3 1999.

Web-based Information: Treat with Care!

Authenticated and credible web-based sources of information are very useful when researching an unfamiliar product. The BBC-approved use of rice flour in bird feed is a good example of this.

During their studies or recreational browsing, your students may well have been inundated with information in response to key-word searches. Working out whether the information is reliable can be a big challenge. There are now several authenticated websites that help teachers and their students to sift through and evaluate websites and the information they provide. See, for example, **www.quick.org.uk**

Further Activity: Developing Edible Baking Cups

The Specific Learning Intentions

Note that all the following learning intentions will be achievable through the practice described and may therefore arise in formative assessment as the unit progresses. It is suggested, however, that for summative assessment, you select three or four that are of particular relevance to your programme.

Planning for Practice

The students will be able to:

- draw up a plan that identifies the key stages in developing a new rice-based product;
- understand the technological principle of optimisation.

Brief Development

The students will be able to:

- explain the purpose of the project being undertaken;
- design and carry out a survey of consumers to find out the preferred attributes of a new rice-based product;
- detail the desired attributes of the product, which have resulted from the consumer survey, personal research, and product testing;
- sketch the intended outcome and provide accompanying notes to describe equipment, materials, shape, and measurements.

Outcome Development and Evaluation

The students will be able to:

- investigate existing edible products for encasing foods, for example, casein film, edible starch, and mesquite gum products;
- describe the key features of expert practice when working with rice flour or paper;
- carry out and record the results of a taste testing exercise that aims to determine the preferred attributes of a rice flour or paper product;
- evaluate their final product against the intended attributes.

An Introductory Scenario

Technology activities can spring from a variety of starting points. In "Room 8's Rice Craze", a teacher's journey through Vietnam motivated students to further investigate and experiment with edible rice paper. The following starter activity could be used in the early stages of a unit in which your students develop edible casings or containers for local food products. The following scenario and focus questions are just illustrative examples, which could be adapted for a wider range of casings or containers.

On the Why Not? website, which invites visitors to contribute and help solve problems by using their own everyday ingenuity, one problem reads as follows:

> It is a nuisance having to peel off the paper liners when eating cupcakes. It would be convenient if the liner cups were made of rice paper so that the consumer could eat the whole thing without the troublesome procedure of peeling off the paper cup.
>
> **www.whynot.net/ideas/2124**

Possible Focus Questions

- Where might we find a variety of recipes for cupcakes and muffins?
- When do people tend to eat them?
- How are they usually presented?
- What are the advantages of lining containers for baking cupcakes and muffins?
- What might people expect of the product if the lining could be eaten?
- Do you think it might affect the taste and texture of the cupcake?
- How can we find out more information to help us?

Planning for Practice

- In discussion with you and their peers, the students should clarify the purpose of their project and plan how they are going to achieve their desired outcome. This may include:
    - researching existing food products that include an edible casing, for example, spring rolls, sausages, samosas, tempuras, and battered foods. The students could find out what the casings are made of, how they are made, and whether they are healthy to eat. This final point could lead to research into who decides what's healthy and why;
    - making contact with experts in Asian cooking to find out "tricks of the trade" for making and using rice paper;
    - briefly researching commercial products, such as edible casein film, starch, and mesquite gum.
- Planning may also include identifying which resources they need and how best to design and trial their outcome. You and a visiting expert could assist with this decision making.
- At this point, information about safe food handling practices will be necessary.

Brief Development

- The students should decide which type of product they wish to develop and why. The reason may be to do with developing:
    - a healthier alternative to, for example, pie or sausage roll crust;
    - a convenient outcome such as an edible casing in which to bake cupcakes or muffins.
- They should also decide which consumer group they wish to target and then explore their preferences.

- This might include developing a simple survey in order to gain information about the attributes consumers would look for.
- For example, consumers are likely to expect visual and textural qualities that do not detract from the product.

Planning for Practice

- Having defined their intended outcome, the students should carry out further planning in which they develop a suitable process.
- They could detail their decisions in the form of simple flow charts that show the planned actions and the necessary time and resources.

Outcome Development and Evaluation

- With your support, students can plan and carry out simple taste tests that will help them develop knowledge about the flavour, texture, and thickness (including multiple layers) of their casings or edible containers.
- They will need to explore those factors in combination with the intended filling. For example:
  - if developing a rice-paper pie or sausage roll crust as a healthy alternative to pastry, they will need to explore how the flavour and texture of the rice-paper crust combine with the filling;
  - if developing an edible container in which to bake a muffin or cupcake, they will need to experiment to ensure that the uncooked batter will not soften the casing too much. (If the hard casing softens, it might collapse before the enclosed mixture cooks solid.)
- The next phase might focus on the visual appeal of the product. For example:
  - a rice-paper crust might not bake golden brown like a pastry crust. If that's the case, will consumers mind? (The students should refer back to their earlier consumer research or conduct further research if aesthetic considerations weren't canvassed earlier.)
  - the students may need to experiment with additives that add colour without affecting the taste, or additives that add colour and a desirable flavour. Healthy eating issues will need to be considered in this instance.
- Production and process options will also need to be trialled. If the students intend to mass produce the casings, aesthetic options such as decorative flourishes may need to be balanced against economic and/or procedural factors. For example:
  - ideally, what shape should the rice paper be cut into in terms of aesthetics?
  - which shape and size would best optimise the quantities of raw materials and which options would suit fast-paced, production-line manufacture?
- When the testing phase is complete, and the students are satisfied they have the information they require, they could draw a simple labelled diagram, including explanatory notes, to show their final design ideas, and present the diagram to their consumer reference group for feedback.
- Finally, students could make up a trial product to test how their selected ingredients and/or product components work together. If all is working according to plan, this should be followed by the completion of their final product.
- Ideally the final product should be formally presented to interested and supportive representatives from a local food outlet or bakery for comment, advice, and maybe even expressions of commercial interest!
  - Most supermarkets have bakery sections and are usually willing to offer support to young designers.

- Your local Futureintech representative could also help you to find suitable experts for this role.
- Watch for opportunities to participate in food technology competitions advertised in Starters and Strategies and other technology education publications.

Cross-curricular Links

"Rice, Rice, Rice" and "Room 8's Rice Craze" provide a springboard from which you could launch a wide variety of activities in science and environmental education as well as technology.

Science

In the process of developing rice-based food products, students could scientifically investigate, record, and analyse the properties of ingredients and the ways in which they change and interact when heated separately and together. They could also scientifically explore the shelf life of edible rice paper and investigate the changes that occur when the product is moistened and reheated.

Environmental Education

Rice-paper food containers are readily biodegradable, as shown by the rapid moulding of Room 8's rice-paper plates. On a local and national level, students could consider the problems associated with increasing residential waste and the need to appropriately locate new landfills. On a global level, the establishment and maintenance of sustainable practices to address these problems could also be explored. See the Ministry of Education's *Guidelines for Environmental Education in New Zealand Schools* (Learning Media, 1999 and online at **www.tki.org.nz/r/environ_ed/guidelines/index_e.php**).

The Good, the Bad, and the Ugly

Possible Achievement Objectives

Science

Living World

- 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;
- 3.1: Distinguish between living things within broad groups on the basis of differences established by investigating external characteristics.

The New Zealand Curriculum: Draft for Consultation 2006

Nature of Science

- 1/2: Students will appreciate that scientists ask questions about our world that lead to investigations and that open-mindedness is important because there may be more than one explanation. (Understanding about Science)
- 1/2: Students will explore and act on an issue that links their science learning to their daily living. (Participating and Contributing)
- 3/4: Students will build on prior experiences, working together to share and examine their own and others' knowledge. (Investigating in Science)
- 3/4: They will ask questions, find evidence, and carry out appropriate investigations to develop simple explanations. (Investigating in Science)

Living World

- 1/2: Recognise that all living things have certain requirements so they can stay alive. (Life Processes)
- 3/4: Recognise that there are life processes common to all living things and that these occur in different ways. (Life Processes)
- 1/2: Recognise that living things are suited to their particular habitat. (Ecology)
- 3/4: Explain how living things are suited to their particular habitat and how they respond to environmental changes. (Ecology)
- 3/4: Begin to group plants, animals, and other living things into science-based classifications. (Evolution)

The Specific Learning Intentions

The students will be able to:

- recognise fungi, bacteria, and viruses as three very distinct types of micro-organism;
- describe key features that distinguish fungi, bacteria, and viruses;
- from a human point of view, explain helpful and harmful effects of micro-organisms;
- investigate the optimal growth conditions for bread mould.

The Key Ideas

- Fungi, bacteria, and viruses are three very common types of micro-organism.
- They can be helpful or harmful to humans, but are usually neutral in terms of direct effects.
- The role that many bacteria and fungi have as decomposers/nutrient recyclers is crucial to ecosystem function.
- Micro-organisms are present everywhere, but they require particular conditions for growth. For example:
    - each bacterial and fungal species requires a specific range of temperature and moisture;
    - viruses require living cells in which to reproduce.

Developing the Ideas

An ideal time to introduce this topic would be when chickenpox or another illness such as a flu or cold is going around the school. Ask the students how they think people catch the illness. Alternatively, you could introduce the topic by showing the students a piece of mouldy bread, fruit, or cheese or by asking, when someone has yoghurt for lunch, how they think yoghurt is made.

When introducing the topic, ask your students whether they have heard the term "micro-organism". If so, can they define it? Can they name three very common types of micro-organism? If not, ask a few simple questions and record the students' responses on a chart. For example:

- What are bacteria, fungi, and viruses?
- How do they survive?
- Where are they found?
- What conditions do they need in order to grow?
- How are bacteria, fungi, and viruses different from each other?

Then read "The Good, the Bad, and the Ugly" in a shared reading context. Afterwards, ask the students to identify the big ideas. You could support them by asking them to read the article again individually to better familiarise themselves with the information. Then hand out photocopies of the article, along with a series of numbered questions that focus on the key ideas. Ask the students to work in pairs, using highlighters to underline and number the sentences in the article that provide the answers. Your questions could relate to all of the following big ideas or to a selection:

- micro-organisms are present everywhere.
- micro-organisms are too small for us to see individually, but colonies are sometimes visible.
- many micro-organisms decompose organic material.
- some micro-organisms cause disease by invading plant or animal tissues.
- fungi, bacteria, and viruses are three common types of micro-organism.
- fungi can be single-celled or multi-celled.
- bacteria and viruses are single-celled.
- viruses are much smaller than bacteria and fungi.
- in order to reproduce, viruses must invade the cells of a living organism.
- some micro-organisms are helpful to people.

- some micro-organisms are harmful to people.
- although some micro-organisms specialise in causing disease, many are only "accidentally" harmful.

Afterwards, discuss the answers as a whole class and review the chart to confirm or amend the students' initial ideas.

Further Activities

You could have the students carry out the following activity as a structured experiment for which you provide the stepwise instructions given below. If taking this approach, discuss the procedures with the students, ensuring that they are able to explain the methodology in terms of establishing particular conditions and controlling the variables. Alternatively, you could begin with some focus questions and during the ensuing discussion, guide the students towards an investigation similar to the one below, allowing them to plan the investigation as much as possible. The focus questions might include:

- Where have you seen mould and other fungi growing?
- What things do they grow on?
- Do you think they:
  - o grow best in light conditions?
  - o grow best in dark conditions?
  - o are not affected by light levels?
- How would you plan an investigation to explore whether mould growing on bread is affected by light, moisture, and temperature? (Think about different ways of treating the bread and different places in which you could leave it to see whether it turns mouldy.)

Activity: Growing Fungi

In this activity, you will investigate how environmental conditions affect the growth of fungi. For your safety and to prevent contamination, the bags must be kept sealed.

Safety Warning

Some people are allergic to fungal spores. It is therefore important to keep the bags sealed throughout the activity. Dispose of the sealed bags by incinerating them or placing them in the school garbage collection.

What You Need

9 slices of white bread (fungal growth shows up best on white bread)
9 snap-lock plastic bags
Sticky tape

What You Do

- Toast 3 slices of bread and allow them to cool.
- Place a slice of toast into each of 3 snap-lock bags and seal them. Secure them shut with sticky tape to ensure they don't accidentally open.
- Place a slice of untreated bread into each of 3 snap-lock bags and seal them in the same way.
- Moisten 3 slices of bread with sprinkled water. Put a slice into each of 3 snap-lock bags and seal them in the same way.

- Place 1 of each slice (toast, untreated, and moist) in a warm dark place such as a hot-water cupboard, 1 of each in a classroom cupboard, and 1 of each in a fridge.
- Giving reasons, predict which slices of bread will have developed the most and least mould after a week.
- Observe the samples daily and record how much mould has developed on each. Use diagrams and/or written descriptions.

Note for Teachers: What to Expect

Mould growth should develop on the moist bread in the warm conditions after 1–2 days; on the untreated bread in warm conditions after 3–4 days; no growth should appear on the toast. The moist and untreated bread kept in a cupboard will also moulder, but not as quickly as the warm samples. None of the refrigerated samples should develop mould in the course of a week. This demonstrates that, as well as a food supply, bread mould needs both warmth and moisture to grow.

Extension

The students could investigate whether different results are obtained when the moulds are grown in light conditions. You could ask them to design and carry out an investigation into this question.

What You Look For

- Do the students link the three ways in which the bread was treated with three distinct moisture levels?
- Do they link the three places in which the samples were stored with three different temperature levels?
- When making their initial predictions, do the students make reference to both moisture and temperature as the two variables?
- Do they correctly infer from the results that both warmth and moisture are important factors?
- If the students go on to design an investigation into the effects of varying light levels, does their suggested methodology reflect the principles of fair testing?

Activity: Growing Bacteria

Bacteria and fungi will grow on nutrient agar plates. Agar is derived from seaweed. Petri dishes lined with sterile agar can be sourced commercially or obtained from the science department of your local secondary school.

What You Need

3 agar plates

What You Do

- Seal one agar plate by running sticky tape around its edge so that the base and the lid cannot be separated. This is your "control" plate – the untreated plate against which you will compare results from the treated plates.
- Treat one plate by opening it and waving the agar-filled base in the air for a few seconds. Close the plate and seal it with sticky tape.
- Treat the third plate by gently but firmly pressing your fingertips against the surface of the agar. Close the plate and seal it with sticky tape.
- Put the three plates in a cupboard at room temperature.
- Giving reasons, predict what will happen.

Safety Warnings for Students

The agar plates must not be heated above room temperature. This is because disease-causing bacteria may grow if they reach body temperature. The plates must also remain sealed at all times. Under no circumstances should you open them. Return the plates to your secondary school for disposal. If this is not possible, either incinerate them or cut the sticky tape with a razor blade and, without detaching the lids, carefully immerse them in a 10 percent solution of water and bleach. Allow them to open when fully immersed, and leave them to soak for 24 hours before disposing of them.

These safety warnings are very important if you are growing bacteria from your fingertips in a Petri dish. Growing bacteria from toilet areas, including sinks and doorhandles, is far more dangerous and strictly forbidden. The Ministry of Education has guidelines for growing micro-organisms. See page 34 of *Safety and Science: A Guidance Manual for New Zealand Schools* (Learning Media, 2000).

Note for Teachers: What to Expect

After 24 hours, there should be signs of fungal and bacterial growth on the treated plates but none on the control plate. Fungi appear as furry-looking growths. The smooth, shiny growths are bacteria. Explain to your students that each growth is made up of millions of fungal or bacterial cells. In the case of fungi, each cell is part of a multi-cellular organism. In the case of bacteria, the growths are colonies made up of millions of individuals.

The plate exposed to the air will generally contain a mixture of evenly-scattered fungal and bacterial colonies. Their presence will reinforce the fact that microbes are found everywhere – even in the air we breathe. Take the opportunity to remind the students how important it is to cover their mouths and noses when they cough or sneeze to avoid spraying microbes into the air.

The finger-treated plate will develop colonies of bacteria and fungi within the areas touched. Take the opportunity to remind students that we all have many micro-organisms on and in our bodies. And, although they are generally not harmful to us, we should wash our hands regularly – especially before eating and after covering our mouths when coughing or sneezing, going to the toilet, touching pets, and so on.

What You Look For

- Do the students understand that micro-organisms are too small to see individually but are visible as colonies?
- Do they understand that, although most micro-organisms are not directly harmful to us, some do cause disease?
- Can they describe some of the everyday precautions we should take to avoid contacting and/or passing on microbes?
- Can they explain the role of the control plate in the investigation?

Related Activities

The following Ministry of Education publications include information or activities about fungi and their ecology.

Book 56, *Bread: The Chemistry of Breadmaking* (Learning Media, 2004) introduces concepts and ideas that can be applied to other food preparation processes. Students at the upper levels could use the activities to study fair-testing procedures, while students at the earlier levels could use them as guided observations.

Book 23, *Fresh Food: How Food Keeps and Loses its Freshness* and Book 24, *Preserving Food: Processes in Food Storage* (both Learning Media, 2002) provide students with opportunities to investigate the physical and chemical properties of perishable commodities, including the properties that denote 'freshness'; how those properties change over time; and the methods we use to keep food fresh.

Book 53, *Moulds Are Fungi: Structure, Function, and Interrelationships* (Learning Media, 2004) explores how moulds grow quickly, have a wide variety of forms, are common around the home and garden, and can be explored in classroom investigations.

The Invasion

Possible Achievement Objectives

Science

Living World

- 3.2: Investigate special features of common animals and plants and describe how these help them to stay alive.

The New Zealand Curriculum: Draft for Consultation 2006

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)
- 3/4: Students will begin to use a range of scientific symbols, conventions, and vocabulary. (Communicating in Science)
- 3/4: They will engage with a range of text types and begin to question the purposes for which these texts are constructed. (Communicating in Science)

Living World

- 1/2: Recognise that living things are suited to their particular habitat. (Ecology)
- 3/4: Explain how living things are suited to their particular habitat and how they respond to environmental changes. (Ecology)

The Specific Learning Intentions

The students will be able to:

- describe how a common viral infection affects the human body at the level of cells and tissues;
- describe how the human immune system reacts to such an infection.

The Key Ideas

- Viruses and many other microbes survive by infecting plant or animal tissues, often causing disease.
- Disease-causing organisms are called pathogens.

- Chickenpox or VZV is a pathogenic virus that infects humans.
- Our immune system protects us from infection and, if we have been infected, it identifies, flags, and destroys the microbial invaders.
- There are many components to our immune system, for example, various types of leucocyte act against invading microbes in different ways.
- The symptoms of a disease are caused by both the invading pathogen and by the immune system's response to the disease.

Developing the Ideas

Explain that the word "pathogen" means an organism that causes disease. Given that definition, ask the students what they think the word "pathology" might mean, prompting them, if necessary, by explaining that "~ology" means the study of something. Having established pathology as the study of diseases and their progress, ask how many students can remember a personal experience with a cold, flu, or other infection. Take a common example, such as a head cold. Brainstorm the main stages in the infection, from the first niggle in the throat through to full-blown symptoms and eventual recovery. On the whiteboard, note the main symptoms at each stage and ask the students to suggest why the symptoms eventually lessen in severity and disappear. Explain that the class is about to read an article that goes inside the body and describes what happens during an attack of chickenpox.

After reading "The Invasion" in a shared reading context, ask the students to identify the big ideas in the article. You could ask them to read the article again individually to better familiarise themselves with the information. Then hand out photocopies of the article, along with a series of numbered questions that focus on the key ideas. Ask the students to work in pairs, using highlighters to underline and number the sentences in the article that provide the answers. Your questions could relate to all of the following big ideas or to a selection:

- Viruses specialise in infecting plants and animals. Chickenpox is a common example.
- Viruses can be spread by touch or through the air.
- The symptoms of a disease result from what's happening inside our body's cells and tissues. For example, we can tell from fluid-filled chickenpox blisters that many skin cells have been killed by the virus and burst.
- A person's immune system protects them from infection and fights against diseases when they have been infected.
- The body's immune system includes a variety of blood cells that identify and destroy pathogenic bacteria, viruses, and fungi.

Further Activities

A good analogy to use with students is that the immune system is like an army that swings into action when we become infected. In "The Invasion", neutrophils and macrophages are described in some detail but lymphocytes are explained more generally. You could present the following information to the class so that they come to appreciate some of the fascinating interactions between various types of lymphocyte.

Information for Students: Lymphocytes – the Stars of the Immune System

As well as gobbling up microbes, macrophages have another special job. They're real tell-tales, and they immediately alert the lymphocytes that there's an infection. The **lymphocytes** are the stars of the immune system – a real crack force made up of different squads, including B-cells, Killer T-cells, and suppressor T-cells.

B-cells make special chemicals called antibodies. These latch onto the viruses. The antibodies are like placards that say "Attack Me". When macrophages and neutrophils recognise that a cell has antibodies stuck to it, they know that the B-cells want them to kill it. And that's just what they do.

Killer T-cells have the best name – and also an important job. The B-cells attack free VZVs, but what about the VZVs that have already found their way inside your cells? The killer T-cells destroy any of your cells that have VZVs in them.

Killing your own cells is sometimes necessary, but you don't want it to get out of hand. **Suppressor T-cells** make sure the other squads don't damage your own tissues too much. This is an important job – especially at the end of an infection, when everything needs to calm down.

To help the students understand some of the complex interactions that take place during an immune response, they could role play some of the processes of infection and immune defence. Be available to guide them by answering questions or discussing points that are unclear.

Flow-chart and Role-play Activity

What You Need

- Materials for a simple flow-chart
- Materials for labels that the students can wear:
  - VZV virus
  - neutrophil
  - macrophage
  - lymphocytes – B-cells, killer T-cells, and suppressor T-cells
- Two or more 3-metre lengths of elastic, or something similar, to represent the boundaries of infected cells

What You Do

- Read the text "Lymphocytes: Stars of the Immune System".
- If there are any points you don't understand, discuss them with your classmates or teacher.
- Form a group of eight to ten classmates.
- Check that everyone in your group understands how macrophages, neutrophils, and the different types of lymphocytes work together. Then present the information as a simple flow chart. Show this to your teacher to make sure that your group has included all the main points in the right places.
- As a group, come up with a simple role play that includes the main points on your flow chart. The other two groups will do the same.
- As each group performs their role play for the whole class, tick the points on your flow chart that you see represented in their role play. (Use a different coloured pen for each group.) Highlight any important points that you didn't see in their role play.

- When all the groups have performed, have a class discussion. Ask about any points that you didn't see represented in the other groups' role plays. Maybe the information was overlooked, or maybe you just didn't recognise it in the performance.

What You Look For

- Can the students represent key points as a complete and correctly sequenced flow chart?
- Can they creatively but accurately present the same information as a role play?
- Can they appraise other people's role plays in terms of correct and complete information, creativity, and clarity?
- Do they both give and receive peer appraisal in a logical and open-minded manner?

The Finishing Touch

Possible Achievement Objectives

Mathematics

Number

- Make sensible estimates and check the reasonableness of answers (Exploring computation and estimation, levels 2–4).
- Recall the basic multiplication facts (Exploring computation and estimation, level 3).
- Write and solve problems which involve whole numbers and decimals and which require a choice of one or more of the four arithmetic operations (Exploring computation and estimation, level 3).

Algebra

- Continue a sequential pattern and describe a rule for this (Exploring patterns and relationships, level 2).
- Describe in words, rules for continuing number and spatial sequential patterns (Exploring patterns and relationships, level 3).

Measurement

- Carry out practical measuring tasks, using appropriate metric units for length, mass, and capacity (Estimating and measuring, level 2).
- Demonstrate knowledge of the basic units of length, mass, area, volume (capacity), and temperature by making reasonable estimates (Estimating and measuring, level 3).

Links with the Number Framework

For students to connect successfully with the mathematics in this activity, they will need to be at or beyond stage 6 on the Number Framework.

Stage Six: Advanced Additive (Early Multiplicative) Part-whole

- The student can estimate answers and solve addition and subtraction tasks involving whole numbers mentally by choosing appropriately from a broad range of advanced mental strategies.

- The student uses a combination of known facts and mental strategies to derive answers to multiplication and division problems.

See Numeracy Project *Book 6: Teaching Multiplication and Division*, especially pages 73–79.

Developing the Ideas

Many of the games that children play and the intuitive decorating strategies they use when illustrating their class work and possessions make use of sequences. Sequences are also used in decorative designs from many cultures: from simple motifs to complicated architectural frescoes. In this story, a young girl sets out to accomplish a simple interior decoration task. In the process, with some guidance from her mother, she uses several stage six (advanced additive – early multiplicative) and stage seven (advanced multiplicative – early proportional) part-whole strategies to come up with a pleasing repeating sequence, or frieze, of stencilled objects. Her mother models how it is possible for an adult to develop a child's problem-solving skills and disposition by encouraging Carrie's initiative and autonomy.

The following ideas suggest how the activity can be used as a resource for developing problem-solving skills and strengthening number strategies. Most of the suggested activities are best done in small groups.

Computation and Problem Solving

1. **Begin by having the students work in groups to identify the mathematical problems that arise in the story.** For example:

   - How long are the walls?
   - How long is one sequence of stencils?
   - How many sequences will fit along one wall?
   - What is the total perimeter of the room?
   - How many sequences does Carrie need to complete the walls?
   - How can Carrie be sure that she won't end up with two stencils of the same colour next to each other?

   Have the students **discuss how Carrie solved each problem** (excluding the straightforward measuring tasks). Ask them to name and explain the strategies she used. For example:

   - To find the length of each sequence of stencils, Carrie could have laid 8 stencils side by side and measured the result. But as the stencils are all the same size, she was able to find the answer using a multiplication: 8 x 25.
   - Her strategy was to halve the 8 (so that she could use her knowledge that 4 x 25 = 100) and then double the result to get an answer of 200.

2. **Keeping the same room dimensions, change the number of stencils.** What if Carrie had used 9, 10, 11, or all 12 stencils? Challenge the students to work out, in each case, how many complete sequences and individual stencils would be needed to complete the job. For example:

   - If Carrie had used 9 stencils, the length of a sequence would have been 9 x 25 = 8 x 25 + 25 = 225 cm. So the number of sequences needed is 1600 ÷ 225.
     - We know from the story that there are fewer than 8 sequences this time, so 7 is a good starting point for a guess-and-check strategy: 225 x 7 = (200 x 7) + (20 x 7) + (5 x 7) = 1400 + 140 + 35 = 1575 (using place-value partitioning).
     - This is just 25 cm short of the 1600 cm perimeter, so we know that 7 nine-animal sequences plus 1 more stencil are needed to complete the wall.

- If 10 stencils are used, the length of a full sequence is 10 x 25 = 250 cm. So the number of sequences required is 1600 ÷ 250.
    - Using 6 as the starting point for guess-and-check, 250 x 6 = 500 x 3 = 1500 (doubling and halving). 1500 + 100 = 1600, so 6 10-stencil sequences plus 4 extra stencils (4 x 25) are needed to complete the wall.
    - As long as Carrie doesn't mind incomplete sequences, she could use a 10-stencil sequence because the fourth animal in the final sequence ends up next to the first.

3. **Keeping the same room dimensions and the 8 stencils, vary the number of paint colours used, checking the outcome in each case.** How many colours should be used to ensure that there are the same number of animals in each colour?
    - We know from the story that there will be 64 animals in the completed pattern. Ask the students to imagine that Carrie has up to 12 different colours of paint.
    - If she used just 2 colours, she would have 32 animals of each colour (2 x 32 = 64). If she used 4 colours, she would have 16 of each colour (4 x 16 = 64). She could also use 4 paints or 8 paints, because the numbers 2, 4, and 8 are all factors of 64.
4. **Staying with 8-stencil sequences and 5 paints, ask the students to imagine that the room itself has different dimensions.** Challenge them to work out what the perimeter would be if the frieze were to include only 1 of each stencil in each colour (for example, just 1 red whale).
    - The number of stencilled animals would be 8 x 5 = 40. Each stencil is 25 cm long, so the perimeter of the room would be 40 x 25 = 1000 cm = 10 m.
    - Now challenge the students to work out what the length and breadth of this room would be if none of the stencils were to bend around a corner. Hint: each wall must be a multiple of 25 cm in length. (Answer: 2 x 3 m)

Measurement

Help the students to **attach meaning to units of measurement**. For example, do they think a room of 2 x 3 m is large or small? As a starting point, how do they think a room this size would compare with the size of their own bedrooms? Then ask the same question about the 3.4 x 4.6 m room in the story. Is this a good size for a rumpus room? Why/Why not?

How many students do they think could stand in a 2 x 3 m room? Select this number of students from the class and have them stand close together in what they think is a 2 x 3 m rectangle. Use a measuring tape to find out the actual dimensions of their rectangle. How much space do the students think would be required to accommodate the group if they were sitting or lying rather than standing?

Further Activities

Mixing up the Order of Colours

What if Carrie were to mix up the order of the colours to give a "random" effect? Challenge the students to work out how many ways it is possible to arrange 5 different colours. Rather than telling them how to do this, suggest that they use the letters A, B, C, D, and E for the paint colours. Then let them come up with their own ways of systematically modelling the possibilities.

The students are likely to find that there are so many possible orders that it isn't a good idea to write them all down. Do they need to? Without writing all the orders down, how do the students know that they have found the total number? Ask them to explain their reasoning to a classmate and then to the class. This could lead to an interesting extension activity involving permutations and combinations.

The students' reasoning could be as follows.

- There are 5 possible choices for the first colour.
- This leaves 4 possibilities for the second colour. So, there are 5 x 4 possible combinations for the first 2 colours.
- There are 3 choices left for the third colour. So, there are 5 x 4 x 3 possible combinations for the first 3 colours.
- Two choices remain for the fourth colour. There are 5 x 4 x 3 x 2 possible combinations for the first 4 colours.
- There is only 1 possible final colour.
- So, there are 5 x 4 x 3 x 2 x 1 = 120 possible combinations.

Creating a Frieze of Their Own

The students who need the support of materials could be given a task that is similar to the one in the story. Although painting a frieze onto the classroom walls is unlikely to be an option, cut-outs or stencilled designs on sheets of paper would work just as well. Alternatively, and on a much smaller scale, the students could decorate a large cardboard carton with a repetitive design. In both cases, the students should calculate before they paint.

Exploring Other Repeating Patterns

As an enrichment activity, the students could investigate kōwhaiwhai, textile, or mosaic designs, looking for repeated elements and sequences. Some excellent websites can be found by way of Internet search engines. Enter keywords such as "repeating patterns" and "repeating designs".

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