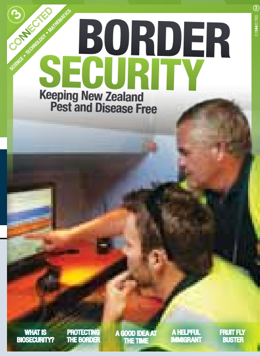
A Helpful Immigrant

by Mike Tapp

CONNECTED 3

SCIENCE • TECHNOLOGY • MATHEMATICS



Overview

This article investigates the use of bio-control agents – insects or other organisms that are imported to manage plant pests. The article explains why they can be safer than chemical-control agents. It then investigates the research and trials that have to take place before a bio-control agent is allowed into the country and the constant monitoring that is required to make sure that these new immigrants are doing the work they have been imported to do.

Curriculum context

SCIENCE

LIVING WORLD

Ecology and life processes

Achievement objectives

L3 and 4: Students will explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.

L3 and 4: Students will recognise that there are life processes common to all living things and that these occur in different ways.

Key ideas

- Every living creature has a specific habitat that supports its survival.
- One aspect of this habitat is its food source.
- While some organisms have a wide range of items in their diet, others are very specific, often limited to one type of plant, insect, or fungus.

Learning goals (to be shared with your students)

In this activity, we are learning:

- to explain how a full understanding of the feeding habits of specific organisms can assist us in combating pests without the use of chemicals
- to describe some imported organisms that are beneficial to the country and will assist us in getting rid of pests that would otherwise damage the environment.

NATURE OF SCIENCE

Participating and contributing

Achievement objectives

L3 and 4: Students will use their growing science knowledge when considering issues of concern to them.

L3 and 4: Students will explore various aspects of an issue and make decisions about possible actions.

Key ideas

- Determining that an imported organism is a suitable bio-control agent that is safe to bring into New Zealand requires a detailed process of research, analysis, and testing.
- Many scientists from a wide range of disciplines are engaged in this lengthy process.

Learning goals (to be shared with your students)

In this activity, we are learning:

- to explain that finding solutions using scientific methods takes time
- to explain that to ensure we make correct decisions, the skills of many people are brought together to make a thoroughly informed choice
- to identify that large amounts of repetitive testing are needed to provide the evidence in order to support a decision.

MATHEMATICS AND STATISTICS

GEOMETRY AND MEASUREMENT

Measurement

Achievement objectives

- L3: Students will use linear scales and whole numbers of metric units for length, area.
- L4: Students will use side or edge lengths to find the perimeters and areas of rectangles, parallelograms, and triangles and the volumes of cuboids.

STATISTICS

Statistical investigation; statistical literacy; probability

Achievement objectives

- L3: Students will evaluate the effectiveness of different displays …
- L4: Students will plan and conduct statistical investigations using the statistical enquiry cycle.
- L4: Students will investigate situations that involve elements of chance by comparing experimental distributions with expectations from models of the possible outcomes, acknowledging variation and independence.

NUMBER AND ALGEBRA

Number strategies

Achievement objectives

- L3: Students will use a range of additive and simple multiplicative strategies with whole numbers, fractions, decimals, and percentages.
- L4: Students will use graphs, tables, and rules to describe linear relationships found in number and spatial patterns.

Key ideas

- When very large populations need to be counted, statistical methods must be used to determine the most accurate estimate possible.
- A technique that statisticians use is sampling.
- Multiple samples must be taken to ensure that a **fair** representation of the population is used for the estimate.
- When something is growing exponentially it can become very large surprisingly fast
- There is a special relationship between the diameter and circumference (perimeter) of a circle.

Learning goals (to be shared with your students)

In this activity, we are learning:

- to analyse a large population by studying a sample group
- to investigate exponential growth
- to measure the circumferenceof a circle.

ENGLISH

READING

Ideas

Achievement objective

L4: Students will show an increasing understanding of ideas within, across, and beyond texts.

Indicators

- Makes meaning of increasingly complex texts by identifying main and subsidiary ideas and the links between them.
- Makes connections by thinking about underlying ideas in and between texts.

The Literacy Learning Progressions

The relevant knowledge skills and attitudes for students at this level are described in the The Literacy Learning Progressions.

Suggestions for providing literacy support for the key ideas

The following strategies will support students to engage with the ideas and information as they use the text for particular curriculum purposes.

The *Connected* series includes a range of texts that provide opportunities for students to locate, evaluate, inergrate, and synthesise information and ideas.

It is expected that students will read across the range of texts in this *Connected* to develop their literacy skills and their understanding of the topic.

Text characteristics

- Non-continuous text
- A variety of sentence types, some with several clauses
- Subheadings, photographs, text boxes, a map, and diagrams to supplement the text.

1. FINDING THE MAIN IDEAS

This article explains some of the reasons why we might bring new organisms into the country. It describes the research that has to be undertaken before organisms can be introduced and discusses the successful introduction of the heather beetle to Tongariro National Park.

The main ideas in the text include:

- Some insects are deliberately introduced into New Zealand to control weeds.
- Weeds are plants that have spread out of control and endanger our environment.
- Gorse and heather are weeds in New Zealand.
- The heather beetle eats heather.
- After testing that the heather beetle eats only heather, the species was introduced into New Zealand.
- It is difficult for heather beetles to survive in New Zealand winters, so scientists have added fertiliser to some of the heather sites to give the beetles more nutrients to help them survive.

During and after the reading, **ASK QUESTIONS** to help students find links (between the subheadings, the information within the subheadings, and the photographs), that will build their understanding of the main ideas.

What clue in the title page suggests what this helpful immigrant might be?

What is the link between insects and plants in this article?

2. DEALING WITH UNFAMILIAR VOCABULARY

IDENTIFY the subject-specific vocabulary on pages 24–26 (“quarantine”, “monitored”, “larvae”, “exponentially”, “genetic diversity”, “nutrients”, “nitrogen”, “predict”).

PROMPT students to use their prior scientific knowledge and the context to work out the meanings of these words.

COMPLETE a shared glossary of these terms.

3.USING THE TEXT FOR THINKING CRITICALLY

After the reading, **ASK QUESTIONS** to help students draw conclusions from the information they have read.

What will happen to the heather beetle when it has eaten all the heather?

Why sorts of data do scientists need to collect once a new insect has been introduced into the country?

Encourage the students to ask their own questions for their own inquiries.

Exploring the science

The following activities and suggestions are designed as a guide for supporting students to develop scientific understandings as they explore the use of bio-agents to control pests.

Key ideas

- Every living creature has a specific habitat that supports its survival.
- One aspect of this habitat is its food source.
- While some organisms have a wide range of items in their diet, others are very specific, often limited to one type of plant, insect, or fungus.
- Determining that an imported organism is a suitable bio-control agent that is safe to bring into New Zealand requires a detailed process of research, analysis, and testing.
- Many scientists from a wide range of disciplines are engaged in this lengthy process.

Read "A Helpful Immigrant" to the class. Prompt a discussion of the article with some focus questions, for example:

- Why is it important that a bio-control agent feeds on a unique food source?
- What would happen if the checking of a bio-control agent was not thorough and it changed its diet once released into the environment?
- What happens to the bio-control agent when it has done its work and there are no more weeds or other pests left for it to feed on?

Activity 1: *Introducing a snappy pest controller*

Flies are a common problem in New Zealand buildings in the summer. Most households combat flies with chemical sprays. Bring a range of fly spray canisters to class and have the students transcribe the warnings in list form onto large sheets of newsprint. (The warnings are usually printed in very small print on the can.) Identify elements of the warnings that are common to all the fly sprays. Use prompts such as:

Can the spray be used near food?

Can the spray be used in bedrooms? What if pillows become covered with spray?

What about babies? Does the spray pose a threat to babies?

Is the spray safe to use around pets?

Obtain a Venus flytrap (Dionaea muscipula) plant and place it a sunny spot in the classroom. The students can observe it catching flies. Challenge them to see if it catches insects other than flies. (These plants also catch other flying insects, even spiders.) Clarify that the Venus flytrap is not strictly a bio-control agent. However, it is a good example of how one living organism can be used to combat another.

Venus flytraps are not indigenous to New Zealand. The students can do an Internet search or use the library to find out where these plants came from. Discuss:

Are Venus flytraps friendly immigrants?

What are the risks of Venus flytraps taking over the New Zealand countryside and becoming a weed that chokes off the natural habitat of our native plants?

Activity 2: *Investigating how bio-agents get passports to enter New Zealand*

How do scientists find bio-control agents and decide that they are safe to import? This question is well answered on the New Zealand Landcare Research website: www.landcareresearch.co.nz/education/weeds/weedinfob-8.asp

Students can access this site and explore the flow chart. Divide the class into groups and have each of them follow one of the hot links to clarify terms such as "natural enemies" and "host-specificity".

Each group can complete a further search to identify an alien plant that is being controlled by a bio-control agent. The students can research how that agent was identified and assessed as being suitable for the task and match the process that was followed to that set out in the Landcare Research flow chart.

Activity 3: *Greening the garden*

Begin with some focus questions such as:

- What plants and vegetables are in your garden?
- Are there pests in the garden that eat them?
- Do the pests eat every plant in the garden, or are they fussy about the vegetables they like?

The last question is important.

Assign a research task to the students. Each of them can research an organism that eats garden plants. (Examples are white butterfly caterpillars that eat cabbages or aphids that infest roses.)

In their research, the students investigate a bio-control agent that could manage the pest that eats the garden plants. For example, ladybugs attack aphids. The students should identify the best bio-control agent for the job, according to their research, and complete a chart that records:

- the name of the pest
- the optimal bio-control agent
- the advantages of using this bio-control agent
- the disadvantages of using this bio-control agent
- the availability of the bio-control agent (where it can be obtained if it is available in New Zealand and/or its status as an imported organism).

MINISTRY OF EDUCATION RESOURCES

- Building Science Concepts (BSC series) Book 3: *Birds*; Book 4: *Animal Life Histories*; Book 21: *Life Between the Tides*; Book 55: *Mammals*

FURTHER RESOURCES

- www.ehow.com/how_7233689_do-biocontrol-agents-commercial-greenhouse_.html
- http://archive.ermanz.govt.nz/news-events/focus/biocontrol-agents.html
- www.landcareresearch.co.nz/education/weeds/weedinfob-9.asp
- http://en.wikipedia.org/wiki/Biological_pest_control

Exploring the mathematics

The following activities and suggestions are designed as a guide for supporting students to develop mathematical understanding as they explore mathematical ideas associated with scientific research.

Key ideas

- When very large populations need to be counted, statistical methods must be used to determine the most accurate estimate possible.
- A technique that statisticians use is sampling.
- Multiple samples must be taken to ensure that a **fair** representation of the population is used for the estimate.
- When something is growing exponentially it can become very large surprisingly fast
- There is a special relationship between the diameter and circumference (perimeter) of a circle.

MATHEMATICAL IDEAS AND LANGUAGE

- Vocabulary (population, sample, average, mean, random, percentage, exponential, radius, diameter, circumference, "pi")
- Units (years, dollars, square metres, paces, centimetres)

FOCUS QUESTIONS

- If we wanted to estimate the population size of a particular type of insect living on the school field, how could this be done?
- Is it likely that insects living on one corner of the field would be the same as those living in the opposite corner?
- How can we measure a round object? Can we find another way to work out the perimeter of a circle?

Activity 1: *Sampling a habitat*

In Exploring the Science for the article "What Is Biosecurity?", activity 2 involved the students marking off square metres of school ground to examine habitats. In this activity, the students do the same task but for a different purpose. Their goal is to sample the school field or property in order to estimate the population size of an easily identifiable species of insect.

Group the students and give each group a set of the tools listed for the activity referred to above. Allocate each group to a different section of the field or the school grounds.

After the students have marked out their square metres, identify a common insect that is found in the area. Show the students one of these insects and explain what it is.

The students can then search their marked-out area and carefully count and record the number of the insects they discover.

Back in the classroom, they can:

- draw a scale plan of the field and plot the number of the insects they discovered in each of the square metres in the different parts of the field that were sampled
- calculate the averege insect count per **sample** square metre
- determine the area of the entire field or grounds in square metres
- use the averege insect count per **sample** square metre to estimate the number of insects on the entire field or grounds – the area of the field multiplied by the average count = the population estimate for the field
- determine what the population estimate would have been if only one of the sample square metres had been included in the study
- determine the advantage of finding a range of samples and determining the mean.

Activity 2: *Exponential growth*

In the section Bio-agents Go to Work (page 24), the article describes how the number of beetles at a site grew exponentially.

If the number of organisms is growing exponentially, it is growing at an ever increasing rate. Exponential growth tends to be very fast. One way to help students develop a sense of exponential growth is to tell them a fable about the inventor of chess.

In ancient times, an Indian mathematician created the game of chess and gave it to the ruler of his country. The ruler was delighted by the game and told the mathematician that he could choose his own reward. The mathematician replied that he would like one grain of rice for the first square of the board, two grains of rice for the second, four grains of rice for the third, and so on, doubling the amount for each square of the chessboard. The ruler quickly agreed, chuckling to himself that a clever person like the mathematician would ask for so little. It took the ruler's treasurer over a week to calculate the number of grains of rice needed by the final square. The ruler would need to give the mathematician his kingdom several times over to fulfil his promise!

Ask the students to work out how many squares there are on an 8 x 8 chessboard. Starting with 1 grain of rice, ask them to work out how many grains of rice there will be on the 10th square.

Then ask them to use a calculator to find out how many squares it takes to reach:

- 10 000 grains of rice
- 100 000 grains of rice
- 1 000 000 grains of rice.

Activity 3: *Measuring a circle*

The sidebar on page 27 includes use of π (pi) to calculate the circumference off a circle. Using formulae and working with the number π (pi) are appropriate for students working at level 5 of the curriculum. However, students at levels 3 and 4 can explore the nature of π using measurement skills.

Introduce the language of circle geometry. The perimeter of a circle is called the **circumference**. The **radius** is the distance from the middle of the circle to the circumference. The **diameter** is the length of a line drawn from one side of the circle to the other, passing through the centre of the circle. The diameter is twice the length of the radius.

Explore the relationship between the circumference of a circle and its diameter. Regardless of the size of the circle, dividing the circumference by the diameter always gives the same number, known as π. This special number has fascinated mathematicians for nearly 4000 years. The value of π is approximately 3.14, but for students at levels 3 and 4 it is enough to discover that the circumference of a circle is roughly three times its diameter.

If the school playground has a large painted circle, ask the students to count the number of paces they use to walk around the circumference of the circle and the number they use to walk across its diameter. Compare the results as a class. The number of paces for the circumference should be approximately three times the number for the diameter.

Provide students with circular objects, such as cans, sauce-pan lids, and plates, and several pieces of string. Working in pairs, tell the students to carefully wrap a piece of string around the circumference of their object, cutting it so that it is the same length as the circumference. Next, have the students stretch the string over the diameter of the circle, making sure that it is both flat and straight. The students should cut as many diameters as they can from the circumference string. By comparing their results, the students will see that the circumference of a circle is always slightly more than three times the diameter.

The same activity can be adapted to provide measurement practice. Ask the students to measure the length of a piece of string wrapped around a circular object and to measure the diameter of the object using a ruler.

Once students have established that the circumference of a circle is approximately three times the diameter, provide examples of heather beetle circles of various radii and ask students to work out the circumference of each circle.

FURTHER RESOURCES

For further information on sampling, view:

- www.mathgoodies.com/lessons/vol2/circle_area.html
- www.worsleyschool.net/science/files/circle/area.html