# Enviroteach

An environmental education resource for teachers

## From the editor

Kia ora! Outdoor environments such as streams, rocky shores, parks and school grounds offer endless opportunities for teaching and learning. This issue of Enviroteach focuses on ways to bring the mathematics curriculum alive through learning experiences outside of the classroom and environmental education. We hope it will inspire teachers to take advantage of the abundant opportunities provided by Southland's outdoor spaces to stimulate and enhance learning in maths.

Teachers already put a lot of thought into what their students are learning, but it is also important to think about where and how children are learning. Many educational studies have shown that student outcomes can be significantly improved through nature-based, experiential learning.

Environment Southland's education team can help teachers to plan and run outdoor learning experiences. Did you know that we have two full-time educators, Mark Oster and Pat Hoffmann, who are available to help and advise all schools in Southland at no cost? We regularly assist schools with field trips and we also visit schools for classroom-based activities. We have a range of environmental education resources written especially, or adapted, for Southland schools. For more information or to make a booking, contact us on 0800 76 88 45 or education@es.govt.nz or visit our website www.es.govt.nz.

All the best for term three.

*Pat Hoffmann*
Environmental education officer

environment SOUTHLAND REGIONAL COUNCIL
Te Taiao Tonga


0800 76 88 45 | education@es.govt.nz | www.es.govt.nz | facebook.com/environmentsouthland

# Integrating maths and environmental education

Maths and environmental education complement each other in the following ways:

- Maths helps students to develop useful skills for investigating, interpreting, explaining and making sense of the world around them.
- The use of environmental contexts for learning can help make maths more interesting and meaningful for students.

In the pages that follow, you'll find many examples of ways in which students can practise their maths skills while participating in activities within the school grounds or on field trips. These outdoor activities also provide opportunities for students to learn about biodiversity within their local or wider environment.

# Maths in the school grounds

Teachers can approach the integration of maths and environmental education in several ways. Here are three examples, all making use the school garden.

## Using outdoor spaces to teach maths skills and concepts.

Sorting leaves: In this activity for younger students, children go out into the school garden to collect a variety of leaves. Back in the classroom, they work in small groups to discover interesting ways to sort the leaves, e.g. by colour, size and shape. This is a fun way for them to explore early concepts of geometry and data management, and can also lead to discussions about different types of trees found in the garden.

## Giving students maths problems to solve, relating to the school garden.

Planting vegetables: Ask the class to imagine that a student has been given a triangular patch of soil in which to grow some broccoli seedlings. If she spaces the seedlings correctly, she can create twelve rows, with one seedling in the first row, four seedlings in the next, seven in the next, and so on. What is the total number of broccoli seedlings she can plant? *(Source: http://nzmaths.co.nz/content/vege-rows)*

## Supporting inquiries in which students investigate and solve authentic problems.

Designing a garden: Invite students to design a new vegetable garden for the school. They will need to use their maths skills to come up with a suitable design and work out how to put their design into reality. Numerous decisions will need to be made, including determining the garden's shape, perimeter and area, and calculating the volume of soil needed to fill the garden. Students can experiment with different shapes and designs, draw their designs on grid paper, and create scale models until they are satisfied. *(Adapted from: http://nzcurriculum.tki.org.nz/Curriculum-resources/Education-for-sustainability/Learning-experiences)*

An inquiry approach such as this allows the teacher to integrate the questions and interests of the students into the learning goals; and there is potential for a deeper level of understanding to grow from the students' own questions and their desire to answer them.

Here are some ideas for maths activities that older students can do in the school grounds.

### Estimating

- Estimating heights of trees which can't be measured or are inaccessible
- Estimating distances around the school grounds, then measuring with a trundle wheel
- Estimating perimeters, areas and volumes of gardens, before measuring them

### Shapes

- Finding symmetry in buildings or in nature
- Identifying interesting curves for later analysis

### Following and giving directions

- Following or creating a route through a nature area
- Doing a treasure hunt using coordinate grids or compass bearings
- Completing a mini-orienteering course

### Time

- Measuring time running, walking over given distances
- Monitoring rates of growth of plants in varied conditions
- Examining tree growth rings

### Measurement

- Using an appropriate measuring device accurately, to design a garden, lay out a path, calculate how many trees to plant, or measure the lawn for re-seeding

### Patterns

- Creating patterns in garden designs
- Finding spirals in plants
- Discovering algebra, by counting the different parts of flowers and finding relationships between them

### Data collection

- Sampling insects and spiders in the school grounds using quadrats
- Devising and calibrating instruments to measure and record weather

### Scaling

- Creating maps and scale drawings of gardens or natural areas
- Creating scale models
- Using "Google Earth" to find an area you have explored outside. Relating actual measurements you have made to measurements on the Google map. Finding out which scale is being used for different magnifications

## Simple sums, out in the sunshine

Younger students, too, can develop their maths skills by participating in nature-based activities:

1. Take students on a nature walk and give them simple mathematical tasks, e.g. collect five leaves, measure 10ml of soil, find the largest flower and the smallest flower.
2. Show the students a leaf and challenge them to find a similar leaf and match it.
3. Collect three twigs and make a triangle; collect four twigs and make a square.
4. Collect small creatures (insects, spiders etc.) and count their legs.
5. Look for geometric figures in nature (e.g. shapes and angles).
6. Look for patterns (such as the Fibonacci spiral).
7. Observe and draw butterflies, paying attention to the intricacy of their designs and colours.

**◂ Adapted from: www.ncetm.org.uk/public/files/265883/Learning_Mathematics_Outside_Module1_Secondary_Handout1.pdf**

▲ **Environmental education officer Mark Oster demonstrates to students how to measure the height of a tree.**

# Maths in nature studies

Nature studies provide excellent opportunities for practising maths skills while learning about plants, animals and soil.

## Breeding earthworms in the classroom

Prepare a terrarium (e.g. a small fish tank) containing some moist soil, leaf litter and a few decaying branches or bark. Place the terrarium in a spot that will remain cool and dark. Ask the students to carefully collect earthworms from the school grounds. They may need to dig up a few spades of soil to find them. Count the total number of earthworms collected and place them in the terrarium. Over a month or two, monitor the earthworm population and graph the results. Maths tasks can include counting the earthworms, calculating how many new ones are produced, working out percentages, determining rates of change (increase in numbers over time) and their reproductive rate (e.g. number of offspring per 10 worms, 100 worms etc.) Students might also like to talk about which areas of the school grounds had the most earthworms and what role earthworms play in the ecosystem.

## Surveying garden birds

The NZ Garden Bird Survey is a simple bird-watching activity that connects children with the outside environment. It can be done as a class activity and/or at home. The survey lasts one hour. Visit www.landcareresearch.co.nz/science/plants-animals-fungi/animals/birds/garden-bird-surveys/discover-and-learn/activities-for-schools for instructions and resources, including a colour poster for bird identification. The date for submitting your data has passed for this year, but you can still do the survey.

## Testing soil composition

Measure how much sand, silt and clay are present in a soil sample. This involves measurements, fractions and percentages. Refer to Enviroteach 2015 – Term 2 for instructions (go to www.es.govt.nz and search 'Enviroteach').

## Working out the height of a tree without climbing it

Ask students to look around the school grounds and estimate the height of the tallest tree. If you needed to cut down that tree, would it be safe to do so, or would it fall and hit a building? Find a tape measure and two sticks of equal length. Stand in front of the tree. Hold the sticks in one hand, perpendicular to each other. The horizontal stick should be held, carefully, against your cheek bone just beneath your eye, while the other stick is held vertically (see photo). Line up the vertical stick with the tree you want to measure and step backwards until the top of the vertical stick is in line (visually) with the top of the tree, and the bottom of the vertical stick is in line with the bottom of the tree. Make a mark on the ground where you are standing. Now walk towards the tree with your tape measure, and measure the distance between the mark on the ground and the tree. That distance is equal to the height of the tree.

# Splashy maths

Stream studies provide excellent opportunities for students to practise their maths skills, while exploring and learning about waterways. Mathematical tasks can include counting animals found in the stream, calculating totals and averages, measuring distances and depths, converting between centimetres and metres, measuring time in seconds, drawing graphs, reading thermometers, measuring pH by comparing the colour of indicator fluid with a colour scale, using equations to calculate velocity and stream health scores, and estimating percentages.

Contact Environment Southland! We may have some resources and information to help you.

Digital thermometers are used to measure temperature.

To measure clarity, students fill a metre-long clarity tube with water from the stream, then slide a magnet along the inside of the tube until it disappears from sight. They measure how clear the water is by reading the centimeter markings along the side of the tube. They repeat this test several times then calculate the average.

To measure pH, students use digital pH meters or indicator fluid.

▲ To measure depth of the stream, students use a metre-long ruler marked in centimetres.

▲ To calculate velocity, students use a tape measure to measure a distance of 5m, then drop a ball in the water, start the stopwatch and time how long it takes for the ball to travel 5m downstream. They use an equation to calculate velocity in metres per second.

▲ Students collect macroinvertebrates in the stream, then count the number of each type. Each type of macroinvertebrate has its own score based on how sensitive it is to pollution. Students multiply the number of individuals of each type by its sensitivity score. They add up all the the scores then divide the total by the number of types found. This gives them an overall stream health score which they can interpret using a rating scale. Students can discuss what types of things might have an effect on stream health and how our human activities contribute to this.

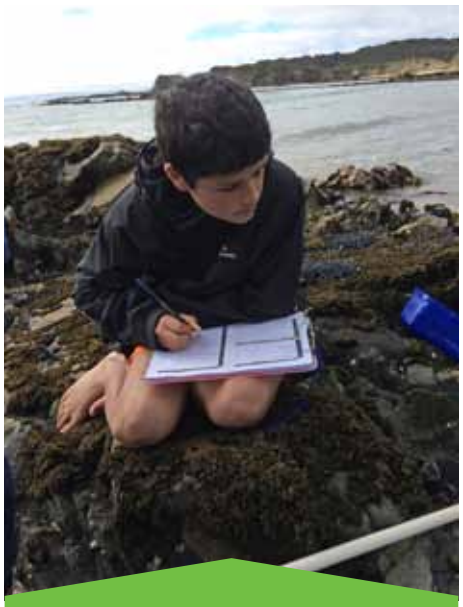
▲ To draw a cross-section of the stream, students span a tape measure across the stream, then use metre rulers to measure the depth at ½ metre intervals across the stream. They plot their data on a graph to show how stream depth changes over distance.


▲ A student's poster showing data collected during a stream study (water velocity, pH, clarity, temperature and macroinvertebrates).

# Coastal calculations

The University of Otago's Marine Metre Squared programme offers a useful structure and purpose for school field trips to rocky shores, beaches and estuaries. The programme is suitable for primary schools, and also offers activities designed for secondary school students. Mathematical tasks include counting sea creatures of different species within a $1m^2$ quadrat, estimating percentage cover of seaweeds and recording data on field sheets. Students can log onto the $Mm^2$ website to upload data, view their data presented in the form of tables and pie charts, and compare it with data generated by their peers or students from other schools.

Contact Environment Southland! We may be able to assist with your field trip or lend you our equipment.



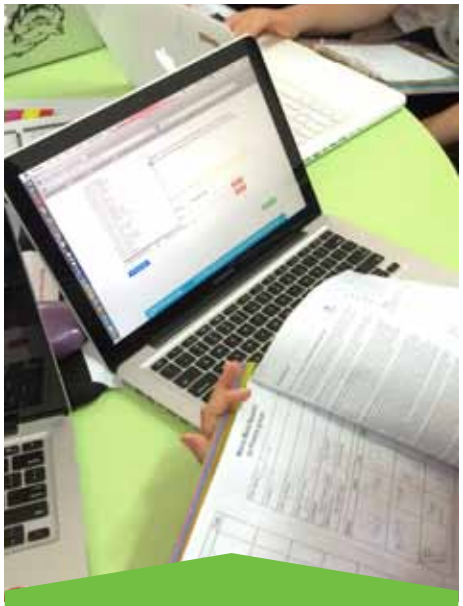
In a rocky shore study, students identify sea creatures within their quadrat, count the number of individuals of each species and record data on data sheets.

This student is counting all the mussels within a $1m^2$ quadrat.

In an estuary study, students collect sediment samples, each representing 1% of the quadrat, and then empty the contents into a sieve to collect the sea creatures living in the sediment.

These students are identifying seaweeds within their quadrat and estimating percentage cover.

The lid of an icecream container has had a 10cm x 10cm hole cut into it to represent 1% of the quadrat.



Students transfer the data from their data sheets onto the marine metre squared website.

# Educational resources

Environment Southland has many educational resources which can help teachers to integrate maths and environmental education.

- The Stream Connections resource provides step-by-step instructions for stream studies and includes notes for teachers and data sheets for students.
  *www.es.govt.nz/Document%20Library/Other%20resources/Education%20resources/stream-connections-all-pages1.pdf*
- Enviroteach: the April 2015 issue includes instructions for investigating soil composition, water percolation and soil pH.
  *www.es.govt.nz/Document%20Library/Newsletters/Enviroteach/april_2015_web.pdf*
- Enviroteach: the February 2015 issue features a Marine Metre Squared investigation at an estuary.
  *www.es.govt.nz/Document%20Library/Newsletters/Enviroteach/february_2015_-web.pdf*

## Other useful websites

- The new Science Learning Hub website offers instructions and handouts for doing a visual soil assessment.
  *https://beta.sciencelearn.org.nz/resources/981-visual-soil-assessment*
- Natural Curiosity Manual.
  *www.naturalcuriosity.ca/pdf/NaturalCuriosityManual.pdf*
- Effective pedagogy in mathematics.
  *www.educationcounts.govt.nz/publications/series/2515/5951*
- NZ Maths – *http//nzmaths.co.nz*
- NRICH – *http://nrich.maths.org*
- National Centre for Excellence in the Teaching of Mathematics – *www.ncetm.org.uk/resources/9551* (You will need to register to use this site).
- Te Kete Ipurangi – *http://nzcurriculum.tki.org.nz/Curriculum-resources/Education-for-sustainability/About-EfS*
- Te Kete Ipurangi – *http://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum/Mathematics-and-statistics*