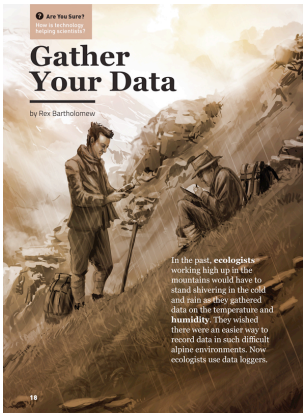
CONNECTED, LEVEL 4 2013, Are You Sure?

Gather Your Data

by Rex Bartholomew



Overview

In this article, students learn how new technology is being used to gather and interpret data about the environment and ecology.

A Google Slides version of this article is available at www.connected.tki.org.nz.

Science capability

Students need to develop a set of **capabilities** that support them to ask informed questions if they are to participate as "critical, informed, responsible citizens in a society in which science plays a significant role". The capabilities enable students to meet the achievement objectives in a way that supports the purpose of science in *The New Zealand Curriculum* and the development of the key competencies. These capabilities include being ready, willing, and able to **gather and interpret data**. Students need to understand what counts as evidence in science, the importance of observation, and the difference between observation and inference.

Text characteristics

- Abstract ideas and concepts, and lengthy sections of explanatory text
- Illustrations, photographs, text boxes, a graph, and a map containing main ideas that relate to the text's content
- Technical vocabulary.

Curriculum context

SCIENCE

NATURE OF SCIENCE: Understanding about science

Achievement objective(s)

L4: Students will identify ways in which scientists work together and provide evidence to support their ideas.

NATURE OF SCIENCE: Investigating in science

Achievement objective(s)

L4: Students will build on prior experiences, working together to share and examine their own and others' knowledge.

L4: Students will ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations.

LIVING WORLD: Ecology

Achievement objective(s)

L4: Students will explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.

Key Nature of Science ideas

- Science knowledge is based on direct, or indirect, observations of the natural physical world.
- Scientists gather data using their senses to make observations.
- Making careful observations often involves measuring something.
- Observations are influenced by what you already know.
- Advances in technology make data collection easier and allow us to learn more about our world.

Key science ideas

- Careful tracking of data helps build understandings of the different variables that impact on living things.
- Careful tracking of data helps build understandings of how to protect at risk species and environments.

ENGLISH

READING

Ideas

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

INDICATORS

- Makes meaning of increasingly complex texts by identifying and understanding main and subsidiary ideas and the links between them.
- Makes connections by thinking about underlying ideas within and between texts from a range of contexts.
- Recognises that there may be more than one reading available within a text.
- Makes and supports inferences from texts with increasing independence.

THE LITERACY LEARNING PROGRESSIONS

The literacy knowledge and skills that students need to draw on by the end of year 8 are described in *The Literacy Learning Progressions.*

Scientific investigation

A science investigation where you change or try something and observe what happens is called an experiment. Not all scientific investigations are experiments; there are many ways of investigating in science. *The New Zealand Curriculum* science achievement aims indicate that students should experience a range of approaches to scientific investigation including classifying and identifying, pattern seeking, exploring, investigating models, fair testing, making things, and developing systems. Many scientific investigations involve systematic observation over time of an object, an event, a living thing, or a place.

Some important things to remember when you do a scientific investigation are: to be systematic and fair; to make sure that only one thing is changed at a time if you are doing an experiment or fair test so you are sure which changes result in which outcome; to observe and record what happens very carefully; and to be open minded so you notice things you are not expecting.

Sound data is obtained when you are able to get similar outcomes each time you do the same thing, or when data has been collected in the same way and in a systematic manner. No investigation or experiment results in a "wrong" outcome. You may have done something differently from others or the conditions may be slightly different so you don't get the same result as others do, but it is not "wrong".

Thinking about and developing explanations about why things happen the way they do, based on evidence, is an important aspect of science. Another important aspect is critically evaluating methods and ideas. Part of a scientist's work is critiquing and evaluating the methods and ideas of other scientists. They expect their work to be subject to critique. If they are going to be able to make informed decisions about scientific issues as responsible citizens, students first need to experience a range of approaches to scientific investigation and to practise critique and evaluation of scientific methods and ideas – both their own and those of others – just like scientists do!

Meeting the literacy challenges

The following strategies will support students to understand, respond to, and think critically about the information and ideas in the text. After reading the text, support students to explore the key science and technology ideas outlined in the following pages.

TEXT CHARACTERISTICS

- Abstract ideas and concepts, and lengthy sections of explanatory text
- Illustrations, photographs, text boxes, diagrams, maps, charts, and graphs, containing main ideas that relate to the text's content
- Technical vocabulary.

TEACHER SUPPORT

Want to know more about instructional strategies? Go to:

http://literacyonline.tki.org.nz/Literacy-Online/Teacher-needs/Pedagogy/Reading#Years5-8

http://literacyonline.tki.org.nz/Literacy-Online/Student-needs/National-Standards-Reading-and-Writing

http://www.literacyprogressions.tki.org.nz/

"Working with Comprehension Strategies" (Chapter 5) from *Teaching Reading Comprehension* (Davis, 2007) gives comprehensive guidance for explicit strategy instruction in years 4–8.

Teaching Reading Comprehension Strategies: A Practical Classroom Guide (Cameron, 2009) provides information, resources, and tools for comprehension strategy instruction.

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INSTRUCTIONAL STRATEGIES

FINDING THE MAIN IDEAS

PROMPT the students to consider the questions raised in the text and to also think of their own.

- *What other questions might an ecologist use a data logger to address?*

ASK QUESTIONS to support the students to identify the main ideas.

- *Why are the devices outlined in this article important for scientists?*
- *What is the value of this information? How might it be used?*

INTERPRETING DIAGRAMS TO CLARIFY THE TEXT

Remind the students that headings in tables or graphs indicate crucial information.

DISCUSS a sequence for reading the information in a graph:

- the heading
- the key
- the labels on the axes
- the data within the graph.

ASK QUESTIONS to remind students of the vocabulary of graphs. Prompt them to refer specifically to the x-axis (horizontal) and the two y-axes (vertical).

- *What is the data being tracked in this graph?*
- *Why have the scientists plotted three different variables on one graph? What do you understand these variables to mean?*

ASK QUESTIONS to clarify the information in the map on page 22.

- *How do the scientists know that Carol "changed her mind"?*
- *When was she near Ninety Mile Beach? Was she ever at Ninety Mile Beach itself?*

DEALING WITH TECHNICAL VOCABULARY

Have the students **IDENTIFY** and **LIST** the scientific and technical vocabulary.

Examples of technical vocabulary include "humidity", "telemetry", and "germinate".

Have the students **SORT** this vocabulary according to how they worked out the meanings of the words. Categories could include:

- I know this word from another context.
- I found a clue to the meaning in the text.
- I predicted this meaning from reading the text.
- We use this word in technology.
- I can see the meaning from the illustration.
- I found the word in the glossary or a dictionary.

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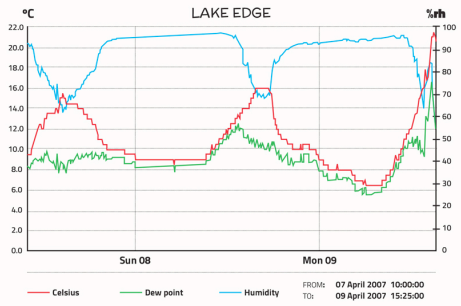
Teacher support



This graph shows the **dew point** (green), temperature (red), and humidity (blue) for two days at the edge of a lake.

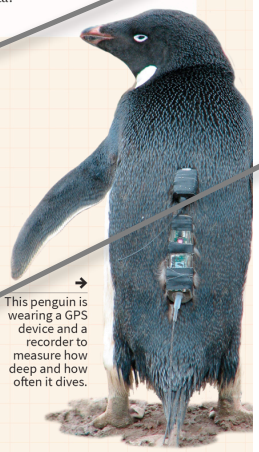
This data was collected using a data logger. What can you spot in the data?

GPS

As well as measuring physical factors, such as temperature, humidity, and light, **GPS** can be used to collect data for animals on the move so that ecologists can see where the animals are and how far they have travelled.

Ecologists can attach large GPS devices to big animals, such as whales, sharks, and elephants, and really tiny GPS devices to small animals, such as wētā.

Recently, ecologists attached GPS devices to albatrosses in the Pacific and penguins in the Antarctic, and "followed" the birds **remotely** for months. Can you think of any reasons why ecologists might want to see where albatrosses and penguins go?



This penguin is wearing a GPS device and a recorder to measure how deep and how often it dives.

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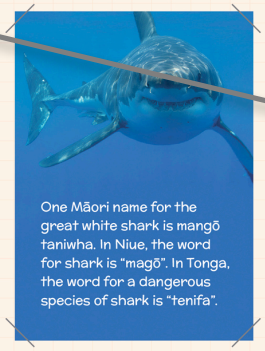
Pop-up tags

New Zealand scientific projects are investigating the movements of great white and mako sharks. Great white sharks are an endangered species, so even though they have been known to kill people, they have been legally protected since 2007.

Not a lot was known about these species of sharks until recently. For example, since 2005, **NIWA** and the Department of Conservation have attached pop-up tags to 35 great white sharks to record their movements. Ecologists have been able to map the data sent from these tags and use the information to calculate that these sharks can swim up to 150 kilometres a day. The data loggers in the pop-up tags have recorded the sharks diving to depths of 1.2 kilometres straight down. Imagine diving that deep! At the bottom of the dive, you would be swimming in total darkness.

Attaching a pop-up tag to a great white shark



One Māori name for the great white shark is mangō taniwha. In Niue, the word for shark is "magō". In Tonga, the word for a dangerous species of shark is "tenifa".

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Data is displayed in different ways to show patterns and trends.

Making careful observations often involves measuring something.

Science knowledge is based on direct, or indirect, observations of the natural physical world.

Scientists work together and provide evidence to support their ideas.

Careful tracking of data helps build understandings of how to protect at-risk species.

Advances in technology make data collection easier and allows us to learn more about our world.

Exploring the science

Some activities focus directly on the science capability of "gathering and interpreting data" and the Nature of Science strand. Other activities extend student content knowledge. You are encouraged to adapt these activities to make the focus on Nature of Science explicit and to support students to develop the capability to collect and interpret data.

LEARNING FOCUS

Students make observations, gather data, and interpret and discuss outcomes based on their observations.

KEY SCIENCE IDEAS

Key Nature of Science ideas

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LEARNING ACTIVITIES

Activity 1: Logging the data

Have the students log some simple data by measuring and recording the temperature in different locations in the room at the same time each day (for example, in a dark corner and on a sunny window sill). Use the same thermometer in the same location, as thermometers are often not exactly calibrated to be the same as each other. Plant a bean seed in each location and record the difference in growth each day in the two locations. Ensure the only change in conditions is the location – all other variables (for example, time and the amount of water) should be exactly the same. Discuss with the students why this should be so.

Tell the students that the purpose of this activity is about gathering and interpreting data. Have them graph and then interpret their data. Discuss whether the temperature affects the growth of the seed and, if so, how – based on what evidence? Are there other factors that may have been involved? Have them discuss how this data collection could be automated.

Have the students select the most appropriate kind of graph for presenting findings from their own data collection. Have them explain the reasons for their selection and provide each other with feedback as to whether their choice was the right one.

You can use the "Well Weathered" activities in the Level 3 Figure it Out book *Statistics* (pages 10–11) if you need to re-visit the concept of time-series graphs.

Extension

Alternatively, the students might identify a question they have of their own and design an experiment using a simple data logger they have created to monitor phenomena in their own environment. Explain that observations are not always visual. For example, they could use audio equipment to monitor noise levels and the impact of using different materials to reduce the impact of external noise. This could be an opportunity for students to identify a solution to a real problem in their own environment and use their findings to address that problem themselves – or to persuade others that they have valid evidence that a problem exists and that they have identified a viable solution.

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Activity 2: Mapping data to the scientific inquiry cycle

Select one example of data-logger usage (for example, NIWA's climate data) and have the students map it to five phases of the PPDAC (Problem, Plan, Data, Analysis, Conclusion) cycle by downloading the "Are You a Data Detective?" poster from the CensusAtSchool New Zealand website. Ask questions to prompt the students to explain the findings, for example:

- *Why were these particular variables collected?*
- *What were the time intervals for collecting data, and why?*
- *How has the data been displayed?*
- *What relationships can you see between different variables?*
- *What trends can you see?*

Activity 3: Why use a data logger?

Set an activity for the students to do that will enable them to understand how difficult, time consuming, and laborious it can be to collect data consistently over a period of time. For example, one group might be measuring the temperature of hot water in a tin at regular intervals as the temperature drops and record the data every 5 minutes over 1 hour. Another group could sit at a window and note down every red vehicle that passes and the exact time it passes.

- *What problems do they incur (for example, boredom, loss of concentration, and getting cold)?*
- *Based on this experience, why do scientists use data loggers? List the reasons why they are a useful tool for scientists*.

The students could identify a local conservation project and find out about the monitoring they are doing. Are data loggers involved? If so, what technology was used in the past and how is the new technology an improvement?

Is there a possibility that the students could get involved in working alongside scientists to collect and interpret data over a period of time?

The students could then list and describe other technological devices they know about. How might these devices be useful when studying different species?

Activity 4: Tagging and tracking

Ask the students:

- *Why do we track sharks?*
- *What do tracking programmes tell scientists?*

Have them record their ideas before learning more about tracking sharks. Read the *New Zealand Herald* article, "Shark Takes Long Way Home" and track Carol's movements since July 2012 (click "NZ Sharks" on the left-hand menu). The resource links include video clips of scientists talking about what they are doing, and why.

Scientists are constantly tracking different creatures and making their progress available online. Groups of students could identify one such project that they could adopt as their own. Each group could track their adopted creature, becoming experts and sharing what they learn over the course of the school year.

Sometimes, electronic tagging and tracking doesn't go as expected. The October 2012 Level 4 *School Journal* has the story of Happy Feet, the penguin. It shows how a tracking device was attached but stopped working, and how the scientists had to make an inference about what may have happened. The students could view the footage of Happy Feet's release before discussing what they think may have happened to the tag and to Happy Feet.

Google Slides version of "Gather Your Data" www.connected.tki.org.nz

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RESOURCE LINKS

Figure It Out *Statistics* Level 3, Levels 3–4, and Levels 4–4+ http://www.nzmaths.co.nz/figure-it-out

Science Learning Hub http://www.sciencelearn.org.nz/Contexts/Icy-Ecosystems/Looking-closer/Antarctica-hut-data

Science Learning Hub: Tagging Sea Stars http://www.sciencelearn.org.nz/Contexts/Life-in-the-Sea/NZ-Research/Tagging-sea-stars

NIWA videos http://www.niwa.co.nz/news-publications/videos

Guy Harvey Research Institute: Shark Tagging http://www.nova.edu/ocean/ghri/tracking/

New Zealand Herald: Shark Takes Long Way Home http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10850670

Big Fish, Calm Sea – White Shark Tagging off Stewart Island http://www.youtube.com/watch?v=7zdRH04V6WQ

Great White Shark – Sighted, Tagged and Tracked http://www.niwa.co.nz/video/great-white-sharks-sighted-tagged-and-tracked

CensusAtSchool New Zealand http://new.censusatschool.org.nz/resources/level-3/

Climate data and activities http://www.niwa.co.nz/education-and-training/schools/resources/climate

Happy Feet Released http://www.niwa.co.nz/news/happy-feet-released-photos-and-footage

Happy Feet Departs Wellington http://vimeo.com/28376936

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