



Overview

"Rūaumoko Rages" explains how volcanoes are formed, introduces the various kinds of volcanoes, and outlines features of New Zealand's volcanic landscape.

Curriculum context

SCIENCE

PLANET EARTH AND BEYOND

Earth systems

Achievement objective

L1 and 2: Students will explore and describe natural features and resources.

Key ideas

- Volcanoes are found in many places on planet Earth – on land and under the sea.
- Heat inside Earth melts rock to produce magma. Magma appears at Earth's surface as lava.
- Because Earth's crust is relatively thin, there are places where molten rock can break through the surface.
- There are different kinds of volcanoes.

Learning goals (to be shared with your students)

In this activity, we are learning:

- to explore what is inside Earth
- to describe what happens when magma gets close to the surface
- to explain why there are so many volcanoes in New Zealand.

MATHEMATICS AND STATISTICS

MEASUREMENT

Geometry and Measurement

Achievement objective

L1 and 2: Students will order and compare objects or events by length, area, volume and capacity, weight (mass), turn (angle), temperature, and time by direct comparison and/or counting whole numbers of units.

Key ideas

- Scale models are useful for comparing proportions of large objects.
- Measuring temperatures in degrees allows temperatures to be compared.

Learning goal (to be shared with your students)

In this activity, we are learning:

- to draw a diagram to scale.

ENGLISH

READING

Ideas

Achievement objective

L3: Students will show a developing understanding of ideas within, across, and beyond texts.

Indicators

- Uses their personal experience and world and literacy knowledge confidently to make meaning from texts.
- Starts to make connections by thinking about underlying ideas in and between texts.
- Makes meaning of increasingly complex texts by identifying main and subsidiary ideas in them.

Structure

Achievement objective

L3: Students will show a developing understanding of text structures.

Indicator

- Understands that the order and organisation of words, sentences, paragraphs, and images contribute to and affect text meaning.

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, integrate, 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

- A mixture of text types; begins with the retelling of a myth and then becomes a science-based, informational text
- Technical and subject-specific vocabulary
- Use of similes and analogies to help explain concepts
- Maps, photographs with captions, diagrams, illustrations, subheadings, and a glossary support the text
- Coloured text boxes provide supplementary information.

1. FINDING THE MAIN IDEAS

The main ideas in the text include:

- Molten rock and gases lie beneath Earth's crust.
- Volcanoes are vents or holes in Earth's crust.
- During a volcanic eruption, molten rock and poisonous gases are pushed out through the vent.
- Volcanoes can be active, dormant, or extinct.
- There are many different types of volcano.
- New Zealand is located on the edge of a tectonic plate in an area known as "the Ring of Fire".

PROMPT the students to skim and scan the headings to find out what information the text will include.

MODEL how to find the main ideas in the text by formulating questions or recognising the author's questioning.

These paragraphs are explaining how magma is produced. They are providing us with information by asking questions, like "So what causes it to move again and erupt?" We can read on to find the answer. What do we do if we have more questions?

IDENTIFY similes or analogies, for example, "He grizzles and grumbles just like a baby, but he spits fire and hot rock", "hotter than a pizza oven", or "like thick soup in a pot". **DISCUSS** the features of volcanoes that the similes and analogies illustrate.

Text	Things compared	Qualities in common
like thick soup in a pot	magma and soup	hot, runny, boils and plops

Explain to students that asking questions, searching for the answers, and interpreting similes and analogies all help to find the main ideas in paragraphs.

2. LOCATING AND USING INFORMATION FROM MAPS AND DIAGRAMS

The article has illustrations and photographs as well as diagrams and maps.

IDENTIFY and review the features of diagrams (for example, the lines that link the text with the image).

Have the students look at the maps and **PROMPT** them to identify any features, for example, the outline of New Zealand. Discuss measurement and scale in maps.

3. DEALING WITH UNFAMILIAR VOCABULARY

The language of the article combines the narrative introduction, which includes Māori names and personification, with clear, scientific information.

EXPLAIN that bold font is used to identify some topic-specific vocabulary, which is defined in the glossary on page 9. Have the students build a bank of vocabulary related to volcanoes. These words could be recorded and displayed around the classroom.

IDENTIFY the measurement terms used, for example, "kilometres" and "degrees Celsius", as well as descriptors, for example, "active", "dormant", and "extinct". Discuss their meanings.

MAKE LINKS to students' prior knowledge of proper nouns by reminding them that names of places, lakes, and mountains are all proper nouns and so will start with capital letters.

MODEL processing and comprehension strategies to decode and make meaning of unfamiliar words.

Tectonic – we can see this word in a sentence and as a label on the diagram. Let's break it into sound-chunks: tec-ton-ic. It sounds just like it looks. Can we work out what it means from the sentence or from the diagram?

Exploring the science

The following activities and suggestions are designed as a guide for supporting students to develop scientific understanding as they explore natural features of planet Earth.

Key ideas

- Volcanoes are found in many places on planet Earth – on land and under the sea.
- Heat inside Earth melts rock to produce magma. Magma appears at Earth's surface as lava.
- Because Earth's crust is relatively thin, there are places where molten rock can break through the surface.
- There are different kinds of volcanoes.

Provide the main purpose for reading as an investigation: “*We are reading this article to find out ...*”, emphasising the nature of science as a way to investigate, explain, and make sense of our world.

Encourage students to record their questions as they read.

Activity 1: Making a model of a volcano

Introduce the concept of molten rock. (To help students, you could use the analogy that when molten rock forms, it is similar to when sugar crystals become liquid sugar when heated.)

Discuss the fact that scientists sometimes use models to simulate an event. They do so to try to understand what is happening and to help make predictions about what would happen if a particular variable was changed. See *Making Better Sense of Planet Earth and Beyond*, pages 17–18, for more about the use of models in science.

Explain that the students are going to make a model of a volcano.

They will need:

Bicarbonate of soda, vinegar, dishwashing liquid, red food colouring (optional), wet sand, dirt, or pebbles, small plastic containers or egg cups.

The process:

- Place a teaspoon of bicarbonate of soda and a squirt of dishwashing liquid in a small container.
- Build up a mound of sand or soil around the container (do this outside or on a protected surface).
- Pour in the vinegar (red food colouring can be added for effect).

The students can observe:

- How quickly does the froth flow out of the container?
- Does the shape of the “volcano” affect the direction the baking soda mixture travels?
- What can be added to the froth to slow it down or speed it up?
- Does the temperature of the vinegar affect the speed of the reaction?
- What proportion of vinegar and baking soda creates the biggest reaction?

Talking about their findings

Check that the students are clear about the reason for the froth (the result of the chemical reaction of vinegar and bicarbonate of soda). Discuss the analogy between this chemical reaction and a volcanic eruption. Discuss the reasons why volcanoes erupt, referring back to the article. Provide opportunities for the students to devise questions they can research, such as the differences and similarities between the various kinds of volcanoes and where volcanoes occur.

Activity 2: Investigating inside the Earth

The students will need:

An avocado, a sharp knife, a diagram showing a cross-section of Earth.

The process:

- Cut the avocado in half, lengthways.
- Pull one half away, leaving the stone in the remaining side.
- Prompt the students to refer to the diagram on page 3 of the text before drawing a diagram of the split avocado and labelling the exposed layers.
- Students can complete a table comparing the structure of Earth with an avocado.

avocado	Earth
stone	core
flesh	mantle
skin	crust

Discuss the difference, explained in the article, between Earth's inner core and the outer core.

As a further activity, the students draw a cross-section of Earth to scale on a tennis or netball court using chalk. (See Activity 1 in Exploring the Mathematics.) Ensure they identify their drawings as a **model** of Earth.

Activity 3: Investigating how volcanoes are formed

For this activity, students will need access to the *National Geographic* video clip about volcanoes, available at: <http://video.nationalgeographic.com/video/player/environment/environment-natural-disasters/volcanoes/volcanoes-101.html>

They will also need:

Wooden puzzle pieces, a tray of play dough or modelling clay, a map showing the tectonic plates of the world (including the Ring of Fire), and a laptop, data projector, or smart board.

Explain to the students that they are going to watch a video clip to observe lava flows, to discover where some of the world's volcanoes are located, and to recall the different kinds of volcanoes.

Play the video clip.

Discuss why lava flow determines the shape and type of a volcano (It may be useful to refer back to observations made during Activity 1.)

Have the students connect the wooden puzzle pieces and place them on top of some play dough or modelling clay. They can then simulate the movement of tectonic plates by moving the dough so that some puzzle pieces push under, over, or against each other.

Prompt the students to discuss their findings in a small group.

Direct students to the map showing the Ring of Fire.

Ask questions about why there are no active volcanoes in Australia and why there are so many in New Zealand. Draw out the idea of what happens when the tectonic plates push into one another or when a plate is pushed under another into Earth's mantle.

Activity 4: Connecting the science to myths and legends

Read aloud “The Wrath of Rūaumoko” in *Children of Earth and Sky*, edited by Gordon Ell and Mervyn Taylor (Auckland: Bush Press 1995).

Discuss the importance of myths and legends in helping people to explain natural phenomena. Discuss how such explanations can differ from scientists' explanations.

Make connections between the myth and the map showing New Zealand's position on the Ring of Fire.

MINISTRY OF EDUCATION RESOURCES

- *Making Better Sense of Planet Earth and Beyond* 1999, pages 23–58
- Building Science Concepts (BSC series) Book 12: *Volcanoes*
- For appropriate tasks, see the Assessment Resource Banks site and linking documents to the *Making Better Sense* books and the Building Science Concepts series:
 - <http://arb.nzcer.org.nz/resources/science/bsc.php>
 - <http://arb.nzcer.org.nz/resources/science/bettersense/>
- *Connected* 2 2003, “A History of Rock”
- *Connected* 2 2005, “Living on a Lava Flow”

FURTHER RESOURCES

- Science Learning Hub, Context: Volcanoes:
 - www.sciencelearn.org.nz/Contexts/Volcanoes
- See also resource lists in BSC and MBS books
- Pita, Graham (1995). “The Wrath of Rūaumoko”. In *Children of Earth and Sky*, ed. Gordon Ell and Mervyn Taylor. Auckland: Bush Press.

Exploring the mathematics

The following activities and suggestions are designed as a guide for supporting students to develop mathematical understanding as they develop concepts of the distances involved in the dimensions of the planet and concepts of temperature. The article refers to several numbers with a magnitude beyond everyday experience. Exploring measurement on a smaller scale can help students to attach meaning to much larger numbers.

Key ideas

- Scale models are useful for comparing proportions of large objects.
- Measuring temperatures in degrees allows temperatures to be compared.

MATHEMATICAL IDEAS AND LANGUAGE

- Measuring temperature
- Understanding large numbers
- Scale models
- Units (centimetres, kilometres, degrees Celsius)

FOCUS QUESTIONS

- How can we make a scale model of a planet?
- How can we compare temperatures?

Activity 1: Measuring the layers

Do this activity outside on tennis or netball courts, using chalk and string.

First, have the students investigate the thickness of the layers of Earth, or you could provide them with the following figures.

- Crust: from 10 kilometres to 100 kilometres
- Mantle: 2900 kilometres
- Outer core: 2250 kilometres
- Inner core: 1200 kilometres

Relate these measurements to distances the students can relate to, for example, the distance from home to school, to the library, to Auckland, to Australia, and so on.

Starting from a point representing the centre of Earth, and using the scale of 1 centimetre to 10 kilometres, the measurements will be 1.2 metres (inner core), 2.25 metres (outer core), and 2.9 metres (mantle). The crust will then be a further 1 centimetre to 10 centimetres.

This investigation can lead to mathematical discussion and problem solving as the students find the answers to:

- How far is it from the surface of Earth to the centre of Earth?
- Is it farther to the centre from different places on the planet?
- What is the distance from one side of Earth to the other?

Ensure that students identify their drawing as a **model** of Earth.

Activity 2: How hot is a pizza oven?

Explore the students' prior knowledge of temperature and thermometers. Ask the students to develop a scale for a thermometer, using words, colours, symbols, or numbers.

Compare the thermometers, discussing how practical they are. Discuss the importance of standardising measurements in order to accurately communicate information.

Discuss temperatures that the students are likely to be familiar with, for example, water freezing (0 degrees Celsius), a sunny day (25 degrees Celsius), a warm bath (35 degrees Celsius), water boiling (100 degrees Celsius), a hot oven (200 degrees Celsius). Compare these values to the temperature of lava coming out of a volcano, which is between 700 degrees and 1200 degrees.