Lesson Plan 10

New Zealand Eruptions

What has happened in New Zealand's 'recent' eruptions?

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Note-Students could be divided into 3 groups with one group covering each eruption and then presenting their work to the class.

The Taupo Eruption

- **Read** aloud to the class or have students read

'*A Bit of a Bang*' by David Hill, School Journal Part 4 Number 3 2004

- **Discuss**

- what is happening to the volcano at different stages of the eruption.

- how cartoons/sketches can show events as well as objects, eg wavy lines for earth tremors

- **Draw** the sequence of events, by breaking the story into 6 stages. This could be done by each individual as six quick sketches on one piece of paper. Alternatively 6 groups could do one scene each with captions to create a larger artwork for display.

The 6 stages and their essential features are described on the eruption outline resource.

The Tarawera Eruption

- **Read** the eyewitness account of the 1886 eruption by Clara Haszard and look carefully at the before and after pictures of her home. Clara is on the far right of the picture.

- **Discuss** the materials the volcano was producing at different stages of the eruption and how they affected the buildings and the people.
  - Frequent earthquakes which became stronger over time
  - A wide, black eruption column that spread out at the top, glowed red at times and produced 'fire-balls' of red hot stones which were seen falling around the summit.
  - Lightning and thunder from the eruption cloud
  - Small stones which hailed down as the eruption cloud moved over Te Wairoa.
  - Mud mixed with water which fell like very heavy rain. This lasted for about 3 hours and coated Te Wairoa in up to a metre of mud and stones.

- **Record** the events that led to the destruction of the buildings and the deaths of some family members by drawing or writing in the space between the pictures.

The 1995/96 Ruapehu Eruption

- **Read** the information sheet about the 1995/96 Ruapehu Eruption.

- **Discuss** the effects of the ash on the surrounding area.

- On a map of the Ruapehu area draw a very small eruption at the simmit and shade the sky lightly to show the ash in the atmosphere.
  - The map could be created using Google Maps or photocopied from a road or topographical map of the Ruapehu/Taupo area. The area covered should extend from just south of Ruapehu towards the Bay of Plenty because this is where wind carried most of the ash.

Comparative Sizes of NZ Eruptions

- On the worksheet **draw** eruption clouds to the sizes shown below each volcano. For example the Tarawera eruption will fill one square of the grid because each square is 1cm²and represents one cubic kilometre of ash. The 1995/96 Ruapehu eruption will be no more than a dot!

Learning Intentions

- Investigate the impact of New Zealand eruptions on people and the environment.
- Choose key facts from written or spoken information and summarise in pictorial form
- Relate the size of eruptions to their environmental, social and economic effects.

Success Criteria

Students can

- Show understanding of information by creating an accurate pictorial summary of events.
- Explain what the Comparative Sizes Worksheet shows about the size of three NZ eruptions.

Resources

- School Journal 4:3 2004
- Outline of events for Taupo Eruption
- Eyewitness account of the Tarawera eruption
- The Haszard Family and the Tarawera Eruption
- 1995/96 Ruapehu Eruption
- Ruapehu Area Outline Map
- Comparative Sizes of Eruptions Worksheet

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Now that students have some knowledge of different sorts of volcanoes and different styles of eruption they can consider what this means for the living things and landscapes of New Zealand.
Listening to or reading accounts of three New Zealand eruptions should help students to visualize the events. By imagining they were there and using their knowledge of volcanoes, students can show the progress of the eruption and its effect on the surrounding area in sketch form. The aim is to develop an idea of the impact of each eruption rather than remember all the technical details.

The largest and most devastating of the three eruptions is the Taupo eruption, 1800 years ago. It is not recent in human terms (and fortunately there were no people here at the time) but it is very recent in geological time. If this eruption were to be repeated today, with the same wind conditions, fall deposits would cause devastation from Hamilton to Palmerston North, an area populated by over 200,000 people. From Rotorua to Gisborne buildings would be damaged or destroyed and farmlands would be smothered. People closer to the eruption would not be able to outrun the pyroclastic flows.

The 1886 eruption of Tarawera is New Zealand's largest eruption in the last 500 years. By comparison with pre historic New Zealand eruptions it was a small event but more than 100 lives were lost. A tourist attraction which some referred to as the 'eighth wonder of the world' was destroyed and the local landscape was changed forever. In a similar way to the destruction of Pompeii, villages around Tarawera were buried under surges or falls of mud and ash. Te Wairoa was home to around 250 people at the time of the eruption and many tourists stayed in the hotel on their way to visit the world famous Pink and White Terraces. Te Wairoa is the only village which has been excavated and visitors today can get some idea of what the experience was like for the residents. Eruptions create as well as destroy landscapes, the hot springs and crater lakes of Waimangu Valley are new tourist attractions formed as a result of the Tarawera eruption.

The 1945 and 1995/96 Ruapehu eruptions were the largest eruptions in New Zealand in the last 100 years. Although significant locally they were very small eruptions. The two eruptions were about the same size but the effects of the 1945 event were much less severe economically. In the 50 years between the two events NZ's population doubled and the number of people using Tongariro National Park increased vastly. In 1945 there was one skifield and no skilifts, by 1995 there were three skifields and 36 skilifts. Skifield closure led to losses to the regional economy of more than $100 million. Damage to the Tongariro Power scheme cost a further $20 million.

The final activity in this lesson is mathematical and shows the relative size of each of the eruptions. Well known eruptions from other parts of the world are included to give some perspective, on a global scale, of the size of the three New Zealand eruptions.

Curriculum Links

Planet Earth and Beyond

Physical World

Science Concept	NOS
PE-Earth Systems L3/4 –develop an understanding of what makes up our planet **LW-Ecology** L3/4-explain how living things respond to environmental changes	**Communicating in Science**
	Investigating in Science

Social Science
L4-understand that events have causes and effects
Mathematics
L4-Measurement-use metric units for volume

Assessment

The key competencies of thinking and using language, symbols and texts could be assessed as students transfer information from one form to another. Showing information in a pictorial form will reveal their understanding of the texts.

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FAQs and links for further inquiry 10

New Zealand Eruptions

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What is volcanic ash like?

At first glance volcanic ash looks like a harmless, grey powder. However it is actually tiny particles of sharp, jagged rock. These particles are very rough and abrasive and they do not dissolve in water. Because the particles are full of holes left by gas they are very light and can be carried great distances by the wind.

For detailed information on volcanic ash see: http://geology.com/articles/volcanic-ash.shtml#

Where did all the 'mud' come from in the Tarawera eruption?

During the 1886 event, eruptions began at the north end of Mt Tarawera. Over the next hour vents began erupting along the whole length of the mountain top and through Lake Rotomahana. The Pink and White Terraces were located on opposite edges of Lake Rotomahana and it was an area with a lot of hydrothermal (hot water) activity such as geysers and hot pools.

When the eruption reached this area the result was more explosive because the magma mixed with water from the hydrothermal system. Steam explosions displaced the lake and blew out large craters. The superheated water fragmented the rock of the lake floor and terraces and produced the fine 'Rotomahana Mud'. This formed an 11km high eruption column which spread mud and tephra over a wide area about Rotomahana. Closer to the vents surges of mud, ash and steam travelled more than 6 kilometres and destroyed nearby Maori villages. Most of the more than 100 eruption fatalities were due to the explosions at Rotomahana rather than at Mt Tarawera.

When are these volcanoes likely to erupt again?

Taupo and Okataina (whichTarawera is a part of) are caldera volcanoes. They are the most dangerous and destructive type but fortunately they often 'sleep' for thousands of years between eruptions. Taupo was last active during the Taupo eruption around 186AD and Tarawera in 1886.

Ruapehu is frequently active but less dangerous. The last small eruption was in 2007 and larger eruptions such as 1995/96 average around once every 50 years. Most New Zealanders will experience more than one eruption of Ruapehu.

Taranaki (Egmont) last erupted in 1755.

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Eyewitness Account of the Tarawera Eruption

On the night of the 9'th of June 1886, 21 year old Clara Haszard was at home with her family in the village of Te Wairoa near Mt Tarawera. Her father was the school master and the schoolhouse was next to their home. Also in the house were Clara's four younger brothers and sisters, a younger cousin and two visiting surveyors (Lundius and Blythe) who were working in the area.

Below is part of Clara's recount of the events of that night.

We were all in bed at eleven o'clock. At a quarter past one I was awakened by a rumbling noise and father asked me if I felt the earthquake. I said 'Yes' and it kept on a long time.

Mr Blythe was awakened, and father said 'It is the most wonderful sight I have ever seen,' and went on the verandah to see it. There was a large inky black cloud hovering over Tarawera, with lightning and balls of fire shooting out of it. We all dressed and went into the sitting-room, thinking it was the safest part of the building, as it was constructed of corrugated iron. We lit a fire in the stove, and mother sat down in the middle of the room with all the children around her. Looking out of the window, it was like a great sheet of fire. Father and Lundius and Blythe were looking out of the window.

At three o'clock we heard a rattling as of stones falling on the top of the house. The noise was so great that we could not hear each other speak. Mr Lundius picked up a piece of the material, when we all came to the conclusion that Tarawera had broken out into a state of eruption. The volcanic shower continued to pour on the house for about an hour. A tremendous gale of wind arose, and then came down the chimney with such a force that we nearly suffocated with smoke. At about four o'clock we were all, excepting Messrs Blythe and Lundius assembled in the middle of the room, believing it to be the safest place, as the walls were bulging and threatening to come in. I walked over to the door, seeing it bulging, to lean against it. Messrs Blythe and Lundius were standing in the same place, when suddenly there was a tremendous crash, and all was dark, the roof falling on top of us. I put out my hands, and grasped on one side Mr Blythe's hand, and on the other Mr Lundius' instinctively for protection. Meanwhile quantities of mud fell on our heads. Mr Lundius jumped up and smashed the windows, cutting his hand very much. Finding he could not do it so well with his hand, he used his foot and got out. He then said, 'I'm out, come out Miss Haszard,' and he pulled me out. Mr Blythe followed, but on getting into the open air we were struck about the head and body by lumps of debris. We shut the door, but finding the roof bulging down, and being unable to get into some of the other rooms, we opened the door and stood in the doorway, so as to be ready to escape. I was perishing with cold, and Mr Blythe got some blankets to protect me from the cold. Just then the house appeared to be struck with lightning and it took fire. We all rushed out into the garden. When a portion of the building in which we were took fire and burst into flames we endeavoured to find some shelter, and got into the paddocks, stumbling over some uprooted trees in the darkness. Seeing by the light of the burning apartment that the hen-house was standing, we went there for shelter, and remained there till day-light, watching the principal building burning.

From: *Tarawera – the Volcanic Eruption of 10 June 1886* by R.F. Keam

Clara and the surveyors survived the eruption. When the roof fell in her father was killed instantly. Her mother was found alive several hours after the eruption ended, still trapped in her armchair by fallen roof beams. Tragically the three youngest children, who were near their mother, were crushed or smothered by the volcanic mud which poured in as the roof collapsed.

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Supplementary 10

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The 1995/96 Ruapehu Eruption

On September 23, 1995 an explosion beneath the Ruapehu crater lake threw water, rocks and scoria bombs onto the snow covered, summit area.

Fortunately the eruption began about an hour after the ski fields had closed for the day and no-one was injured.

Lahars flowed down the slopes and entered the Whakapapa skifield only 90 seconds after the eruption began.

Eruptions continued throughout October, with more lahars and complete emptying of the crater lake. Ash falls from each small eruption were a few millimetres thick close to the volcano but traces of ash fell up to 250km from the mountain.

On June 17, 1996 further eruptions began and continued until August. Once again the eruption began just after the skifield closed. The crater lake which had begun to refill was emptied and there were more small lahars.

The main product of these eruptions was millions of tonnes of fine grey ash. The wind carried most of this ash north-east to the coast and across the Bay of Plenty.

Some of the problems caused by the ash were:

• The 1996 ski season was completely ruined which meant the local economy lost around $100 million.

• Occasionally the Desert Road (State Highway 1) was closed because of ash fall. Cars driving through ash led to ash clouds and poor visibility. At times ash concealed road markings.

• Cars and other metallic objects suffered some damage due to corrosion by the acidic ash.

• Aircraft were diverted away from the ash cloud so their engines didn't fill with abrasive ash, at times flights were cancelled and airports closed.

• Air conditioning systems were damaged by ash being drawn into the filtering system.

• Farmers noted that their stock were put off eating the grass by the ash covering and there were some deaths of ewes and lambs.

• Acidic ash fall and rain caused minor acid burns to plants and the loss of the annual cauliflower crop in Gisborne

• Over 2 million tonnes of ash was carried into Lake Taupo where it forms a silty layer over most of the lake bed.

• Some stream life including fish were killed by the large amount of ash and lahar debris carried in waterways.

• Drinking water for people (water tanks) and stock was contaminated with ash.

• Ash in the Tongariro River caused damage to the Rangipo Power Station

• Ash falls limited people's ability to work outside.

It is estimate that around 100,000 people were affected by the 95/96 eruptions. For most of those people it was a nuisance rather than a danger, however many people suffered financially due to the lack of a ski season.

Even when eruptions ceased there was one final danger still to come. The eruptions built an unstable wall of loose tephra around the outlet area of the crater lake. As the lake refilled it was inevitable that this wall would eventually collapse and trigger a lahar. This final result of the 95/96 eruptions happened on March 18, 2007. The lahar warning system operated exactly as planned, the flow stayed within the river banks and no serious damage was done.

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Activity sheet 10/1

Name:

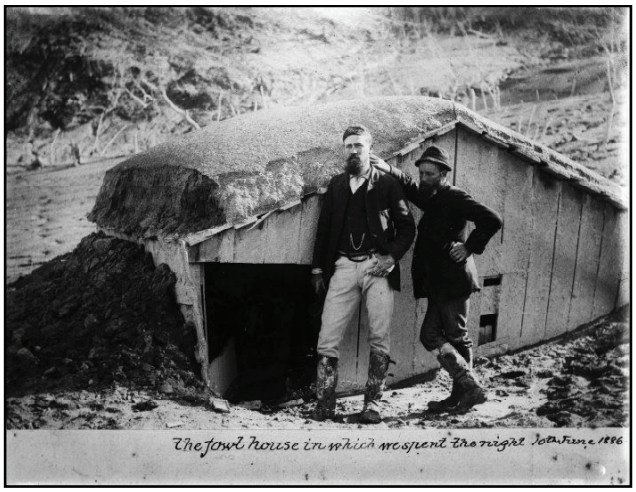
New Zealand Eruptions

What has happened in New Zealand's 'recent' eruptions?

The Haszard Family and the Tarawera Eruption

Haszard home and schoolhouse at Te Wairoa before the 1886 eruption of Tarawera.

Remains of the schoolhouse after the eruption



The henhouse where Clara Haszard and the two surveyors sheltered. Note the volcanic debris on the roof.

All images from the collections of the Alexander Turnbull Library http://mp.natlib.govt.nz/detail/?id=7591).

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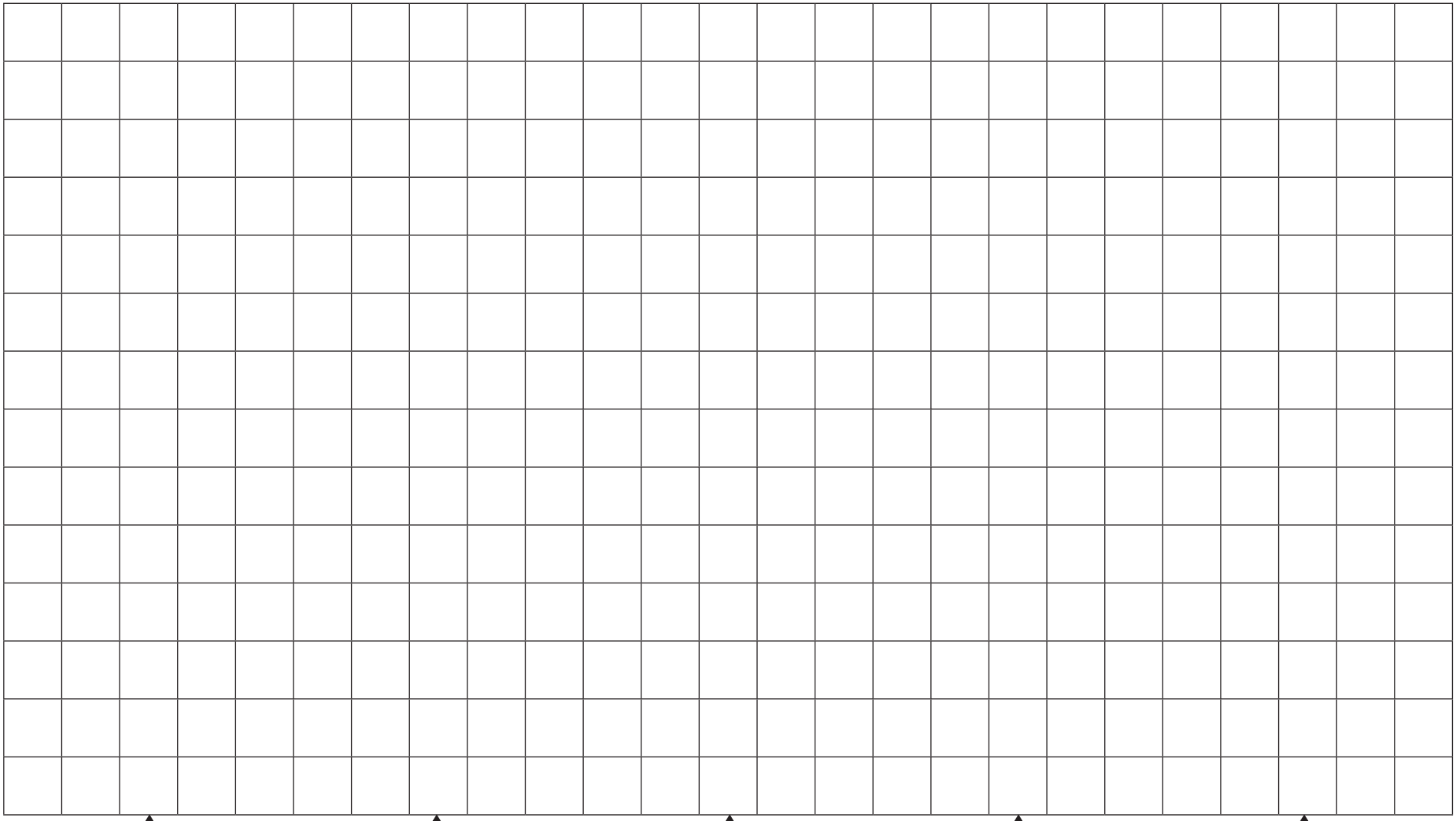
Comparative sizes of eruptions measured in cubic kilometres of tephra (ash) 1cm^2 = 1km^3

Name:



New Zealand Eruptions

Activity sheet 10/2

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New Zealand Eruptions

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Sequence of events for drawing the Taupo Eruption from 'A Bit of a Bang' SJ 4:3 2004

A small lake (with floating pumice), a hill to one side of the lake showing cracks and a landslide, three snow covered mountains in the background. Small earthquakes are occurring.

↓

Steam, ash and small pieces of pumice rise with a roaring sound from a split in the hilltop. They form a low eruption plume and earthquakes continue.

↓

The hill is lower because it has been blown apart and partially collapsed forming a crater. Lake water can now reach the magma in the crater.

↓

A high eruption column with an enormous mushroom plume blots out the daylight. Lightning flickers, lava bombs and pumice are hurled from the crater.

↓

Most of the eruption column falls back to Earth creating an avalanche of ash, gas and pumice which races in all directions and goes over the top of the two closest volcanoes (Tongariro and Ngauruhoe). Trees are flattened, birds are killed, the sky is full of ash.

(This sketch could be an aerial view to show a wider area.)

↓

The hill has disappeared and been replaced by a wide crater partly filled with water. The surrounding area is covered in pale coloured rock (ignimbrite) or loose pumice and ash.

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