



Activity: Which Dating Method

In this activity, students learn to recognise some of the different relative and absolute dating methods that are referred to throughout the Science Learning Hub website.

Article references from <https://www.sciencelearn.org.nz>

1. Reading rock core samples

One important question that scientists like Dr Phil Shane at The University of Auckland are asking is: "When did the volcanoes in Auckland last erupt?" So how do you find out what happened a very, very long time ago? One method involves identifying the age of an eruption by looking at rock core samples.

What are they looking for?

Scientists are able to see different layers in the cores. These layers represent different rock types, for example, ash floating down from a Taupō eruption might look white, lake sediment is a dull brown muddy colour, while basalt rock from local Auckland volcanoes is dark and grainy.

Putting the story together

Phil can read the rock core like pages of a book. He sees each layer as a page that records a period in time:

- A light-coloured layer of rock at a depth of 60m below the surface corresponds to a massive eruption from the Rotorua area. This is white ash (tephra) that has travelled many miles to settle in the basin.
- A layer of sedimentary mud immediately on top of the ash layer shows that there were no eruptions at that time and the lake bottom was naturally forming and settling.
- Further up the rock core, there is a dark layer, which is basalt rock. Auckland volcanoes erupt this type of rock, so scientists can see how many layers of this darker material there are and how frequently this layering occurs.

Relative

☐

Absolute

☐

Don't know

☐

Specific method

2. Exploding Taupō

The Taupō Volcanic Zone contains many extinct volcanoes as well as several that remain active today. One of the biggest eruptions in the area was the caldera explosion that created Lake Rotorua 240,000 years ago.

Also around this time – 250,000 years ago – Mt Ruapehu started erupting. This volcano remains one of the most active in the world with eruptions recorded as recently as 2007. Ash from Ruapehu covers much of the central plateau, and during recent eruptions, ash and mudflows have disrupted road and rail transport across the central North Island region.

It is estimated that Tongariro was also active around 250,000 years ago. Consisting of a collection of vents, Tongariro contains 12 separate cones. It has remained active over its history, with the latest eruptions occurring just 30–40 years ago. One of the vents of Tongariro has been active enough to form its own separate peak, which we refer to as Mt Ngāuruhoe. The earliest eruptions of Ngāuruhoe seem to date from 2,500 years ago, and the volcano remains active today.

Relative

☐

Absolute

☐

Don't know

☐

Specific method

3. Carbon-14 dating artefacts

Dr Fiona Petchey, of the University of Waikato, is using carbon-14 (C-14) to date artefacts of historical importance excavated from the Wairau Bar archaeological site in Blenheim.

In the C-14 dating laboratory that Fiona works in, two dating techniques are used.

Liquid scintillation spectrometry involves converting all of the carbon in the sample to a liquid called benzene. A special chemical is added to the sample that produces tiny specks of light called scintillations when carbon-14 atoms decay. A special detector called a spectrometer can 'see' these specks and, with the aid of a computer program, can count them and determine the date of the sample.

Accelerated mass spectrometry (AMS) is the other technique used. It involves converting the carbon in only a very small piece of the artefact to carbon dioxide gas by controlled combustion. The carbon present in the gas is then converted to a small plug of a graphite/iron composite. This is then analysed in a device known as an accelerated mass spectrometer. The AMS can count all of the C-14 atoms in the sample resulting in increased sensitivity.

Relative

☐

Absolute

☐

Don't know

☐

Specific method

4. Old rat bones provide key to past

Old rat bones are providing scientists from Landcare Research and Oxford University with clues about human settlement in New Zealand. The scientists used radiocarbon dating to work out how old the bones are. The scientists also tested seeds which had distinctive tell-tale rat bite marks, preserved in peat and swamp sites from the North and South Islands. The dating project worked out that the rat bones and gnawed seeds are approximately 720 years old.

"The width of the teeth marks left on the woody seeds exactly match those of a rat's two front teeth and cannot be mistaken for any other seed predator. We have dated over 100 individual seeds, some rat-gnawed, others intact or bird-cracked, which show that rat gnawed seeds only occur in both the North and South Islands of New Zealand after about 1280 AD," Dr Janet Wilmshurst from Landcare Research explains.

This is significant as rats are not native to New Zealand and are intimately associated with humans. When a large canoe or ship arrives in port it almost invariably brings rats with it. "As the Pacific rat or kiore cannot swim very far, it can only have arrived in New Zealand with people on board their canoes, either as cargo or stowaways. Therefore, the earliest evidence of the Pacific rat in New Zealand must indicate the arrival of people."

Relative

☐

Absolute

☐

Don't know

☐

Specific method

5. Glaciers provide global climate puzzle

Glaciers – large slow-moving rivers of ice – are sensitive indicators of the climate. They become shorter when the climate warms and lengthen when it cools. Arcs of rock debris called moraines mark where glaciers advance to and stop before receding. Research recently published on dating glacier moraines has come up with a puzzling picture of the global climate system.

Dating glacier moraines

Many scientists believe that the Northern and Southern Hemispheres are climatically linked during periods of global warming and cooling (ice ages). If the moraines of different glaciers around the world could be dated and compared, this could provide further evidence of this connection. If the moraines corresponded in age, this would represent a time marking the beginning of global warming.

A group of 9 scientists, including 3 from New Zealand, have come up with a way to tell precisely how old these moraines are using an isotope called beryllium-10.

Surface rocks are continually bombarded by cosmic rays. Over time, cosmic radiation causes the build-up of certain isotopes in the rock. By measuring the amounts of beryllium-10 in rocks on the moraines, the scientists have been able to pinpoint dates when glaciers started to recede.

They have been using this dating technique to ascertain a reliable timeline of advances and retreats of glaciers in the Mount Cook region over the past 7,000 years.

Relative

☐

Absolute

☐

Don't know

☐

Specific method

6. Middens

What is a midden?

People in the past threw out their rubbish in particular sites much as we do today. These sites are called middens and are the archaeological treasure troves of how people used to live.

Middens can contain food remains such as shellfish shells, animal bones, ash from fires, broken tools and household objects. The rubbish left behind by people long gone gives us an insight into what people ate and how they lived. In New Zealand, a midden is the most common archaeological site.

How do we know how old the midden is?

If archaeologists are able to recover charcoal, bones or shells, they are able to use radiocarbon dating techniques to estimate the age of the material in the midden. Radiocarbon dating is only possible on material that has once been alive, so it is not possible to date any stone tools or shards.

Relative

☐

Absolute

☐

Don't know

☐

Specific method