**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.

By the end of this activity, students should be able to:

* read and comprehend a variety of science texts
* recognise and distinguish between relative and absolute dating methods
* realise that dating is important in several fields of science
* use the Science Learning Hub as a research tool.

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**Introduction/background**

Our collection of resources on dating the past is about methods of relative or absolute dating and how they have been applied by New Zealand scientists. Students will need to be familiar with these techniques, especially the difference between relative and absolute dating, before they carry out this activity.

They should also be aware that scientists choose the method that best suits their material – they might use relative or absolute dating or a combination of methods, depending on the type of material they are working with and the precision they need.

Geologists are just one group of scientists who need to know when past events happened. A range of dating methods is mentioned in a number of other articles on the Science Learning Hub. Topics that involve some dating include Antarctic ice cores, Auckland volcanoes, glaciers, earthquakes, archaeological artefacts and sites, and the first human occupation of New Zealand.

Often, scientists do not actually refer specifically to the terms ‘relative dating’ or ‘absolute dating’ in their writing.

This classroom activity asks students to look at items throughout the Hub and to decide what sort of dating methods are being presented. How you organise the activity will depend on the level of access your class has to the internet.

Here are some alternatives:

* Working in groups, students explore printed extracts from Hub text articles. Video clips are displayed using a data projector and discussed as a class.
* Articles and video clips are all displayed using a data projector. Students keep their own notes (or in groups) and discuss together afterwards.
* Student groups take it in turns accessing their given article or video on <https://www.sciencelearn.org.nz>.

**What you need**

* Copies of [Article references](#2et92p0) or [Article excerpts](#1t3h5sf)
* Copies of [Video references](#tyjcwt)

**What to do**

1. Give each student or group either:

* one of the [Article references](#2et92p0) or [Video references](#tyjcwt) if they are using the website
* one of the [Article excerpts](#1t3h5sf) if they are not using the website.

1. Explain that they need to:

* read the article or watch the video
* tick the box next to the dating method referred to – tick both if the item refers to both, tick ‘don’t know’ if it is not clear
* if a particular dating method is used (for example, radiocarbon dating), make a note of it.

1. Use the [Teacher notes – possible responses](#4d34og8) to discuss findings.

**Discussion questions**

* Did the articles or videos always tell you if the author was referring to relative or absolute dating, or did you have to work it out for yourself?
* Were you always given enough information to work out the dating method?
* Under what circumstances do you think it is acceptable for scientists to assume the reader knows certain things without them having to explain everything?
* When do you think scientists should explain things more fully?

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

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| **1.** [**Reading rock core samples**](https://www.sciencelearn.org.nz/resources/643-reading-rock-core-samples) | | | | | | |
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| Relative |  | Absolute |  | Don’t know |  |  |
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| **Specific method** | | | | | | |

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| **2.** [**Exploding Taupō**](https://www.sciencelearn.org.nz/resources/941-exploding-taupo) | | | | | | |
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| **3.** [**Carbon-14 dating artefacts**](https://www.sciencelearn.org.nz/resources/1686-carbon-14-dating-artefacts) | | | | | | |
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| **4.** [**Old rat bones provide key to**](https://www.sciencelearn.org.nz/resources/1555-old-rat-bones-provide-key-to-past) [**past**](http://link.sciencelearn.org.nz/resources/1555-old-rat-bones-provide-key-to-past) | | | | | | |
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| **5.** [**Glaciers provide global climate**](http://link.sciencelearn.org.nz/resources/1554-glaciers-provide-global-climate-puzzle) [**puzzle**](https://www.sciencelearn.org.nz/resources/1554-glaciers-provide-global-climate-puzzle) | | | | | | |
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| **6.** [**Middens**](https://www.sciencelearn.org.nz/resources/1460-middens) | | | | | | |
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| Relative |  | Absolute |  | Don’t know |  |  |
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**Video references from** [https://www.sciencelearn.org.nz](https://www.sciencelearn.org.nz/)

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| **7.** [**Explaining a rock core**](https://www.sciencelearn.org.nz/videos/191-explaining-a-rock-core) | | | | | | |
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| **8.** [**The use of calibration**](https://www.sciencelearn.org.nz/videos/1077-the-use-of-calibration-curves) [**curves**](http://link.sciencelearn.org.nz/videos/1077-the-use-of-calibration-curves) | | | | | | |
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| **9.** [**Dating ice cores**](https://www.sciencelearn.org.nz/videos/545-dating-ice-cores) | | | | | | |
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**Article references from** <https://www.sciencelearn.org.nz>

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| **1.** [**Reading rock core samples**](https://www.sciencelearn.org.nz/resources/643-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. | | | | | | |
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| **2.** [**Exploding Taupō**](https://www.sciencelearn.org.nz/resources/941-exploding-taupo) | | | | | | |
| 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. | | | | | | |
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| **3.** [**Carbon-14 dating**](http://link.sciencelearn.org.nz/resources/1686-carbon-14-dating-artefacts) [**artefacts**](https://www.sciencelearn.org.nz/resources/1686-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. | | | | | | |
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| **4.** [**Old rat bones provide key to past**](https://www.sciencelearn.org.nz/resources/1555-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.” | | | | | | |
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| **5.** [**Glaciers provide global climate puzzle**](http://link.https:/www.sciencelearn.org.nz/1554-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. | | | | | | |
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| **6.** [**Middens**](https://www.sciencelearn.org.nz/resources/1460-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. | | | | | | |
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**Teacher notes – possible responses**

**Articles**

**1. Reading rock core samples**

Relative.

Refers to layers in a rock core that are used to determine the order of volcanic events. There is no mention of actual dates.

**2. Exploding Taupō**

Absolute.

Refers to the date (number of years ago) of a number of past volcanic eruptions but does not state the methods used to determine these dates.

**3. Carbon-14 dating artefacts**

Absolute.

Describes two methods of radiocarbon dating.

**4. Old rat bones provide key to past**

Absolute.

Radiocarbon dating.

Dated rat bones and seeds that had been gnawed by rats in a very distinctive way.

**5. Glaciers provide global climate puzzle**

Absolute.

Beryllium-10 radiometric.

Method used to date advances and retreats of glaciers.

**6. Middens**

Absolute.

Radiocarbon dating.

Mentions that radiocarbon dating of once-living material is used to date middens.

**Videos**

**7. Explaining a rock core**

Relative and absolute.

Talks about younger rocks at the top of a column, older towards the bottom. Also refers to ‘geochemical fingerprinting’ of ash layers giving an age of an eruption between 50 and 60 thousand years ago.

**8. The use of calibration curves**

Absolute.

Radiocarbon dating.

Describes how radiocarbon years are converted to calendar years. Date is often a range rather than a specific single year.

**9. Dating ice cores**

Relative.

Correlation – if you find an ash layer in an ice core, you can relate this to an event dated somewhere else.