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91922R

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

# Level 1 Science 2024

## 91922 Describe features of science that have contributed to the development of a science idea in a local context

Credits: Five

RESOURCE BOOKLET

Refer to this booklet to answer the questions for Science 91922.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

**YOU MAY KEEP THIS BOOKLET AT THE END OF THE EXAMINATION.**

## SCIENCE IDEA ONE: Using long-term studies to research human development

The Dunedin Multidisciplinary Health and Development Study, or the Dunedin Study, is a unique research project in New Zealand. The Dunedin Study has been following the lives of 1,037 people of varied ethnicities born between April 1972 and March 1973 in Dunedin, New Zealand.

Every few years participants undergo assessments (see Figure 1) where a lot of information is gathered, including weight-to-height ratio, smoking habits, intelligence, and memory. Researchers will be able to use this data later in the study to see if there are common causes for various illnesses. This data can help to answer the question: how can we grow old in as healthy a way as possible?

### Studying how we age

Research that continues for a long time, and gathers a lot of data like this, is known as a **longitudinal study**. It is using an entire lifetime's data to look back to early childhood and see if there are things that we can know about well in advance that will influence the ageing process.

**Figure 1: Points at which participants have been assessed**

## Connecting gait speed, intelligence, memory, and brain ageing

In April 2017, 904 participants completed a gait (walking speed) test and an MRI (magnetic resonance imaging) scan. Before then, MRI technology was not available to the researchers. By scanning participants' brains at 45 years old, the researchers can get a good picture of things before the ageing process gets properly underway.

Researchers used an MRI (see Figure 2) to take very clear images of brain structures inside participants' heads. MRI uses a large magnet, radio waves, and a computer to produce detailed images. This might help to predict future health outcomes.

## MRI findings

Some of the data compared how thick parts of the brain (called **cortical areas**) are against each of the 904 participants' gaits. The trend line data is shown in Figures 4 and 5 on page 4.

When we get older, our cortical thickness (see Figure 3) decreases. This can be associated with various ageing-related diseases such as Parkinson's. Parkinson's is a disease that leads to unintended or uncontrollable movements, such as shaking, stiffness, and difficulty with balance and coordination.

One major idea the MRI gait test found is that people with a lower intelligence rating and whose memory got worse from childhood to adulthood tend to have slower gait speed at age 45. This might help to understand age-related memory loss or be linked to the way the participants grew up.

## Te Kura mai i Tawhiti

The Dunedin Study is involved with another study called Te Kura mai i Tawhiti. It focuses on how kaupapa Māori early life and whānau programmes can impact on whānau health, well-being, and educational outcomes as adults. This study has completed three parts of the project so far with plans to continue.

Like the Dunedin Study, researchers want to find out ways to make people healthier now and for generations to come but with a unique focus on tangata whenua, Māori people. For instance, researchers want to answer questions such as, "how might a strong sense of Māori identity and behaviour make Māori communities better?" It is hoped that evidence from this project could be used to support Māori children as they grow.

**Figure 2:** A patient being scanned in an MRI machine

**Figure 3:** Human brain with cortical thickness highlighted

**Figure 4: Mean data about participants' gait speed compared with cortical thickness**

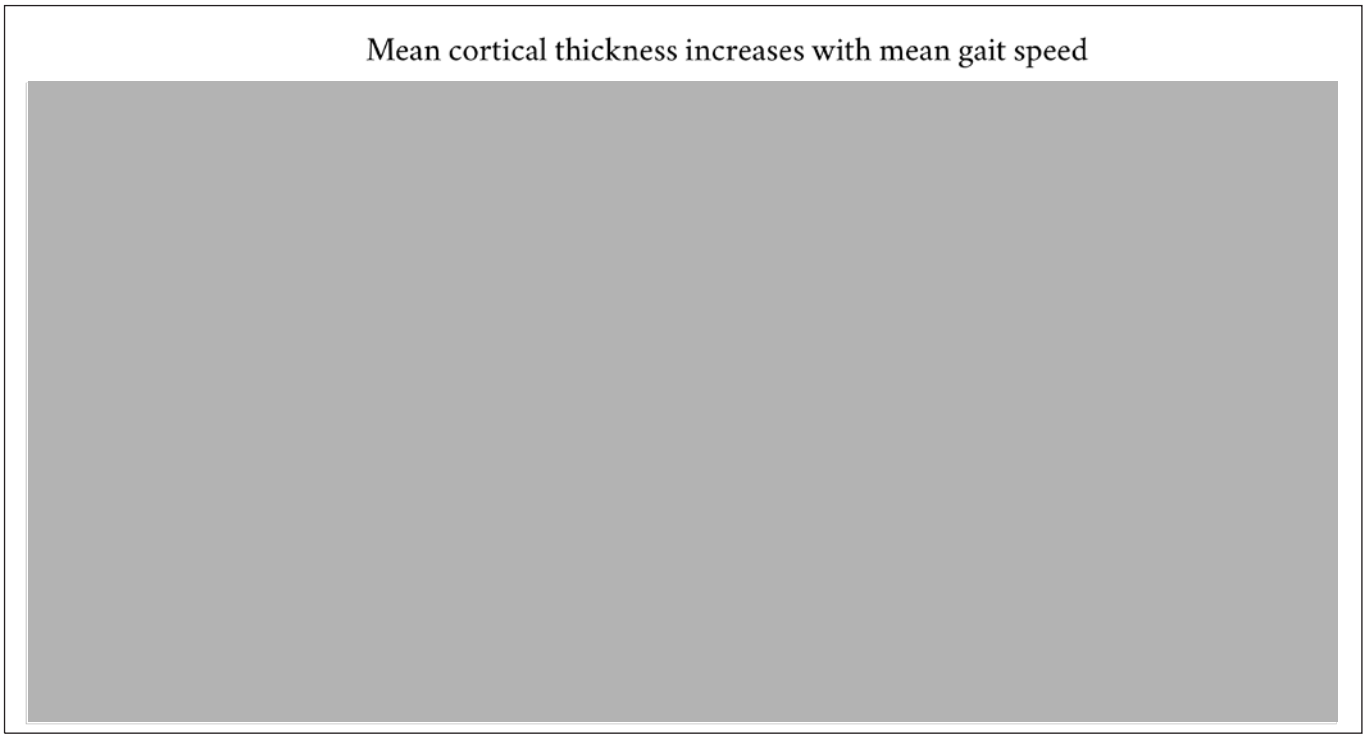
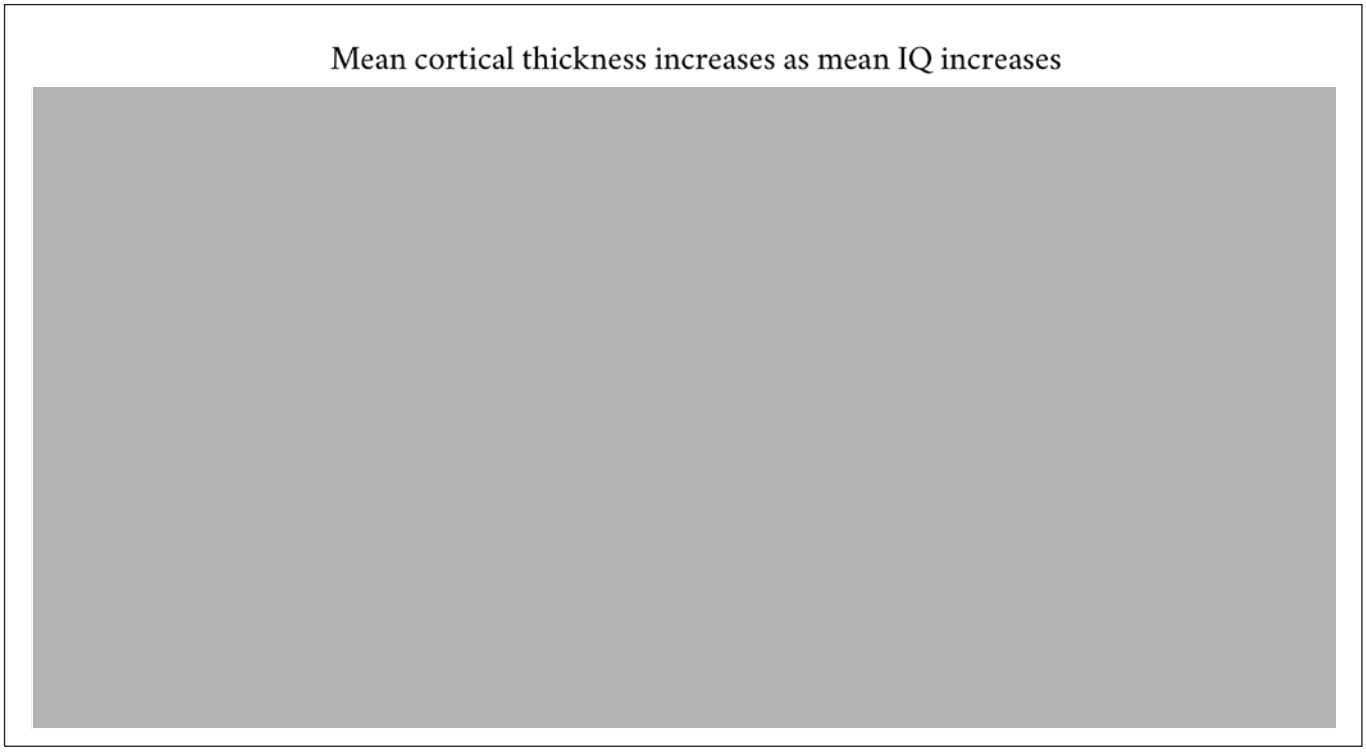



**Figure 5: Mean data about participants' IQ compared with cortical thickness**

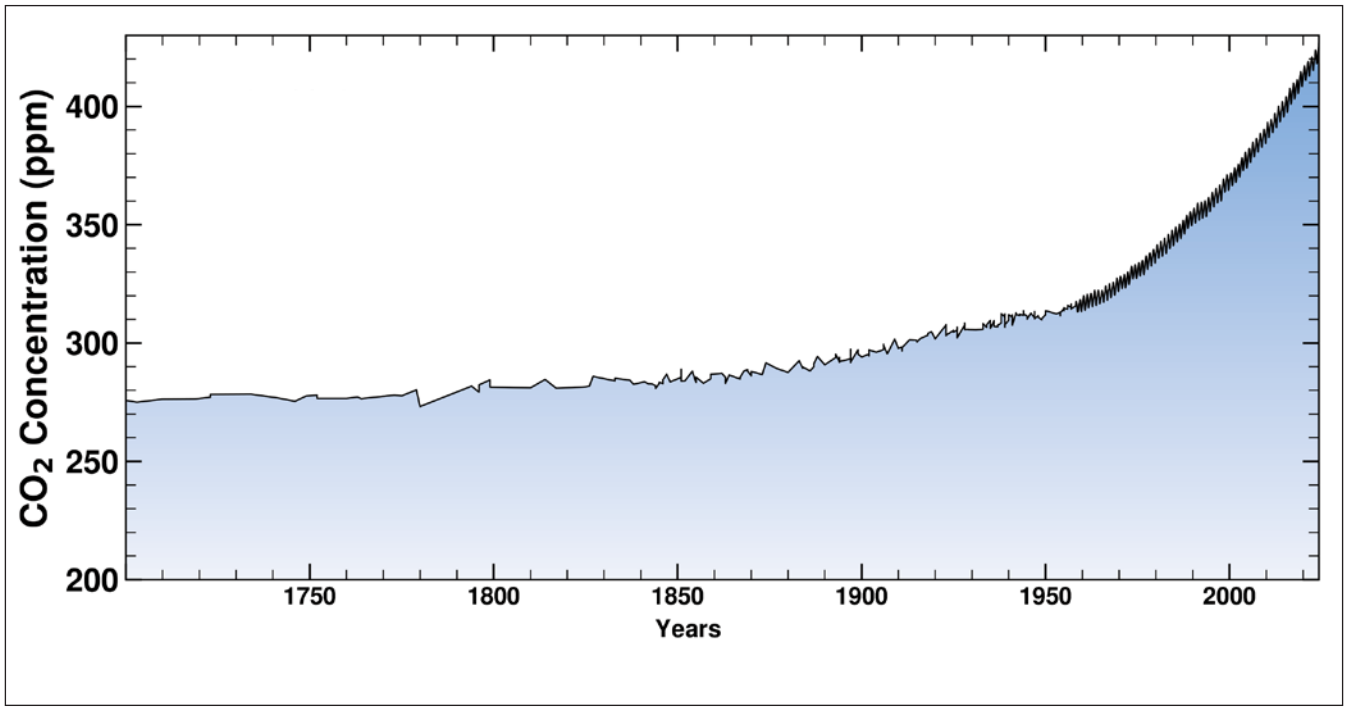


**SCIENCE IDEA TWO: How are the oceans affected by increasing carbon dioxide in the atmosphere?**

In 1953, Charles David Keeling was concerned that burning fossil fuels produced carbon dioxide ($CO_2$). He thought this issue was so important that he decided to study the relative amount of $CO_2$ in water and air. To do that, he first had to measure the level of $CO_2$ in the atmosphere, which had never been accurately done before.

Keeling decided to make daily measurements of $CO_2$ at the Mauna Loa Observatory in Hawai'i. He chose this spot because there weren't many human activities that could affect the measurements. He measured the $CO_2$ concentration in parts per million (ppm). These measurements continued, and a pattern began to emerge, which is shown in Figure 6.

**Figure 6: Keeling curve data from 1700 to present-day**




### Dr Kim Currie

In 1992, Kim Currie was studying at Otago University in Dunedin and learned about Charles Keeling's measurements. She was inspired to build on his findings but took a different perspective. She wanted to study how changing atmospheric $CO_2$ could affect the ocean. She decided that measuring the amount of $CO_2$ in the ocean would help her to understand this relationship. She wanted to understand:

- How does the uptake of $CO_2$ from the atmosphere vary around New Zealand's coast?
- How is the uptake of $CO_2$ from the atmosphere changing over time?

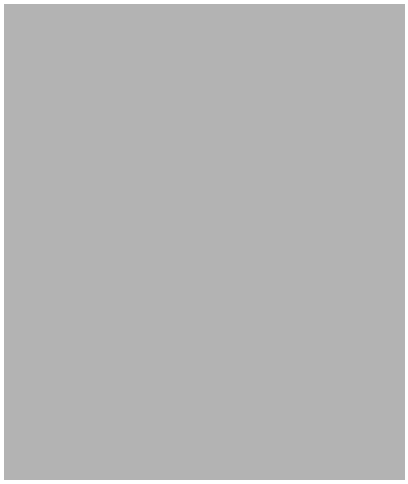


**Figure 7:** Dr Kim Currie

## Getting started

Since not many people had done this kind of research before, Dr Currie had to design and make new measuring equipment. This equipment would be able to measure the parts per million of $CO_2$ in the ocean very accurately. As time went on, her equipment became more accurate and easier to use (see Figure 8).

**Figure 8:** Dr Currie's measuring equipment

Dr Currie used ocean-going research vessels to take samples and bring them back to her lab. This helped her to make very accurate measurements of the $CO_2$ in the different samples.

Dr Currie realised that to fully understand what affects $CO_2$ in the ocean, she would need to measure many other variables very accurately, such as ocean salinity (salt concentration in the ocean), temperature, and pH.

## Results and patterns

Dr Currie decided to take pH measurements off the coast of Dunedin at different points. This was called the Munida Transect and was made up of eight stations out to a distance of around 65 kilometres from the coast. Data was collected as a **time series**, which is when many precise measurements are taken in a constant way over a long period of time.

Over time, Dr Currie produced a time series that showed a pattern. The pH of the ocean seemed to be getting lower (see Figure 9). She wanted to know if other scientists were finding similar results. However, to do this, she needed to make sure that the other scientists' measurements were made in the same way and meant the same thing that hers did.

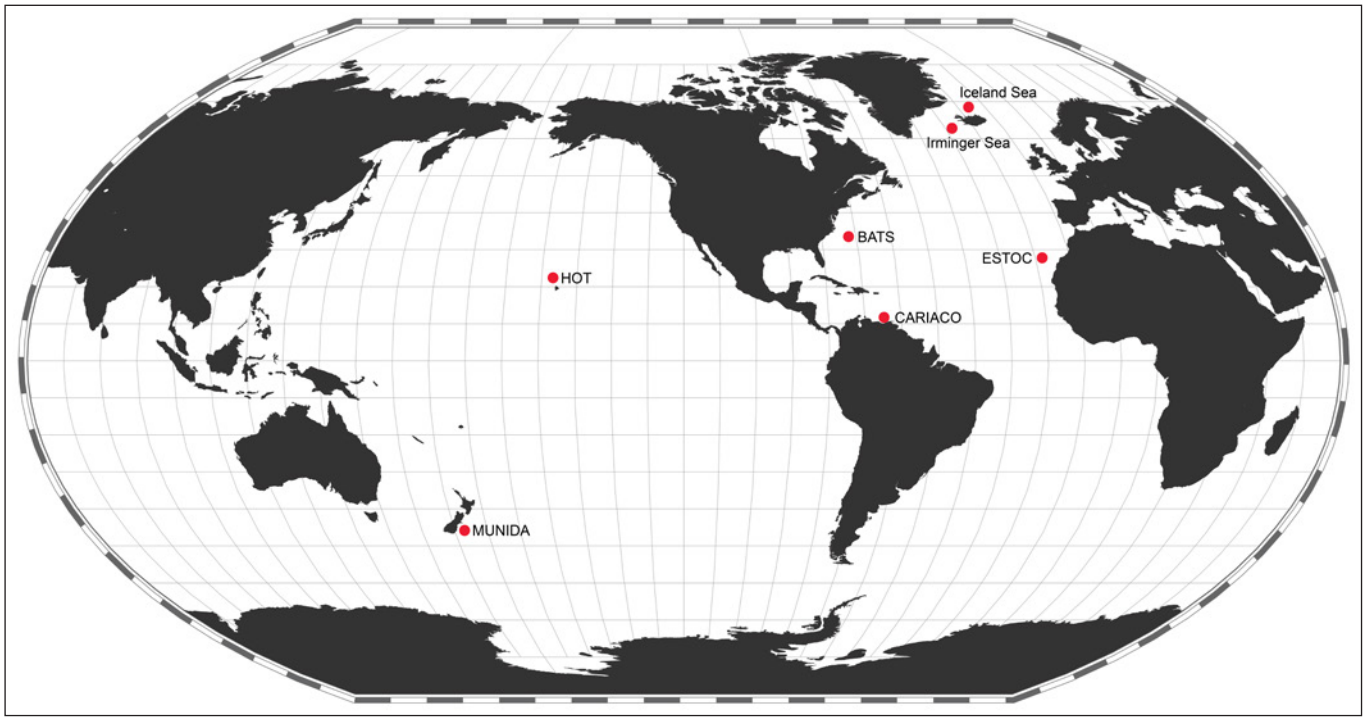
**Figure 9: Time series showing change in ocean pH over time**

## Global cooperation and global patterns

Dr Currie met with scientists from all over the world and compared how she did her measurements. Some of the places they had measured $CO_2$ as a time series are shown in Figure 10. They were then able to compare their results, and they had all found the same pattern.

When pH values decrease it means something is getting less alkaline and more acidic. Dr Currie discovered a pattern that showed that more $CO_2$ is being absorbed from the atmosphere into the ocean. This is lowering the pH of the ocean, which means it is becoming more acidic.

**Figure 10: Locations of other scientists' time series measurements**



**Acknowledgements**
Material from the following sources has been adapted for use in this assessment:

**Science idea one**

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**Science idea two**

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