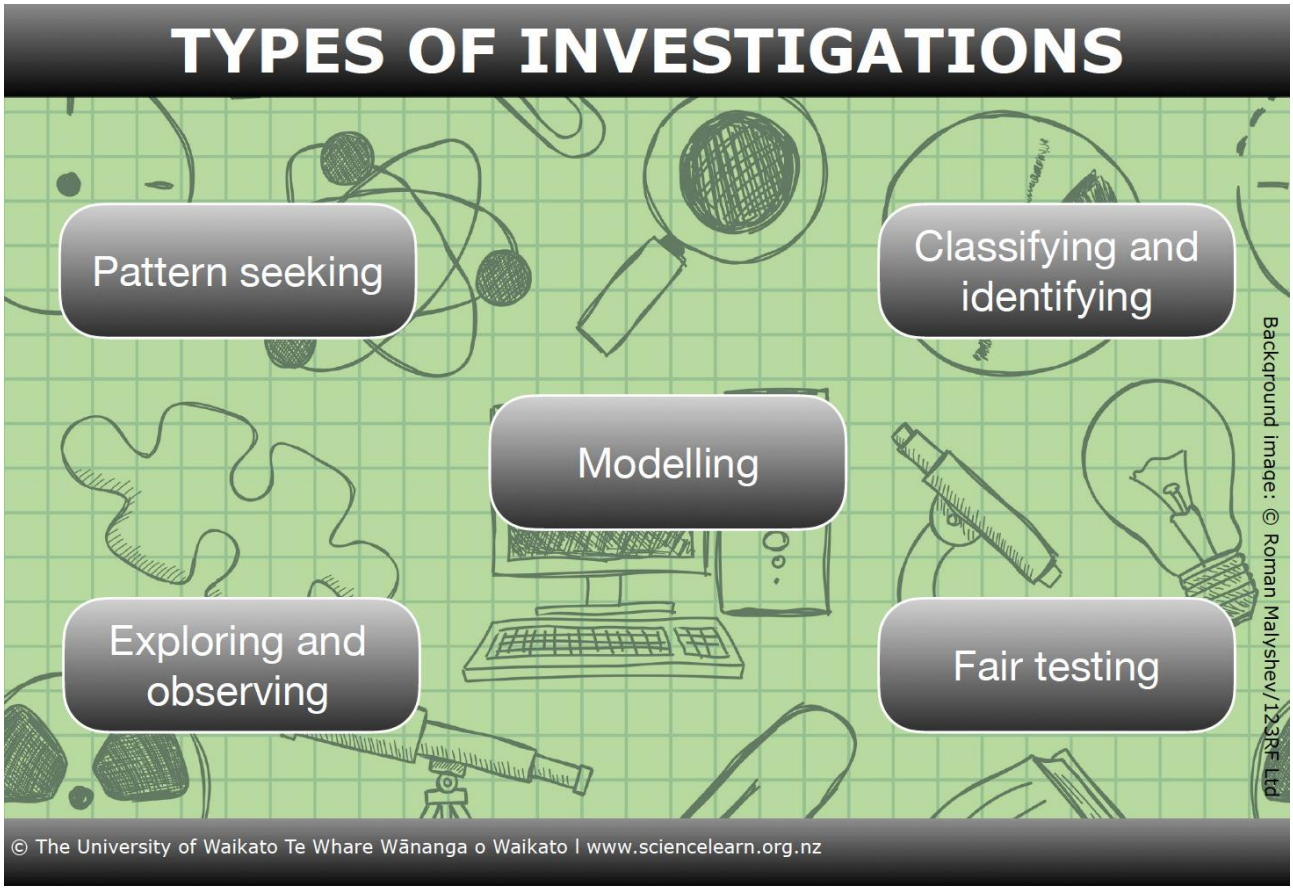
Ways of investigating in science



Scientific investigations are used to answer questions about the living, material or physical world of planet Earth and beyond. Scientists and rangahau pūtaiao use different techniques for investigating different types of questions. Some of these methods include (in no particular order) fair testing, classifying and identifying, modelling, exploring and observing, and pattern seeking.

It is important for students to experience the different types of investigations and understand their use for different purposes.

The article Investigating in science provides additional curriculum information and pedagogical support, which may be helpful when planning for students to use different types of investigation.

Transcript

- Pattern seeking
- Exploring and observing
- Modelling
- Classifying and identifying
- Fair testing

Pattern seeking

Select here to view links to the scientists and stories highlighted in this video.

This method involves observing and recording natural events or carrying out experiments where the variables can't easily be controlled.

In pattern seeking, it is still important to note and record variables or factors. The investigator needs to try to identify patterns that result from these variables.

This method is well suited to system sciences like geology, astronomy, ecology or meteorology.

Connections to other methods

Once a pattern has been observed, this may lead to other investigations in an effort to try to explain why a particular pattern occurs and to a classifying and identifying system.

Pattern seeking can also help us create models to explain observations, for example, to explain the phases of the Moon.

Related resources

- Climate oscillations – video
- Tracking the migratory flight of bar-tailed godwits – activity
- Agent Exoplanet – citizen science article

Examples of kairangahau Māori using pattern seeking as part of their research

Project Mātauranga: Bringing the kiwi back – this video explains how a pattern has been observed in decreased survival of kiwi chicks with the introduction of predators such as stoats.

Select here to view the video transcript.

Exploring and observing

Select here to view links to the scientists and stories highlighted in this video.

Exploring involves discovering new things such as new knowledge. Observing involves using our senses to look at objects, environments, interactions or events carefully. Recording in the form of labelled diagrams is often important. Observing and exploring go hand in hand because, in order to explore new subjects or new ideas, observation is a key tool.

This may involve using tools like a magnifying glass, telescope or microscope to extend our senses. Students may be asked to observe a chemical reaction, the movement of waves in a coastal bay, constellations and the Moon, strata on a field trip or the adaptations of a mussel.

Activities that use exploring and observation

Examples of kairangahau Māori and scientists using exploring and observing as part of their research

In the video Kauri dieback: Death in the Ngahere, Dr Stanley Bellgard discusses the microscopic nature of the disease and what they do to observe it.

Research studying the impacts on Rotorua's natural geothermal taonga has been using local observational data. This data has provided scientists validation, and they are more confident in their predictions.

Select here to view the video transcript.

Modelling

Select here to view links to the scientists and stories highlighted in this video.

A model can be used to help scientists understand how a process works, validate thinking, predict changes or explain ideas or a concept. Models are developed to better understand Earth's processes like ocean currents or climate. More than one model can be used to explain different aspects of the same concept. For example, there are several models that help describe the structure of the atom.

Digital models can show sequences and processes such as the phases of the Moon. Simulation models allow manipulation of variables to explore how they influence the outcomes of processes such as natural selection or the effects on gravitational field strength on the motion of objects.

Related content

- Models in science – video
- Scientific modelling – article
- Tracking plastics in our oceans – article
- Modelling tsunamis and protecting the coast – article
- Melanoma spread pattern model – article

For information about the learning challenges of models, see Teaching with models.

Examples of kairangahau Māori using modelling as part of their research

The Toheroa Abundance Project combines data from transect sampling with knowledge from the past (collected from oral histories) to model and manage future toheroa populations.

Dr Kepa Morgan established a mauri model to incorporate mauri into engineering decisions. It was tested in relation to the Christchurch earthquakes and following the impacts of the Rena grounding.

Select here to view the video transcript.

Classifying and identifying

Select here to view links to the scientists and stories highlighted in this video.

Classifying and identifying involves sorting objects or events into groups or categories. Clear systems (criteria) must be developed and used. Keys are often used as criteria to carry out a classifying process, for example, when identifying and naming plants.

If the criteria are changed, the groupings that result may be quite different and can lead to new scientific discoveries. For example, living things were initially divided into two kingdoms – plants and animals. When microorganisms were discovered and studied, changes were made to the classification system and the number of kingdoms. A five-kingdom classification system is now commonly used but is by no means the only system that might be applied as students explore and make sense of diversity.

Classification systems for stars and minerals use a different range of characteristics to distinguish and group specimens.

Related resources

- Making moth identification guides – article
- Develop a classification system – activity

Examples of kairangahau Māori using classifying and identifying as part of their research

Researcher Dr Priscilla Wehi uses both mātauranga Māori and western science in her research into Aotearoa New Zealand's ecological past.

Select here to view the video transcript.

Fair testing

Select here to view links to the scientists and stories highlighted in this video.

Fair testing finds relationships between variables (factors). A single variable is changed while keeping other variables the same. Any differences are said to be the result of the changed variable.

This method is most easily suited to physical sciences – for example, will the reaction go faster if a more concentrated acid is used? – and technology investigations – for example, which paper towel can soak up the greatest volume of water? Fair testing is particularly well suited to investigations that record measurements.

This method may not work well where investigations

- need to be done in the field
- are monitoring change over time
- need to examine a whole system, not just isolated parts.

Activities that use fair testing

- Nutrient impact experiment
- How much water is in honey? – experiment
- Cleaning up oil in water

Examples of kairangahau Māori using fair testing as part of their research

Hemi Cumming is researching sea sponges and rongoā to investigate new cancer treatments.

Select here to view the video transcript.