MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

# Supporting NCEA Numeracy in Science

**This resource is aligned to the New Zealand Curriculum (2007) and provides support for the teaching and learning of literacy and numeracy in preparation for the NCEA Co-requisite. It aims to support those students who are using the NCEA qualification pathway.**

## In Science, ākonga rely on mathematics knowledge and skills when they undertake scientific inquiry and communicate about their own and others' ideas.

**Knowing how mathematics and statistics ideas progress can help you support ākonga in their numeracy, teach mathematical and statistical concepts in a way that encourages deeper understanding, and assist them in understanding more complex mathematical and statistical ideas found at higher levels of science.**

### Ākonga specifically use numeracy skills when they:

- gather data by making observations and taking measurements
- process data using calculation, tabulation, and graphing skills
- interpret data by identifying patterns and trends
- calculate and predict values
- make judgments about accuracy of data
- consider issues of uncertainty and reliability.

This Numeracy Pedagogy Guide (NPG) takes a selection of mathematical and statistical content ideas from Unpacking Numeracy and illustrates the small, effective steps that you can trial and weave into your teaching practice.

### Additional resources

A rich source of Mātauranga Māori and Science resources is the Science Learning Hub - Pokapū Akoranga Pūtaiao website.

A glossary of statistical terms is available from TKI and contains common statistical terms.

# Science Numeracy Pedagogy Guide

| Operations with numbers | What can this look like in Science? | What can I do as a kaiako of Science? |
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| **Recognise the (degree of) precision required for the context.** | Recognise that answers to scientific calculations may need to be rounded to a certain number of decimal places, or the nearest whole number. | Model how to round numbers using number lines and discuss when and why numbers are rounded.[1] This NZMaths resource may be useful. |
| **Work with whole numbers up to billions, fractions, decimals to 3 places, percentages, and integers.** | Understand the size of very small fractions.<br><br>*Ākonga know that if mass of an electron is 1/2000 the mass of a proton or neutron, this means that the electron is significantly smaller than a proton or neutron.*<br><br>Apply knowledge of ratios in scientific contexts.<br><br>Order integer values and do basic calculations with integers.<br><br>*Ākonga determine whether -2°C is colder than 1°C.* | Use visual representations of very small and very large numbers to support ākonga to get a sense of their size and relative scale. The Scale of the Universe is a useful resource for this.<br><br>Create opportunities for ākonga to use ratios.<br><br>*A recipe for kawakawa balm is 500g of kawakawa, 70g of beeswax and 500g of almond oil. If you give ākonga 400g of almond oil, then to make the kawakawa balm, ākonga would use 400g of kawakawa and 56g of beeswax.*[2]<br><br>Use a number line to illustrate ordering and adding/subtracting integers with ākonga. |
| **Calculate averages (including the mean).** | Understand that average refers to the calculation of mean, median and mode.<br><br>Calculate mean, median and mode for a dataset.<br><br>Select the appropriate average to use.<br><br>*Ākonga find the mean result from multiple trials when investigating using a ramp to lift a load.* | Acknowledge that when "average" is used, this often refers to the mean; however, average is defined as the mean, median and mode.<br><br>Encourage ākonga to calculate all three averages and select the average they think is most appropriate to their situation. Ask them to justify their thinking. |

| Mathematical relationships | What can this look like in Science? | What can I do as a kaiako of Science? |
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| **Work with linear relationships that are represented as graphs or word rules.** | Compare the slope of their straight line graph to the straight line graph of another ākonga.<br><br>*An ākonga notices that their marble rolled down the ramp faster than their friend's marble. The slope of their straight line graph confirms this observation, as their straight line graph is steeper than their friend's graph.* | Provide opportunities for ākonga to compare their graphs and connect this to the experiment they undertook.<br><br>Encourage ākonga to read their graphs from left to right.<br><br>A graph that slopes up from left to right is a positive linear relationship.<br><br>A graph that slopes down from left to right is a negative linear relationship. |

| Measurement | What can this look like in Science? | What can I do as a kaiako of Science? |
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| **Use and interpret results of the measurement (including timetables and time charts).** | Recognise that physical measurements in experiments need to be given to a certain degree of accuracy.<br><br>*Ākonga decide how precise their measurement needs to be when investigating the energy transfer in a hāngī and umu (to the nearest degree Celsius).*<br><br>Read scales to determine volume or mass when carrying out experiments.<br><br>*Ākonga measure the increase in temperature of water when heated hangi stones are submerged as part of an investigation into energy transfer.*<br><br>*Ākonga interpret, or share their knowledge about the maramataka (Māori lunar calendar).* | Discuss the level of precision different measurement tools provide in experiments, for example a 1 metre ruler (to the nearest cm or mm) or callipers (to the nearest 0.02 mm).<br><br>Provide ākonga with a variety of measuring tools to give them experience with reading scales with different increments.<br><br>Ask ākonga to identify potential measurement errors (eg. the scales are not zeroed) and the actions they would take to minimise these errors.<br><br>*Invite ākonga to share their knowledge about hangi and umu.*<br><br>*Invite local experts, kaumātua, kuia, mana whenua and* ākonga *to share their knowledge about the maramataka and how it is used for agricultural productivity, marine and forest gathering, resource management, health, and healing.* |
| **Select appropriate units and convert between metric measures for the same attribute.** | Convert between different measures of distance (e.g. cm, m, km) and time (s, min, hour). | Brainstorm with ākonga the units that can be used with length, weight/mass, and time.<br><br>Discuss how distances and time measures can be converted between different units to meet a purpose. |

| Statistics and data | What can this look like in Science? | What can I do as a kaiako of Science? |
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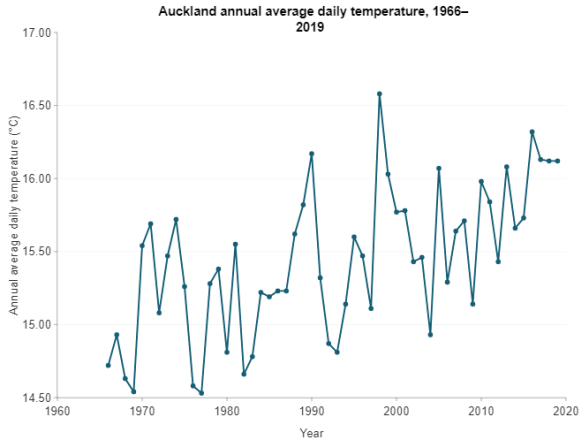
| **Recognise and use appropriate data displays to investigate questions or claims for summary, comparison, and simple time series situations.** | Select and draw an appropriate graph for a set of data.<br><br>*Ākonga use a scatter plot to investigate the relationship between speed and stopping distance in dry and wet conditions.*<br><br>Identify whether data is categorical, discrete, or continuous.[3] | Discuss with ākonga factors that determine which data displays are most useful for a set of data:<br><br>» Pictographs, bar graphs, strip graphs and pie charts can display categorical or discrete data.<br>» Dot plots and stem-and-leaf graphs can display discrete or continuous data. It helps order values so that averages can be calculated.<br>» Scatterplots are used to show relationships between two variables.<br>» Time series graphs show change over time.<br><br>For more information about each type of graph click here. |
| **Interpret data displays using features such as clustering, centrality, spread, unusual pieces of data, frequencies, and patterns.** | Identify key features of graphs.<br><br>Discuss what these features mean in context and why this might be happening.<br><br>*Ākonga interpret a time series graph on temperature changes.*<br><br>  <br><br><br>Graph from StatsNZ<br><br>*What I notice: In general, the annual average daily temperature in Auckland is increasing.*<br><br>*Evidence: The troughs (or lower temperatures) are slowly getting higher, and the peaks (or higher temperatures) from 2005 onwards are slowly trending upwards too.*<br><br>*Relate to context: This means that over time, Auckland is starting to get warmer.* | Use sentence stems to help ākonga:<br><br>» state what they notice on the graphs<br>» specify their evidence<br>» relate this back to their context<br><br>For pictographs, bar graph, strip graph, pie charts, dot plots and stem-and-leaf graphs common observations may be:<br><br>» The most popular result<br>» The least popular result<br><br>For dot plots and stem-and-leaf graphs and scatter plots common observations may be:<br><br>» Clusters of values<br>» Any unusual values, like a value that does not fit a pattern or is extremely low or extremely high<br><br>For time series graphs, common observations may be:<br><br>» Long term trends (increasing or decreasing over time)<br>» Seasonal trends (if there are spikes or dips at certain times every cycle)<br>» Any unusual spikes or dips |

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| Evaluate statements and representations made by others, based on data that is provided to them. | Evaluate claims in reports made about topics such as climate science, vaccinations, health issues.<br><br>*Ākonga explain how climate change claims were made based on the available data.* | Provide questions that support ākonga to evaluate the credibility and reliability of statistical data, for example:<br>» What was the purpose of the study?<br>» Who collected it?<br>» What information was gathered?<br>» When was the information collected?<br>» How was the information gathered?<br>» Is the information consistent with other sources? |

# Footnotes

[1] To round to a whole number, ākonga must:

Look at the digit (singular number) after the decimal point.

If this digit is between 5 and 9, then the whole number increases by 1.

If this digit is between 0 and 4, then the whole number stays the same.

[2] To do this calculation, ākonga need to know:

What value does 500 g need to be multiplied by to get 400 g? This is the mathematical calculation 500 × ? = 400.

Division is the opposite of multiplying. This means ? = $\frac{400}{500}$ or $\frac{4}{5}$ can mean four-fifths or 4 ÷ 5.

Each portion of the ratio must be multiplied by $\frac{4}{5}$ to obtain the correct ratio if 400 g of almond oil is used.

[3] Categorical data is where the data is a worded, non-numerical response. eg. What colour are your eyes?

Discrete data is a numerical response that is a whole number. This means it cannot be a decimal. eg. How many cats do you have?

Continuous data is a numerical response that is often a measurement. The number can be a decimal. eg. How tall are you?