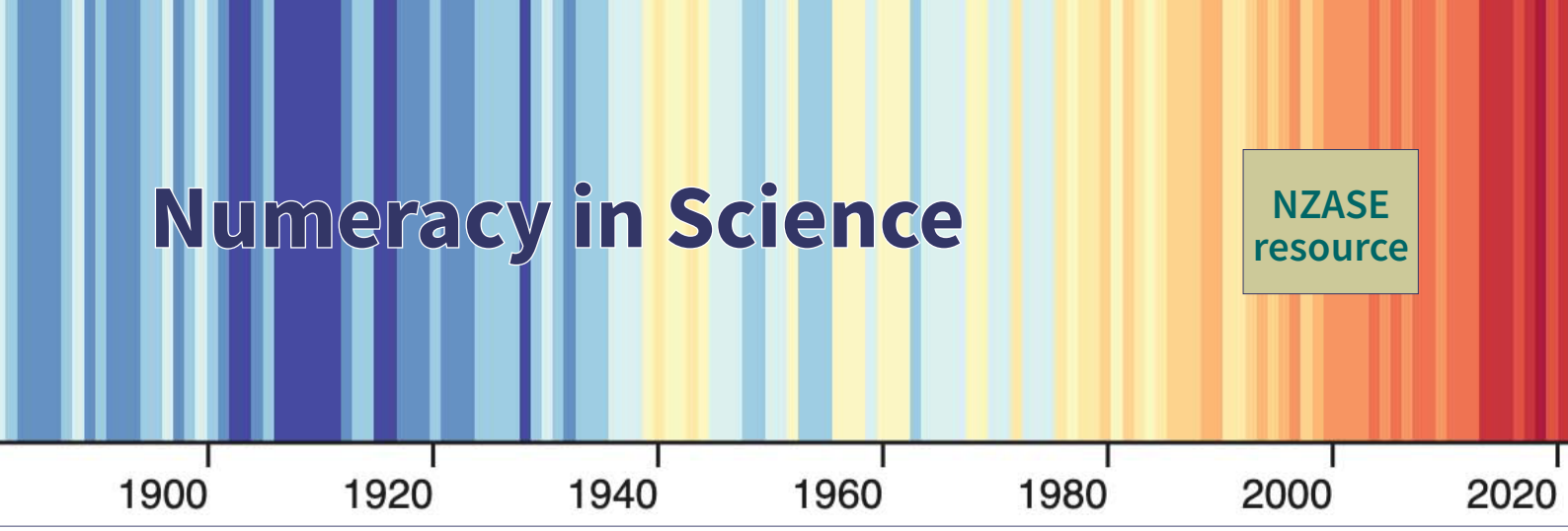
Numeracy in Science

NZASE resource



*Annual average global temperatures visualised in colour. Data from the Global Warming and Climate Change API, by /*CSS { in real life }, a blog about web technologies.*

While secondary teachers may be rewriting junior programmes in the light of changes to NCEA, it is important to remember to include some numeracy, preferably in every unit. NZASE Science Communicator Mike Stone explores numeracy in Science – what the skills are and how we can teach them effectively.

Clarifying numeracy

Numeracy is the ability to understand and use mathematics and statistics in daily life; eg, measuring medicine doses, adjusting a recipe to serve extra guests, handling money, using scales, and reading data in graphs and tables.

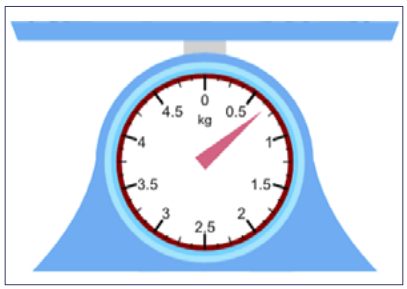
While the basic skills may well be taught in Maths, all teachers are expected to create opportunities for students to practice their numeracy skills, including in Science.

Primary students explore the foundational Maths skills of geometry and measurement, but don't call it numeracy as such.

Secondary Science teachers need to include numeracy in their junior programme, to help students become more numerate and to improve their skills in preparation for the assessment of this NCEA co-requisite.

There are many resources available to support this assessment: a resource bank; NCEA education's Pedagogy guide for Science (NPG), as well as their documents on Effective Practices, Enhancing Planning and Unpacking Numeracy.

In secondary schools, it helps when Maths teachers work with other departments to ensure that numeracy language, skills and approaches are consistent across the school; for example, in drawing a graph, finding the slope, or calculating a mean.



Top: *Reading scales*

Below: *Where is the meniscus measured?*

Numeracy in Science – the skills

In Science, teachers need to give students practice in:

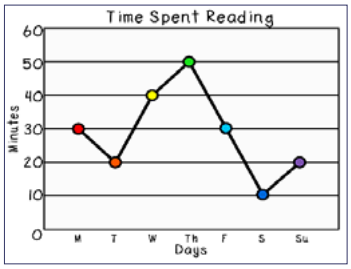
- **Gathering data** – making observations and taking measurements. This includes dealing with very large and very small numbers; understanding temperatures lower than 0°C; reading scales; using units and converting between different measures; reading the meniscus correctly.
- **Processing data** – using calculation, tabulation, and graphing skills. This includes using fractions, ratios and percentages; being able to draw line, bar and pie graphs by hand and digitally; understanding and using the conventions of graph and table construction; calculating the slope of a line. Find out more about types of graphs and tables.
- **Interpreting data** – identifying patterns and trends. This includes reading graphs and summarising the trend in words; comparing graphs or slopes; and recognising linear relationships using graphs or words. Sentence stems can provide scaffolding.
- **Calculating and predicting values** – eg, averages and percentages. Science teachers need to be careful with the word average, as in maths students learn that an average may be a mean, median or mode. These skills may include interpolating and extrapolating graphs, and using physics equations to find unknowns. Students need to be able to justify their answer – explain what they did and why.
- **Making judgments about data accuracy** – including rounding numbers; decimal places; discussing the level of precision and sources of error. See some useful rounding activities.

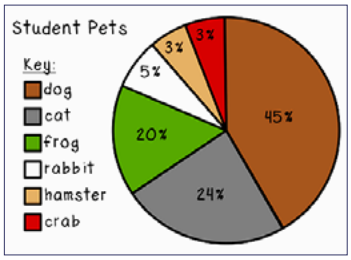
- **Considering uncertainty and reliability** – This may include evaluating scientific claims that are based on data. The CRAAP test is just as useful here as it is in evaluating research sources.
- **Justifying and explaining their observation and reasoning** – this is crucial for success in assessment, and it is the main thing that every learning area needs to focus on.

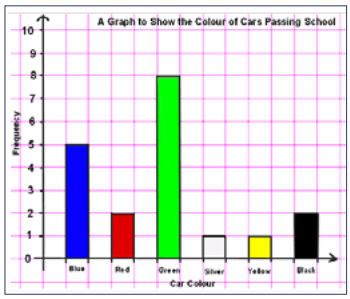
Students also need to practise changing information from text to data, and vice versa. As well as describing the trends in tables and graphs, students can use information from text to construct a table or graph, or select information from a text to solve an algebraic problem in physics.

Be aware that the bivariate data that Maths teachers talk about is simply data with dependent and independent variables; ie, the results of a fair test. Take care with language as this describes a relationship rather than causation.

- **What I notice …**
- **Evidence from the graph …**
- **What this means …**







Top: Sentence stems for interpreting a line graph, from Science NPG.

Below: Line, pie and bar graphs.

Numeracy in Science – effective practice

The pedagogy of numeracy includes:

- Using real-world contexts.
- Modelling approaches; eg, think-alouds, where teachers show students the thinking that goes with a step-by-step process.
- Promoting discussion; eg, talk moves describe the different ways we can encourage discussion – wait time, turn-and-talk, revoicing, reasoning, adding-on, repeating, and revise-your-thinking.
- Ensuring that all ākonga can contribute to discussions; helpful processes include think-pair-share; mini whiteboards; and mixed-ability groups.
- Finding out what students are thinking to inform what you do. It can be helpful to use open questions, prepared in advance. See questions for different purposes.
- Allowing students to solve the same problem in different ways.
- Using incorrect responses to begin conversations, which move the learning forward.
- Having high expectations; "everyone can be numerate".
- Using a range of scaffolding practices, such as excavating, modelling, collaborating, "convince me," reflecting, and apprenticing.
- Using multiple representations – eg, words, pictures, diagrams, graphs, symbols, and equations.

It is good practice to make the numeracy skills in a lesson obvious in both the planning and the execution.

Useful classroom resources

- The Figure it out series has four books in a specifically Science context: *Sustainability*, *Forces*, *Energy* and *Using resources*. Each has 20 pages or more of activities.
- The Assessment Resource Banks also include activities using data in the Science bank. They are free for NZ teachers but you need to register.
- The Science Learning Hub has many resources using data.
- *Connected* booklets include articles focussed on data.
- This US data science website has resources for teachers and students.
- The School Gen resource on Measuring wind power.

Teacher resources

ASE, 2016, The language of Mathematics in Science: Teaching approaches.

Stile Education, 2020, Our approach to scientific numeracy skills.

NCEA literacy & numeracy case studies, Newlands College.

Ngā Kupu

Te Aka Māori Dictionary & Paekupu

Hautau – Fraction
Kauwhata – Graph
Mātau pāngarau – Numeracy
Ōwehenga – Ratio
Raraunga matarua – Bivariate data
Rōnaki – Slope, gradient
Tātai – Calculate; calculation
Tauanga – Statistics
Toharite – Mean, average
Tūtohi – Chart, table (of data).

This article benefitted from critique by Robyn Headifen and Linda Haycock.