

Argument in Science

Measuring paper

Aims

This is a simple activity which aims to show that there is no such thing as a 'right answer' in science. Rather, we have degrees of confidence in science in our answers. This activity explores that by asking pupils to measure the length of a piece of paper in millimetres. Their answers will differ and the role of the teacher is to explore **a)** why they differ; **b)** which answer we can have most confidence in; and **c)** how we might express that confidence. It is a simple activity but raises many issues about certainty in science and how scientists analyse and interpret data.

Learning objectives

To show that there are limits to how exact measurement can be and to the certainty we can have in data from experimental measurements.

Teaching sequence

- a** Start by asking all to measure with a ruler the length of a piece of paper in millimetres.
- b** Ask for one measurement.
- c** Does anybody have a different measurement?
- d** Why might they disagree?
- e** Are there any other different measurements?

At this point a good way of recording the measurements is to use a stem and leaf representation (bar chart) by recording each value on the board.

Length of paper (mm)	Number recorded
98	✓
97	✓✓✓✓
96	✓✓✓✓✓✓✓✓
95	✓✓✓
94	✓✓
93	✓
92	
91	✓

For each time a value is offered, put a tick beside it. Having done this, you can ask:

- *How can we agree on a common value?*

This can then be used as an introduction into the idea of taking an **average** as the most likely value if you want to do the mathematics.

This can be followed up by asking:

- *How confident can we be of the result?*

This should lead to the idea that we can improve our confidence by **repeating** the measurement. This is an important part of science – replication. Scientists build confidence in their ideas by repeating the work they do.

It should also introduce the idea of expressing confidence within certain limits. We cannot definitely say the paper is 96 mm long.

- *Can anybody think of a better way of expressing it – to the nearest mm, half mm or whatever?*

Hence, scientific results are often expressed with a **confidence** limit.

- *The paper is 96 mm long \pm (plus or minus) 1 mm.*