

WHAT STUDENTS NEED TO KNOW AND UNDERSTAND ABOUT MEASUREMENT

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Introduction

The following sections contain information about what your students need to understand about measurement, what happens when they do not understand, how to recognise this, and what to do about it.

Early learning about measurement begins with the use of language to compare one thing with another with reference to a specific attribute. Within the measurement strand, students learn to:

1. Identify attributes to be measured
2. Use comparative language
3. Make direct comparisons of attributes
4. Make indirect comparisons using standard and non-standard units
5. Estimate

Identify attributes to be measured

Students need to:

- Gain an awareness of the different attributes that can be measured and compared.
- Be able to identify the attribute they are comparing (length, mass, volume, area, temperature, angle and time).

Use comparative language

Students need to develop the ability to use language to describe attributes and make comparative statements. This includes:

- Words that are used to describe attributes (big, small), different words that are used to describe the same attribute (tall, short, long, wide) and words that are used to compare objects while referring to the same attribute (short, shorter, shortest, as short as);
- Words associated with naming attributes including, length, mass, volume, area, temperature and time (point in time and duration of time).

Make direct comparisons of attributes

Concepts students need to understand:

- Students need to be able to recognise situations in which they can directly compare the attributes of objects.
- Students make direct comparisons by aligning the objects that are being compared. This may include: placing two things side-by-side to compare their length, placing two shapes over each other to compare their area, beginning activities at the same time to compare the time they take to complete, hefting an object in each hand to compare their mass, pouring liquid from one container into another to compare their volume.

Make indirect comparisons using standard and non-standard units

Concepts students need to understand:

Students need the ability to recognise situations in which indirect comparisons are necessary. This involves situations in which it is not possible to align the objects and requires the use of a device (e.g. length of string, strip of paper) or unit (non-standard or standard) to measure each object and then compare the result. A number of concepts relate to this skill including:

- The unit chosen must be appropriate for the purpose (e.g. hand spans are useful for measuring the length of a table but not for measuring the area of a mat);
- It is the attribute of the unit (length of your hand span) that is used to measure rather than the thing itself;
- The accuracy that is required depends on the purpose for measuring. Sometimes, it is not necessary or convenient to use very accurate measures (e.g. when working out if a table will fit through a door) and therefore, larger units can be used;
- When accurate measurements are required, the following conventions need to be observed:
 - The units used to compare objects must be the same for all of the objects being compared (e.g. when comparing the volume of two containers, you must use the same cup to measure both and the cup must be filled to the top each time).
 - The attribute of the unit being used must always remain the same (e.g. if you are using the length of some blocks to measure a doorway, the length of the blocks must remain constant while the other attributes of the blocks may vary).
 - You have to fit in as many units as possible when measuring, ensuring that there are no gaps or overlaps.
 - If you were to measure the object a number of times using the same unit, you should get the same result.
 - The number of units used to match the attribute being measured tells us the size of the object.
 - Parts of units are used where a whole unit cannot fit. We use fractional language to describe these parts.
 - Measurements can be made more accurate by choosing smaller units.
- A calibrated scale can be used instead of repeated units. Understanding of these scales should begin with students making their own scales using non-standard units and later progressing to conventional scales (e.g. students can make their own tape measure using a strip of paper and marking the length of a block along it). As students become more proficient, a range of scales should be introduced including scales where some marks are not labelled or one mark represents more than one unit.
- In situations where students need to communicate measurements accurately so that others can understand them and reproduce them or when measurements are required to be used over time, the need for standard units becomes apparent. Others, who are using the measurements, must know the appropriate dimension of the unit used and so, standard units become necessary.

Estimate

Concepts students need to understand:

- Students need to be able to recognise and make reasonable estimates of measurements.
- Estimation is useful when:
 - accurate measurements are not needed or practical;
 - there is a need to judge whether measurements are reasonable;
 - quantities are so large that measurement is difficult;
 - students are confident about the accuracy of their estimates.
- To estimate, students need to develop a set of referents including personal referents (the length of their stride, the width of their finger) and other commonly used units. Students need regular opportunities to practice using these referents to make estimates and then check the accuracy of their estimates. By checking their accuracy, students are able to consciously improve their estimates and gain confidence in them.
- Students come to realise that estimating requires the use of perception and thinking rather than simply guessing.
- Useful estimating skills include:
 - Making comparisons between what they are measuring and the same attribute of other known objects, times or temperatures;
 - Using the attribute of something they know the measurement of to compare with what they are measuring;
 - Breaking the attribute they are measuring into chunks and adding the estimates of each chunk to obtain a total estimate.