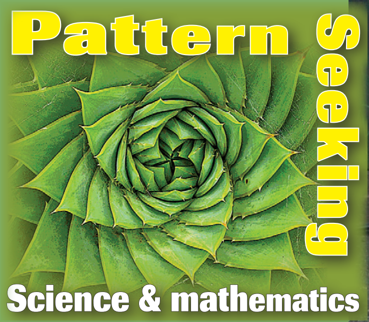

Figure 1 Teaching measuring skills in a science context

Naomi Hiscock shows how important science is for contextualising maths skills

MAKING LINKS BETWEEN MATHS AND SCIENCE

For some children maths and science are exciting subjects that work side by side, one providing the opportunity to practise and hone skills and knowledge gained from the other. For other children the subjects are disjointed and seem to bear no relationship to each other. The way that teachers approach these two subjects can greatly influence this relationship. Indeed, children taught maths discretely often find the abstract nature of maths daunting and therefore have decreased motivation, particularly if they cannot see the relevance to their everyday lives.

Science can provide a wonderful opportunity to practise a variety of maths skills within an engaging context. Moreover, the small-group-work nature of investigative science offers a supportive environment in which to work. So, how can a science context be used to enhance understanding in a few specific areas of the maths curriculum?

Measuring

Within the maths curriculum, children are expected to learn to measure length, weight and capacity using appropriate equipment. At the heart of using measuring equipment is the ability to read a number line, as this is what the scale on any measuring equipment is.

Measuring skills can be taught in one of three ways:

- **abstractly – where the measuring equipment is used but with no context;**
- **in a maths context – where there is a purpose to the task;**
- **in a science context – where some additional knowledge or understanding will be gained by carrying out the task so motivation to carry out the task will be greater.**

Box 1 illustrates the three ways of teaching children to measure.

Some aspects of teaching measuring can be made simpler using the interactive whiteboard to demonstrate how to read the scale beforehand. Examples are available among the Primary National Strategy Interactive Teaching Programs (see *Resources*). One of the many programs available here is for teaching about capacity. It involves a measuring cylinder that can be filled and emptied by turning different taps; the size of the cylinder and its scale can also be altered in order to differentiate. In many ways this is ideal, as all

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Box 1 Teaching length

- **Abstractly.** The children are provided with a set of lines on the page and asked to use a ruler to measure each of them accurately.
- **In a maths context.** The children are given a packet of jelly worms and asked to investigate whether they are all the same length. This will involve the children in accurately measuring each of the worms in turn and recording the results in some way. This is a fun activity, but has little relevance in the real world.
- **In a science context.** The children are asked to investigate how to use a rubber band to launch a marshmallow to land on a target (Figure 1). This will involve the children exploring a range of variables, including the length and thickness of the rubber band, the distance it is pulled back and the angle of launch. Depending on the variables the children choose to investigate, they may potentially measure a range of lengths (band dimensions, distance pulled back, distance travelled by the marshmallow). They may also need to use a protractor to measure angles. They will be learning about the forces involved in stretching rubber bands and how changing the angle affects the path of the marshmallow. They will be able to relate this knowledge to real-life situations e.g. catapults, bungee jumping.

the class can see the fluid level and the scale and can therefore engage in the demonstration more effectively than when huddling around a cylinder on the teacher's desk.

However, what is lacking is that sense of 'feel' for what capacity represents. If children are not given the practical experience of measuring capacity they have no understanding of what one millilitre (cubic centimetre) or one litre (cubic decimetre) represents. While working recently with some 11-year-olds, it was noted that, although the children knew that capacity was measured in litres, they had no understanding as to whether you would measure medicine using millilitres or litres. This was because the children had not had enough practical experience. If these children had engaged in a range of science investigations, such as measuring the amount of water absorbed by different cloths or investigating the drainage of different soils, they would have a much better feel for what a millilitre or litre represents.

There are other aspects of measuring that are not specified in the maths curriculum, such as measuring forces and temperature. When the children are faced with these in a science investigation, they will benefit from being reminded of their maths skills.

Measuring accurately

When children are measuring during a science investigation it is important to ensure that they are measuring to an appropriate degree of accuracy. This will depend on the age of the children and the task. For example, consider a group of children using a forcemeter to 'weigh' objects suspended in the air and then in water in order to learn about upthrust. The needle on the forcemeter will be stationary so they can make an accurate reading. If, however, they are using a forcemeter to measure the force required to snap a thread, the needle will be moving continuously and then ping back to zero at the moment the thread snaps. The children will not be able to get an accurate reading as they will be rounding to the nearest marked division.

Measuring time during investigations can also support aspects of the counting and understanding number strand of the maths curriculum. Children learn about decimals from year 4 (ages 8–9) onwards and need to move on to rounding these numbers. Science can provide a context not only for practising these skills, but also to help them to understand circumstances in which they are useful. For example, when measuring the time it takes for parachutes of different sizes to drop to the ground, children will often use a stopwatch that measures in hundredths of a second. They will usually copy this number down into their table of results, producing a set of results such as that shown in Table 1.

From these data the children may well draw conclusions about how the size of the canopy affects the time it takes for the parachute to drop. It is worth asking the children to pause and think about the significance of these figures by asking the following questions:

- **How accurate were you with your measuring?**
- **Do you think you were able to measure to the nearest hundredth of a second?**
- **Should you round these values to the nearest tenth or whole second?**
- **Is there a significant difference between the results?**

These types of questions will prompt the children to realise that the data are not sufficient to draw conclusions, which will lead them to evaluate how they could get more meaningful results, for example by making the canopies very different sizes or by increasing the height from which they are dropped.

Presenting data

Children need to learn how to draw a range of graphs and to decide which is appropriate to represent their data. Bar charts, line graphs and scattergrams all involve first identifying a suitable scale for the axes. Children can be supported to do this by providing a scale selector. This consists of a range of scales that the children can place alongside the axis to support them with numbering (Figure 2). Again, children's understanding of number lines will help here.

A fun activity to support children in their understanding of how to create graphs is to make human bar charts – see Figure 3.

Table 1 Timing the fall of parachutes

	Test 1	Test 2	Test 3	Average
Small	3.42	3.26	2.99	3.22
Medium	3.11	3.57	3.44	3.37
Large	3.22	3.72	2.77	3.23

Interpreting data

Children can often complete the process of constructing a bar chart or line graph, but lack the understanding to interpret what it shows. If the children are involved in gathering the data during a science investigation, for example, this helps considerably with their ability to interpret and question the data.

Using dataloggers allows children to gather data very quickly and the software can be used to present the data instantly. This limits the time spent on the lower-level skills of gathering, recording and presenting data and allows more time for the higher-level skills of interpreting and drawing conclusions.

Using the snapshot function, where a reading is taken and can be instantly displayed on a bar chart, the children can quickly measure, for example, the amount of light passing through different fabrics, when considering which to use for a tent or curtains. Seeing the data visually presented as a bar chart will mean that they can make better comparisons. They may find that two fabrics let similar amounts of light through and may then be prompted to think of other properties that will be important, such as strength.

Dataloggers are vital for helping children to investigate how things change over time. After the children have practised measuring the temperature of water using a thermometer, and perhaps tried to take readings every minute to see the cooling effect, it is a much more efficient use of time to set the investigation up using a datalogger that can then be left until the water has cooled. The time that would be spent on gathering and presenting the data can be spent on interpreting this and other similar data (Box 2).

Conclusion

Alongside these specific maths skills, using and applying skills will be reinforced through the problem solving, communication and reasoning required in any science investigation. Embedding maths skills in other subjects makes a real difference to children's understanding and enthusiasm for the subject. Lessons are more interesting, the children are more motivated and can see the relevance of the work they are being asked to do.

The two subjects are perfect accompaniments for each other. Why not see how closely you can connect them? There are sure to be benefits for both subjects.

Figure 2 (top picture) Scale selectors build on the understanding of number lines and are helpful for drawing graphs

Figure 3 (lower picture) Making a human bar chart can help with the abstract nature of some data-handling

Box 2 Using a datalogger to record cooling of water

The children can be asked to look for clues in the graph to try to work out what activity was taking place. They will notice things such as:

- The graph is showing a change in temperature.
- The temperature starts at 22 °C
- It rises to about 100 °C (boiling point of water); therefore it is probably water being boiled.
- The temperature then drops – perhaps something is added to the water. This will need to be something cold to reduce the temperature significantly, e.g. frozen food.
- The temperature goes back up to 100 °C for a few minutes – while the food cooks.
- The temperature then steadily decreases as the water cools back to room temperature.

Resources

Primary National Strategy Interactive Teaching Programs: **www.taw.org.uk/lic/itp/index.html**

Getting to grips with graphs, AKSIS project book available from the ASE: **www.ase.org.uk/booksales**

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