Teaching science enquiry in the new 'normal'

Figure 1 Which polar explorers had the most suitable clothes? On the left the equipment used by Roald Amundsen, and on the right by Robert Scott

Sherralyn Simpson and Caroline Thomas offer ideas around how science can be taught well under challenging circumstances

The new 'normal'

Sherralyn Simpson

As schools in England re-open their doors and welcome children back in September 2020 after the COVID-19 lockdown, what can, and should, primary science look like in the 'new normal'? If timetables are constricted to adhere to the demands of social distancing, innovative practical science enquiry will be needed. Even if they are not, the principles within this short article remain valid.

Science enquiry applies '*the nature of science in real-world contexts and multidisciplinary arenas*' (Billingsley *et al.*, 2018) through explicit identification of scientific methodology. Ofsted (2019) highlighted in a recent report that children's engagement with 'working scientifically' needs to be more than just being asked to recall the experiment. Practical enquiry is a vital component and children should be reflecting on the scientific process itself in the contexts of practical experiences.

In the new 'normal', a blend of class, online and home learning can provide a cohesive approach to practical scientific enquiry through simple experiments, which can be easily resourced and taken home. Through home experiments, children can practise science enquiry, gaining substantive knowledge, while also developing epistemic insight as light is shone on scientific methods. The Epistemic Insight Initiative (a funded research strategy to support enquiry in schools; www.epistemicinsight.com) can support you with developing essential science activities for primary children to connect working scientifically at home with school. There are webinars and online content, including downloadable investigation cards. The initiative will also provide support through bespoke and off-the-shelf 'essential science' sessions in schools, once schools are open to visitors. These align to the National Curriculum 'working scientifically' guidance, drawing out scholarly thinking through disciplinary language.

Not all science questions can be answered by using the same scientific process. Through epistemic insightfulness, children gain awareness of how to work scientifically by selecting

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the most appropriate scientific method(s) to apply to a question or investigation. These include, but are not limited to, pattern seeking, fair testing, observation over time, identifying and classifying (DfE, 2013: 165). Another strategy is to give students a topical or bridging question to enable them to work across two disciplines. This is a good way to learn about two disciplines, as they will see how a discipline such as history brings another perspective to what they found out in their scientific investigation.

An example of a bridging question investigation

Why did Amundsen beat Scott in the race to the South Pole?

The science investigation

Science enquiry could ask: '*Which material is the best insulator?*' and introduce the idea that the explorers' clothes were made from different types of material (Figure 1). It could consider how suitable a material is in terms of thermal insulation, which is covered within *Properties of materials* in year 5 of the National Curriculum (DfE, 2013: 169–70). It could address that keeping warm in the extreme temperatures of –40 °C was a basic need for survival and therefore how the properties of clothing material chosen by each expedition team may have affected the different expedition outcomes. Through scientific enquiry children will 'think like scholars' to design a way to test a range of materials to find out which are best at keeping in the heat.

You could begin by introducing Captain Robert Falcon Scott's expedition through this short four-minute BBC video (BBC, 2020).

This can lead on to a very simple experiment in terms of the materials the children need, which can be easily transported home (Box 1). If you run this as a classroom activity, children can investigate more systematically.

This practical science activity (Riley, 2015) explores the substantive knowledge of properties of materials; findings can be presented as a line graph, written up and discussed when returning to school. Importantly, this 'essential science' activity provides opportunity for children to explain how they worked scientifically through observation, while identifying, classifying and grouping the materials to present their findings.

The topic could be further explored within school through designing a thermal coat prototype, where children work together in small science hubs using a range of materials and consider whether it should be waterproof and how the materials would be affected if they get wet (British Science Week, 2020: 11).

Box 1 Investigating which material is the best insulator

Resources: Three plastic cups, a thermometer, two fabrics (one thick and one thin), sticky paper/tape, a stopwatch, scissors.

Method:

1 Secure the fabric around two cups using the sticky paper or tape to secure and the scissors to cut to size. Leave one cup uncovered.

2 Fill the cups with hot water from the tap and record the temperature of the water in each cup using the thermometer.

3 Start the stopwatch and take the temperature every two minutes for half an hour.

4 Record the findings in a table:

Time (mins)	Thick fabric cup (temp/°C)	Thin fabric cup (temp/°C)	Non fabric cup (temp/°C)

The historical enquiry

The cross-disciplinary investigation continues through historical enquiry, asking: '*Did Scott's expedition fail because of bad planning?*' It turns to the human story in 1911–1912 and considers the impact of the decisions made by Roald Amundsen and Robert Scott as regards clothing, food and transportation. Did these choices result in the different outcomes for the two simultaneous expeditions to the South Pole (Andrews, 2018)? This investigation views this through a contrasting lens by identifying, collecting and interrogating a range of sources to draw conclusions and offer explanations for the expedition outcomes.

Bridging science and history

Interacting with the epistemic insight 'bubble tool' (Figure 2), the question '*Which material is the best insulator?*' is considered amenable to science investigation because it can easily be investigated first-hand by direct observation and testing through a simple experiment. However, the decisions made by each South Pole expedition team are less amenable to science enquiry because of the need to interrogate historical accounts. Practical science enquiry fosters opportunity to work scientifically through recurrent use of the scientific language of prediction, testing and, importantly, observation. It needs to be used in conjunction with historical analysis to address the multidisciplinary question: '*Why did Amundsen beat Scott in the race to the South Pole?*', demonstrating the interaction between 'essential science' practical and other disciplinary methodology.

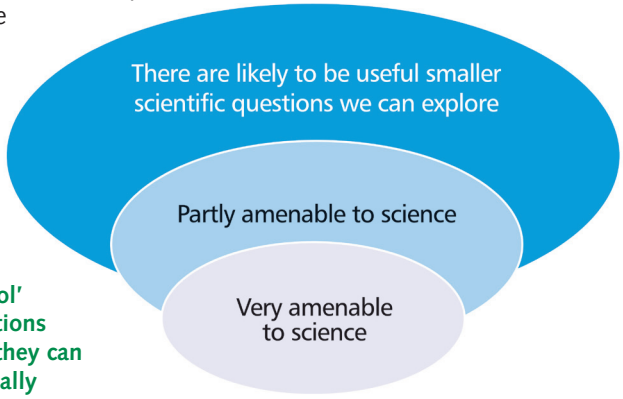

Figure 2 The 'bubble tool' can be used to sort questions according to how easily they can be investigated scientifically

Developing epistemic insight through enquiry outdoors

Caroline Thomas

Enquiry outdoors can enable children to gain epistemic insight. Epistemic insight in its broadest sense refers to children having the attitudes and understanding that are associated with thinking and working like a scholar (Billingsley and Hardman, 2017). The term 'epistemic insight' is used because it is a label that can apply in every subject. Epistemic insight is already

Figure 3 Sorting leaves into those with rough edges and those with smooth edges

embedded in the National Curriculum in England but it is labelled differently in each subject. The purpose of teaching epistemic insight is to help children understand the unique processes, methods and norms of thought that guide scholars in various disciplines – by bringing them together and comparing them.

The National Curriculum for science requires children to learn about the nature of science, alongside developing scientific skills and concepts (DfE, 2013). The epistemic insight research team at Canterbury Christ Church University investigated key stage 2 (ages 7–11) children's notions of science and the scientific enquiry process. The findings reinforced existing research that says children are often missing key ideas about the nature of science and, in particular, the key role that observation plays when working scientifically. To understand the nature of science, children need to plan, carry out and talk about their actions. An important question to ask children is '*What types of activities do you think you are engaged in when you are undertaking scientific enquiry?*'

Outdoors, children can explore science in real-world contexts and multidisciplinary arenas. They can investigate big questions, requiring enquiry through more than one discipline to provide a full understanding, such as '*How do we share our outdoor spaces with wildlife?*' Alternatively, children can be invited to ask and investigate questions amenable to science, such as investigations to identify and sort autumn leaves (Figure 3).

Through exploring natural objects, such as seeds, children learn about how observation helps relate the form of natural objects to their function. Children can explore how observations depend on how they view objects. Seeds can look different when viewed upside down or side on. Open questions such as '*What do you notice?*' invite children to examine objects and explore their shape, size, colour, form and structure. '*What is it?*' invites children to identify the names of objects and living things. Asking '*Where did you find it?*' can lead to exploring the habitat, appreciating its features and considering how animals or plants are adapted for life in the habitat.

Children can explore the behaviour of natural objects. The question '*How does the sycamore seed fall off the tree to the ground?*' invites children to observe them spin as they fall to the ground, to record what they see and communicate this. This can be through the use of rich descriptive language, the use of observational drawings, through diagrams or even by the child modelling the spinning action through physical movement. Children learn that science begins with observations of the natural world and constructing ways to explain their observations. Making working models of sycamore seed dispersal using everyday materials can help children to explore the ways in which scientists use models to test hypotheses about the factors influencing such a process.

Summary

The 'new normal' offers opportunities for home–school partnership through 'essential science' practicals and engagement with epistemic insight to develop 'scholarly thinking' among primary children. The epidemic insight approach has been tested out and offers a range of tools and resources to connect home and school. We are keen to work with teachers to explore the benefits of engaging with epistemic insight teaching tools and invite you to make contact with **LASAR@canterbury.ac.uk**.

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