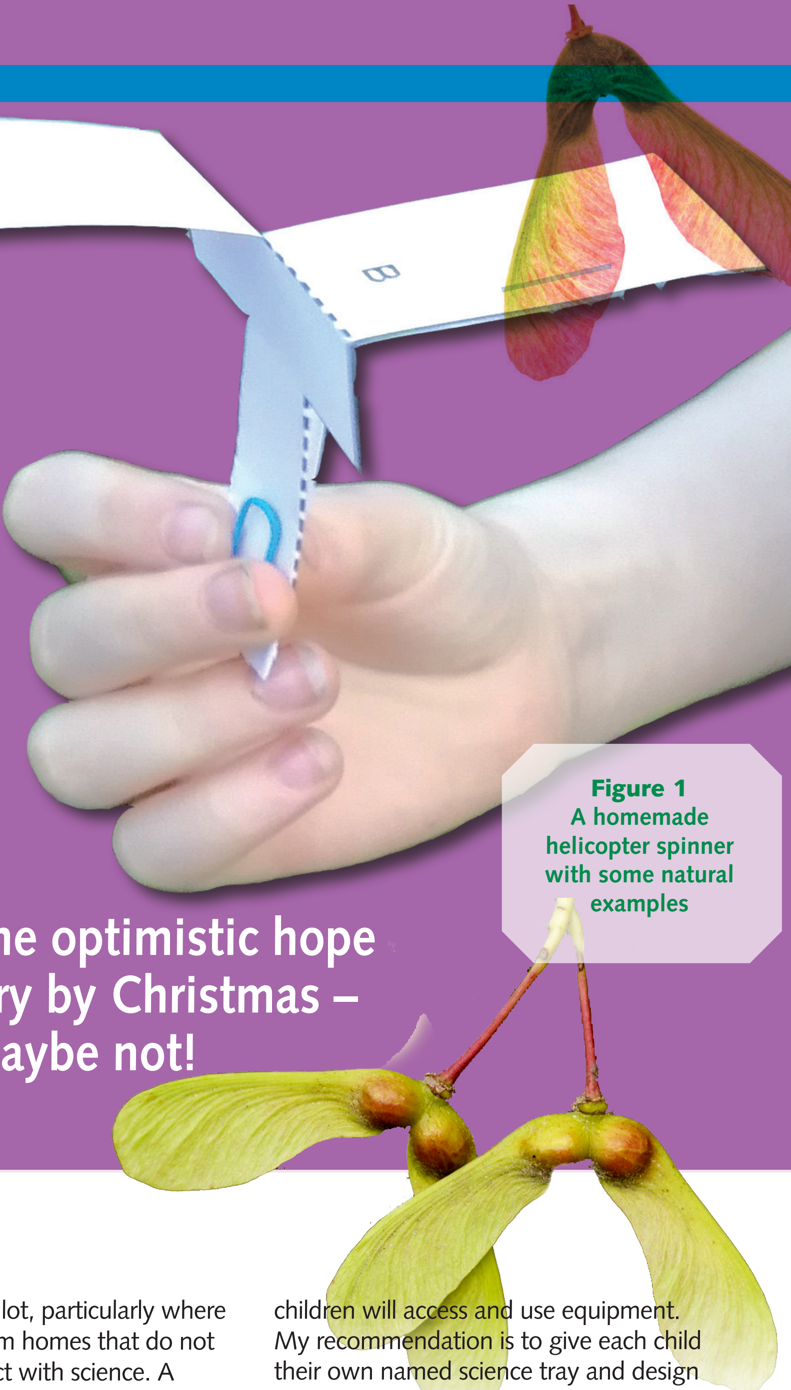
Science under COVID-19 restrictions: making the impossible possible!



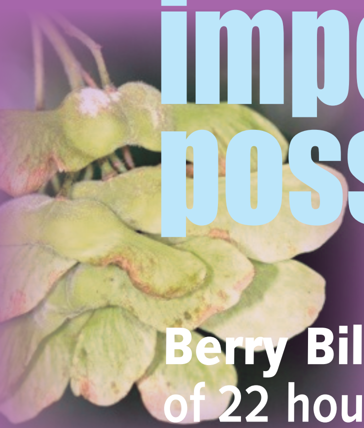


Figure 1 A homemade helicopter spinner with some natural examples

Berry Billingsley discusses the optimistic hope of 22 hours of scientific enquiry by Christmas – Impossible? Unreasonable? Maybe not!

It might sound to some like an impossible target to give children 22 hours of scientific enquiry by Christmas, but the current COVID-19 pandemic has already demonstrated its capacity to make the impossible happen and to upturn so many of the assumptions that have shaped the way we teach and learn.

So while we are dreaming the impossible, what else would we like? Lots of hands-on investigations, with children asking and exploring questions inspired by curiosity about the natural world around them. Activities that can be done in school or at home so that science can continue even if there is a local lockdown. It is not as ambitious as it sounds. Children can reach 22 hours of enquiry if we plan some enquiries that are 'science only' and some that work with two disciplines at a time. Teachers can also share experiences and research on how to make it work.

Creating time and space for scientific enquiry matters a lot, particularly where children come from homes that do not have much contact with science. A few simple materials and instruments are all we need to teach the key ideas. These essential first-hand experiences of thinking and working like a scientist are vital: they can switch a child onto science forever. It is one of my favourite quotations that '*science without practical is like swimming without water*' (SCORE, 2008: 3).

Equipment

In primary science, we focus on exploring aspects of the natural world that we can study first hand in our classroom, outside and at home: floating and sinking in water, falling through air, kitchen chemistry. Essential skills at primary level include learning how to start and stop a stopwatch – the high-end stuff with lasers and fume cupboards has to wait!

The first challenge to overcome is how children will access and use equipment. My recommendation is to give each child their own named science tray and design investigations around paper spinners, tubs, straws and individual whiteboards. This means resources that are low cost and do not need to be shared. The whiteboard is great for sharing ideas and findings across the classroom without shouting out.

Top up these everyday materials with one or two specialist pieces of equipment to add extra excitement and/or help persuade children who are 'tricky to reach'. My list of exciting extras includes torches for year 4 (ages 8–9) to make shadows, a pipette for year 5 (ages 9–10) to investigate the properties of water and, for year 6 (ages 10–11), a bulb, wires and battery to make circuits. All the children will also need a hand lens to study seeds, slices of fruit and so on. Any equipment that children share will need to be cleaned after use.

Another option is to make use of the

Key words: ■ Scientific enquiry ■ Home schooling ■ Cross-curricular learning

Figure 2 Example of a science investigation card, which can be freely downloaded

offer from the Epidemic Insight Initiative (a funded research strategy to support enquiry in schools) to help you to give a kit of essential equipment to every child to keep. The vision is that all children will have these 'must-have' science experiences, especially if they are in groups that traditionally miss out or are at home shielding. Schools signing up to the Initiative make a commitment to aim for 11 investigations in the term. The resources include free investigation cards to use in school and at home (Figure 2).

Social distancing

How are children going to work together while also keeping physically apart? The *Paper Drop* experiment has all the children standing by their desks, dropping a scrunched up ball of paper and a flat sheet at the same time, and then sharing their results to draw a collective scientific conclusion about the factors affecting how things fall. They also talk about the characteristics of science: what makes this question a particularly good one for science to investigate? The next step is to make a homemade helicopter spinner and to vary the length of its wings to see what happens to its speed of rotation as it falls (Figure 1). Sycamore seeds are a one-winged natural spinner that children can investigate as soon as they start to appear. Websites such as that of the Woodland Trust have pictures of other 'helicopter' seeds you are likely to see in the autumn on the paths and grass around trees.

Essential experiences of science in key stage 1 (ages 5–7 years)

The basic building blocks of science are observations and measurements, which we use to make inferences about how the natural world works. Inferences are not guesses and they are supported by observations.

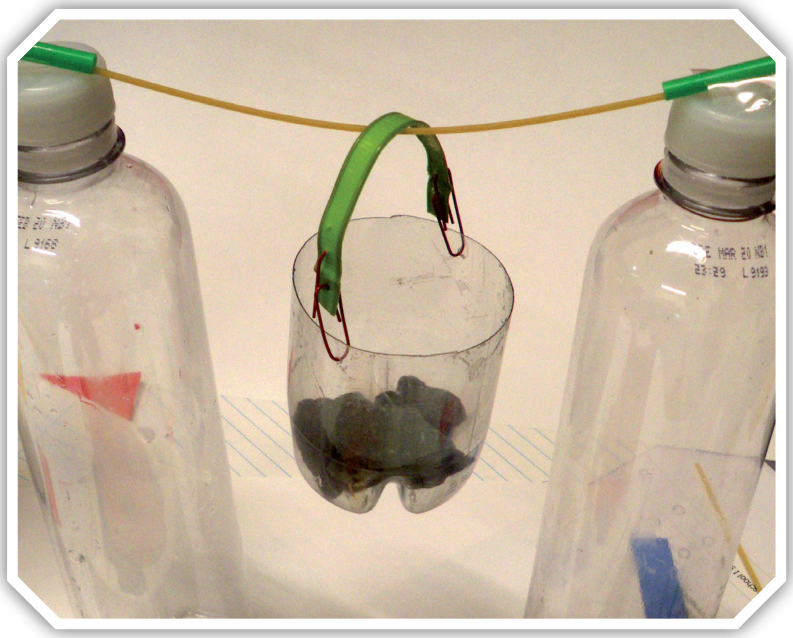
The *Mystery Bag* investigation gives each child a small paper bag, sealed shut with some objects inside. Children use their senses to make observations, such as: Does the bag contain one thing or more than one thing?, Are the object(s) inside weighing the bag down or are they light? and Do they roll or slide, rattle or brush? And what if they smell the bag? There are four of each type of bag and at this point some children are likely to identify the distinctive smell of popcorn coming from their bags. Can other children in the class find out who has a bag like theirs and what all the bags contain?

Essential experiences of science in key stage 2 (ages 7–11)

With the idea of 'observation and inference' established, enquiry steps up in key stage 2 to include learning to ask and sort different types of questions.

In the *Spaghetti Test* (Figure 3), children make a spaghetti bridge with a single strand of pasta. In this essential experience of science,

Figure 3 Testing the mass a spaghetti bridge can support



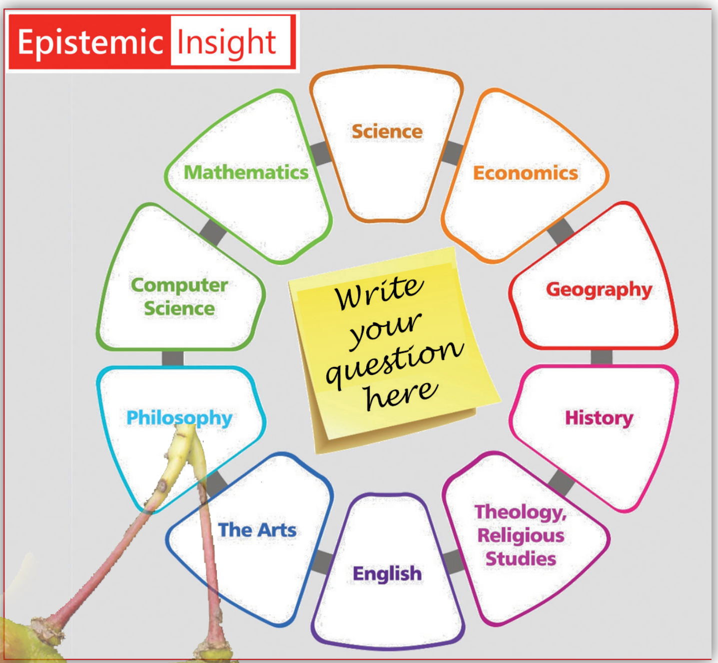
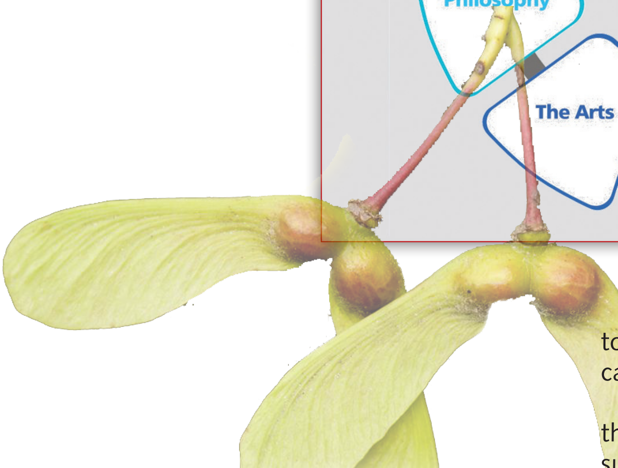


Figure 4 The Discipline Wheel



children carry out an investigation to answer a question and come up with testable predictions. On this occasion the question and method are set by the teacher. The question is, '*What mass can your spaghetti bridge carry before it breaks?*'

Children make a small gondola by attaching a loop of string to a section of plastic bottle or a paper cup. They have a stack of pennies or pebbles, ready to put into the gondola one at a time. Before they begin to test their bridge they write down a silent prediction about the maximum number it might take before breaking. The teacher turns it into a competition: '*We'll see who dares to put in one more penny/pebble than everyone else – without breaking their strand of spaghetti!*'

Of course children are likely to notice that each piece of spaghetti is very similar but no two are exactly the same. If they are working with pebbles rather than coins, they can put in the smallest first, but they cannot be sure that everyone's pebbles are the same size as theirs. In engineering, it is important to notice that objects in the real world can never be relied upon to behave exactly like our mathematical models or the carefully controlled experiments we set up in the lab. Children do the investigation again to find out the range of weights that can break a spaghetti bridge.

Children can also come up with their own questions to investigate, such as '*How much stronger are two strands compared with one?*' and '*Does the length of the bridge affect how much mass it can support?*'

Using science and other disciplines to answer questions

The *Discipline Wheel* (Figure 4) is a tool that children can use to practise thinking like a scholar, one discipline at a time. A question is placed at the centre such as '*Why did the Titanic sink?*' and children consider what kind of answer we might produce if we 'think like a scientist', 'think like a historian', 'think like a geographer', 'think like a mathematician' and so on. This challenge makes a good project for children to work on independently because, alongside some fun physics they can do at home or in the classroom, there is plenty of research to do using secondary sources to fill in the bigger story. The Discipline Wheel highlights that science is one of many disciplines we use to understand and improve our world. Each discipline has its strengths and weaknesses and its preferred questions, methods and norms of thought.

Here's another activity that can go home at the end of any of the investigations. Children are given a list of questions including, '*What does the liver do?*', '*How does the size of the blades affect the spin of a spinner?*' and '*Why did Henry VIII marry so many times?*' They sort the questions into ones that are particularly amenable to science and/or they suggest which other discipline(s) could help to provide an answer.

Water is a great theme to revisit at frequent points across the curriculum subjects throughout the school year. Put a watery question in the middle of the Discipline Wheel that children can explore through lots of scholarly lenses, such as '*Why do we care about water?*' Add to the display on the classroom wall: World Water Day is on 22 March 2021.

Touching on COVID-19

The ASE's award-winning video, *Why you'll never catch smallpox* (see *Weblinks*) dramatizes the story of 'James', the boy Edward Jenner injected with cowpox, and the investigation that established the real-life efficacy of a vaccine. It makes a useful addition to your term of science because it obliquely provides an opportunity to talk about COVID-19. It also highlights the progress of science, not just in terms of new knowledge created but also as an area of human endeavour that looks very different now to how it did then.

In *Trading Secrets* children go into a hall or outside so that they can move around a marked track while still staying apart. When the teacher calls stop, they use their whiteboards to show the nearest child their secret number. Each pair of children write down each other's numbers. Children move around again and they stop and share their original number again, twice more. Now they each have four numbers on their boards. They erase their original number, leaving three. The teacher tells children which number corresponds to the virus and children count how many people are now infected and infectious and how many are not. The game is played again and this time there are more numbers at the start that correspond to having the virus to signify how the virus multiplies across the population.

In this investigation we are discovering the mechanism behind a pattern. The 'R' rate – if the virus is unchecked – for COVID-19 is about 3. That means that each person infected is likely to give the

Figure 5 The Buddy Bench Challenge

virus to three others before they recover. Point out to children that this virus doesn't really spread when numbers are shared on whiteboards. Ask children what they know about how the virus spreads and also why in this activity we used whiteboards instead.

The *Buddy Bench Challenge* (Figure 5) is concerned with helping children to overcome some of the social impacts of virus prevention strategies. It asks children to come up with alternatives to the 'buddy bench': how else can a child who feels lonely at break time signify to their classmates that they'd like to have a friend? So far my favourite solution is the 'tennis wall'. The teacher puts a basket of tennis balls by a wall and a child who is lonely starts to bounce a ball on the wall. Other children can come and join in, each taking a ball to bounce from the basket.There is a video that children can watch together or at home that explains the science behind social distancing (see *Weblinks*). This activity can also be used as part of a 'back to school' transition programme for children before they first come to school.

In summary

This article has barely begun to explore possibilities. You can find more ideas on our website, with investigations and problem-solving activities designed to give children hands-on experiences in science while building scientific knowledge and skills and an understanding of science as a discipline. We have put on our scholarly thinking hats to work within and across disciplines to work out what is special about science and whether science can answer all of our questions. The activities map directly onto the primary curriculum. Each activity covers what Ofsted calls substantive knowledge in science (such as the properties of water) and also disciplinary knowledge or what we call 'epistemic insight', which is knowledge about the discipline and the kind of knowledge it produces.

These nine activities would mean children do about 18 hours of science and science-related learning. The timetable commitment in the school day is only 9 hours, with another 9 hours coming from projects bridging curriculum subjects and some activities children do at home. For the last three, or to make some swaps, there are more puzzles and projects on the website, such as *Why don't shadows have colour?* and *Can life live on other planets?* The website also has tools for the teacher to track children's progress and learning. So, is 22 hours of science, possible? We think so.

Next steps

We (the Epidemic Insight Initiative) are asking teachers to contact us if they would consider working with us to assess the impacts of these activities against a selection of goals for the term. The goals we suggest are to develop knowledge, understanding, skills and attitudes in science, boost children's love of learning, enable them to become better scholars, support their emotional and social needs, strengthen the home–school partnership, empower them to be good citizens and inspire them with possible careers.

We can support you with equipment, investigation cards, links to videos for children, webinars, and research instruments, such as surveys to track progress. There are also take-home discovery bags for 300 schools – first come, first served. Contact us at **LASAR@Canterbury.ac.uk**

Reference

SCORE (2008) *Practical work in primary science*. London: Science Community Representing Education. Available at: www.score-education.org/media/3674/primary.pdf

Berry Billingsley is Professor of Science Education at Canterbury Christ Church University and leads the Epistemic Insight Initiative, a curriculum and research strategy – see www.epistemicinsight.com
berry.billingsley@canterbury.ac.uk

Weblinks

Epistemic Insight Initiative: **www.epistemicinsight.com**

Buddy Bench Challenge video: **www.newgenerationteachers.com**

'Helicopter' seed images: **www.woodlandtrust.org.uk/blog/2019/05/helicopter-seeds**

Why you'll never catch smallpox video:
www.ase.org.uk/resources/ase-coronavirus-resources-why-youll-never-catch-smallpox