# 'WORKING SCIENTIFICALLY' WITH ENQUIRY

*Science Enquiry*, now *'Working Scientifically'*, is *the* continuous area of study in the National Curriculum for Science in England. It is the lifeblood of each and every area of subject matter and is what gives life and sustenance to learning new knowledge and developing understanding. It will be the driving force of science learning, teaching and – dare we say it – assessment.

This may sound fairly obvious, but it is worth re-stating. As we see the shift from fair testing to other types of enquiry, we should consciously work to champion and make evident how working scientifically can breathe fresh life into subject learning. In so doing we should endeavour to ensure that there is no longer a decoupling of the development of skills and knowledge.

So what are our aims?

- To ensure that children have greater exposure to a range of enquiry types.
- That they will recognise when the various forms of enquiry are taking place, so they will ultimately be able decide for themselves which type to use in order to tackle the question they are investigating.
- That within each enquiry type a range of skills will be developed. It is important to see the opportunities for skill development in the various types of enquiry. Decisions on how to go about the investigation, how to collect data and present results are just a few of these.

What might this look like in school? A few like-minded people have helped us tell this story by contributing to this collection of enquiry ideas that should not only give you a few thoughts for a cross-curricular approach, but also help to clarify the different enquiry types.

## Enquiry 1: Which is the best towel for a hairdresser?

**Hairdressers have been told that biodegradable towels are better than ordinary towels and they decompose in three months. Should a hairdresser swap or not?**

Initial discussions focus on what a towel is for and what properties it needs to have. There could be links to mathematics in terms of cost of the towels, number of towels used per customer, how long a towel might last and how these factors may affect the hairdresser's decision. But what type of enquiry would it be?

It depends on the question that is asked (Box 1). If you simply asked various hairdressers '*Which towel would you choose?*', then you would be carrying out a *survey*. If you sorted them by feel (without any further testing), this would be *classification*. Traditionally, a context like this would provoke a *fair-test* enquiry by testing absorbency or perhaps which one dries fastest (so it can be used again).

These are valid questions and enquiries to carry out and it may well depend on the age of the children you are working with as to what type of question you

### Box 1 Types of investigations with hairdressers' towels

- **Fair test:** Comparing what makes a difference, e.g. *Which 'towel' material will absorb the most water?* Used when we can control all the variables except the one we are changing.
- **Exploring:** e.g. *What happens when you add water to fabrics?*
- **Observing over time:** e.g. *How long does it take to rot?* (often linked to exploring).
- **Pattern seeking:** e.g. *Do thick fabrics absorb more water than thin fabrics?* Used when there are many variables that we cannot control and so we cannot do a true fair test.
- **Problem solving:** Using the science we know to solve a problem, e.g. *Using what you know about materials, design a fabric that would make a good towel – which thread would you use, how might you weave it?*
- **Sorting and classifying:** Putting things into groups based on their characteristics/properties, e.g. *In how many ways can you sort these materials?*

### Box 2 Developing 'explanation' with the hairdressers' towels enquiry

Using a pattern-seeking style of question, such as: '*How does the thickness of the towel affect the amount of water it absorbs?*' we can focus on explaining the results, in a conclusion, ensuring that it is consistent with the evidence presented, i.e.:

- Can the children explain the strength/limitations of the evidence that supports their decisions/judgements/conclusion?
- Have they provided a scientific basis for what they have found out?

You might provide some prompts for the children to scaffold their work:

- **Conclusion: Look for a pattern**
  - Look at your table of results or graph.
  - Describe any patterns you can see.
  - Are there any results that do not fit the pattern?
- **Make a concluding statement**
  - Answer the question you are investigating.
  - Was your prediction correct?
- **Explain your conclusion**
  - Find some science that explains your concluding statement.
  - Is there another investigation you would need to do?

or they ask and work on.

Once you have decided on the type of enquiry, you need to consider which skill you want to work on and develop with the children. Some enquiry types lend themselves better than others to certain skills. It is worth recognising that teaching skills from scratch in the middle of an enquiry is not ideal; this reminds us of Anne Goldsworthy's point that '*It is impossible to teach these skills when the investigation is going on if you and the children wish to stay sane*' (Anne Goldsworthy's blog), but you can and should have a single one that you want to focus on with the children in order to develop success criteria with them (Box 2).

This activity links directly to subject knowledge in the curriculum; many are not such good illustrative enquiries but still apply subject knowledge and provide open-ended questions for investigations, such as bubbles (*Enquiry 2*), paper aeroplanes, tea bags (*Enquiry 3*) and biscuits, among others! They could be part of a science day or week.

## Enquiry 2: I'm forever blowing bubbles – but I want mine to be the biggest and best. How can I do this?

**Sometimes the 'best' way to start an enquiry activity is with a 'best challenge', such as developing 'the best' bubble mixture using unknown quantities of washing-up liquid, water and glycerine. This is a great way to get children engaged and motivated (especially boys!) and they can start to notice patterns and relationships between variables. Ideally, it lends itself to small-group, open-ended investigation.**

Children will first need to discuss their definition of 'best bubble' (life span, quantity, size, etc.) and then plan, carry out and record in their own chosen way. However, although by considering the variables you might think this is a fair-test investigation, it isn't – you can't control the blowing of the bubble unless you have a mechanical device. It is more of a pattern-seeking enquiry; noticing patterns and relationships is a good skill to develop with this enquiry.

Open-ended investigations, such as challenges like 'the best', are a fantastic way for teachers to focus on teaching other specific skills of enquiry, such as children setting up their own tests, choosing and using equipment and making observations and measurements. They don't have a specific 'answer' so they enable children to work as 'real scientists'.

You will be amazed by the squeals of delight coming from everyone as they blow their bubbles: you are never too old to blow bubbles – yes even teachers!

This activity can be adapted to suit the full primary age and ability range, so could be a whole-school investigation, perhaps as a science day or part of a science week, especially as it isn't what you would normally teach as part of subject knowledge.

# Enquiry 3: A cup of tea fit for a queen

**Most of us drink tea but what investigations can be done with a tea bag or with loose-leaf tea?**

Box 3 gives some examples.

## Box 3 Examples of investigations with tea

- **Classification:** The tea bag style, the holes, the colour or size of the tea leaf, etc.
- **Pattern seeking:** Do any of the above factors affect the colour of the tea? Does the time the tea bag is left in the water or the temperature of the water affect the colour of the tea?
- **Researching:** Where does tea comes from?
- **Observing over time:** How long does tea keep warm in a teacher's playground mug?
- **Modelling** (older children): How does a tea bag work?
- **Design and make**: A machine to dunk a tea bag for the right amount of time for the perfect cup of tea.
- **Surveying:** Milk in first or last – what do people think?

# *'Mary, Mary, Quite Contrary'* – our seedlings are being eaten by invading birds. How can we stop them?

**Were the silver bells in the poem a way of keeping off the birds, or were they a type of flower? How did Mary keep her garden safe from marauding birds?**

## Box 4 Types of investigations with bird scarers

Depending on the age of the children carrying out the investigations, different skills and knowledge can be covered:

- **Fair testing** and **comparative tests** can be used to investigate various properties of materials, including strength, whether they are waterproof or will be damaged by water, how reflective they are or their flexibility.
- **Observation over time**, and/or **research** can be used to find out which materials are biodegradable (and consider the implications of this for the durability of the product), which birds are visiting the garden, which seedlings they are eating and what predators might be deterring them.
- Younger children can use **classification** to describe properties and group and identify materials.

In terms of subject knowledge (linked to the new English Curriculum):

- Children in year 1 (ages 5–6) have opportunities to name and model body parts of humans and other animals when making a scarecrow.
- Children in years 2 (6–7 year olds) and 5 (9–10 year olds) could link properties of the materials used and their uses.
- Children in years 3 (7–8 year olds) and 6 (10–11 year olds) could consider reflection and shadows.
- Children in year 4 (8–9 year olds) could investigate how sounds are made and the sounds that can be made using different materials.

Obviously 'context' is important and having a reason for carrying out the enquiry provides realism. The hairdresser's problem (*Enquiry 1*) sets a real problem and can provide opportunities for links to literacy and numeracy. One type of enquiry that provides the simplest context is making things and developing systems. A design-and-make project for the whole school with a different curriculum focus for different year groups is a great cross-curricular idea, either for a topic in a half term or a science week.

You can make this as big a project as you like! A range of different methods of scaring can be tried including:

- **Building scarecrows** of human appearance or that look like predators.
- **Movement** – using materials that flap in the wind.
- **Light** – using materials that reflect sunlight as they move or that cast shadows that move or have the appearance of predatory birds.
- **Sound** – using wind chimes or similar.

Importantly, this type of enquiry links to the design-and-make process, and the science investigations carried out to inform the design process mean the children will use many of the working scientifically skills across a range of types of investigation as well as learning and applying knowledge (Box 4).

Why not look at the next investigation activity you are doing and consider asking the enquiry question in a different way. What type of enquiry would you be doing then?


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### References and further reading


Anne Goldsworthy's blog: http://annegoldsworthy.wordpress.com/2012/06/21/the-draft-primary-curriculum-for-science-thoughts-about-working-scientifically-proposed-title-or-scientific-enquiry-old-name/

CIEC Promoting Science, *Kitchen Concoctions*, a great resource for teaching essential elements of primary enquiry and chemistry: see the 'Topic Bank' at www.ciec.org.uk.

Turner, J., Keogh, B., Naylor, S. and Lawrence, L. (2011) *It's not fair – or is it?* Sandbach: Millgate House.