The Ogden Trust

making physics matter

'Working scientifically' in primary science

Develop children's skills in observing over time

Introduction

Observing over time enquiries are a fantastic way for children to be curious about the world around them. The changes they observe can take place in seconds, minutes, hours, or days, or over longer periods of time, such as weeks or months. This type of enquiry lends itself to observing the natural world, but can also be used when comparing materials and observing physical processes. There are many opportunities to take children outdoors when carrying out these types of enquiries, and children's observations will often lead on to other, different, types of enquiries.

Big questions

Here are some examples of 'big questions' that can be explored by observing over time in KS1 and KS2. There is at least one for every area of the curriculum, so it is easy to plan opportunities for children to revisit this type of enquiry and develop their skills.

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
How does a daffodil bulb change over the year?	What happens to my bean after I have planted it?	What happens to celery when it is left in a glass of coloured water?	How does the variety of invertebrates on the school field change over the year?	How do brine shrimp change over their lifetime?	What happens to a piece of bread if you leave it on the windowsill for two weeks?
How does my sunflower change each week?	How does a tadpole change over time?	How do flowers in a vase change over time?	How does an egg shell change when it is left in cola?	How does a bean change as it germinates?	How does my heart rate change over the day?
How does the oak tree change over the year?	How does the school pond change over the year?	How does tumbling change a rock over time?	Which material is best for keeping our hot chocolate warm?	How does our compost heap change over time?	How do different animal embryos change?
How does my height change over the year?	How much food and drink do I have over a week?	What happens when water keeps dripping on a sandcastle?	How does the level of water in a glass change when left on the windowsill?	How does a container of salt water change over time?	How much exercise do I do in a week?
What happens to materials over time if we bury them in the ground?	How long do bubble bath bubbles last for?	If we magnetise a pin, how long does it stay magnetised for?	How does the mass of an ice cube change over time?	How does a sugar cube change as it is put in a glass of water?	Does the temperature of a light bulb go up the longer it is on?
What happens to shaving foam over time?	What will happen to our snowman?	When is our classroom darkest?	How long does a battery light a torch for?	How does a nail in salt water change over time?	Which brand of battery lasts the longest?
How does the colour of a UV bead change over the day?	Would a paper boat float forever?	Is the Sun the same brightness all day?	When is our classroom the quietest?	How long does a pendulum swing for before it stops?	How does my shadow change over the day?

‘Working scientifically’ skills

When observing over time, there is a wide range of ‘working scientifically’ skills that children can practise and develop. A key skill is measuring; measuring time in seconds, minutes, hours and days, but also measuring a variety of variables that they observe to change, such as temperature (°C), light levels (lux), and sound levels (dB). This provides opportunities for children to become skilful in using a range of measuring equipment, as well as methods for recording their data in tables, charts and graphs.

Many observing over time enquiries will involve children recording their observations in the form of scientific drawings and labelling key features. This is a skill that children should get to practise regularly throughout KS1 and KS2; learning how to look closely and record fine details. The use of magnifying glasses and microscopes can help with developing this skill. The labelling of scientific drawings helps children develop confidence in using a wide range of scientific vocabulary correctly.

Observing over time enquiries are an effective way of inspiring KS1 children to ask questions about the world around them and develop their sense of curiosity. For KS2 children, observations from these kinds of enquiries often enable children to make predictions about how things might be, leading on to the planning of further comparative tests and fair tests to find out more.

Resources

There is a range of equipment that schools will find useful to support observing over time enquiries:

Stopwatches/timers	Thermometers	IR thermometers
Data loggers	Light sensors	Temperature sensors
Sound sensors	Clipboards	Digital cameras with time-lapse
Magnifying glasses	Microscopes	Digital microscope
Tape measures/rulers	Scales/balances	Graph/squared paper

Reporting learning

When considering what pupil outcomes might look like, there are a variety of ways in which children can report their learning for these types of enquiries. For younger children, keeping a diary of their observations with labelled drawings and observation notes for everyday is a great application of their writing skills, as well as creating a piece of work to be proud of.

For longitudinal enquiries that might take place over the academic year, it works well to have a dedicated display in the classroom, where children add their weekly measurements, and a large graph that grows over the year to focus discussions and prompt questioning from children.

For KS2 children reporting on their observations over time, the outcomes can take different forms. Sometimes it may be detailed scientific drawings with labels, and descriptive writing of what they have observed. In some cases, their writing may end up being comparative, where they are examining differences and similarities in what they have observed in different situations; this is a fantastic opportunity for the science curriculum to provide opportunities for developing writing skills. Other observing over time enquiries are more quantitative; and children will tabulate repeat measurements, calculate averages, and create charts and graphs to explore changes in more depth. This kind of reporting provides opportunities for children to report their conclusions through an explanation text. A useful framework that supports children with this is Point-Evidence-Explanation (PEE):

Point – Children describe what they have discovered. What is their answer to their 'big question'?

Evidence – Children justify their answers by referring to the data they have collected, using data values with units and/or describing trends in graphs and charts.

Explanation – Where possible children then use scientific ideas to explain what is happening. This will often require teacher input in advance.

In lower KS2, children should try to write three sentences to form their conclusion (PEE), which will lead to a well-structured paragraph. Children in upper KS2 should be encouraged to really develop their ideas in writing with three paragraphs – one to make their point, a second to use evidence to justify it, and a final paragraph to use scientific ideas to explain it. Regular practice at this will help children become skilful in formal writing, as well as support them in becoming ready for the next steps in KS3 science.

Additional information

There are many real examples of observing over time enquiries that have taken place over long periods of time, which are interesting to share with children. Here are a few examples that you might want to find out more about and share with your class:

NASA's A Year in Space Experiment

An enquiry that explored the long-term effects of microgravity on humans while working in space; you can find out more **https://www.nasa.gov/content/a-year-in-space**

CERN's AMS Experiment on the ISS

This experiment constantly monitors Cosmic Rays in space, as well as searching for evidence of the mysterious dark matter; you can find out more about this enquiry **https://home.cern/about/experiments/ams**

The Ringing Bell Experiment at the University of Oxford

Since 1840, an electric bell has been ringing in the Clarendon laboratory in Oxford – the *Guinness Book of Records* have declared the bell the world's most durable battery; find out more about this extraordinary experiment **https://www.smithsonianmag.com/smart-news/mystery-continuously-functioning-battery-1840-180954028/**

Planning

Curriculum Mapping	Identify a potential observing over time enquiry in every science unit.	Aim for each class to revisit observing over time five or six times over the academic year.	Plan to include scenarios where children get to suggest their own observing over time enquiries.
Progression Planning	Using National Curriculum documents, map out Age Related Expectations (ARE) for observing over time enquiries.	Establish age specific success criteria for observing over time enquiries.	Develop a collection of exemplar outcomes to support consistent expectations (WAGOLL).
Resource Audit	Take stock of science and maths resources, making a comprehensive list of items that would support this type of enquiry.	Provide teaching staff with a list of resources that their pupils should get the opportunity to use over the year.	Put procedures in place for teachers to alert senior leadership when resources are broken, faulty or missing.
Support and Challenge	Ensure that teachers are aware of ARE for the academic years before and after the one they are teaching.	Teachers develop support materials for children working below ARE in their class. Examples include classroom displays, writing frames or sentence starters.	Teachers develop extension tasks for gifted and talented learners to extend their 'working scientifically' skills.
Quality Assurance	Review children's work to look for coverage of all enquiry types as well as progression and challenge across year groups.	Carry out a 'learning walk' while all classes focus on observing over time – identify good practice and highlight areas for development.	Lead pupil voice work that focuses on 'working scientifically', exploring children's perceptions on experiences and levels of understanding.
Celebrate	Have a 'working scientifically' notice board with a display that changes to a new type of enquiry each half term.	Display high-quality examples of observing over time enquiry work from each class and identify key features and progression.	As a special whole school focus, put in place a system of reward for individual success in 'working scientifically'.