The Ogden Trust

making physics matter

Age 5-11 years

Working scientifically

Developing children's skills in exploring how scientific ideas have changed over time

Introduction

Ideas over time enquiries really help children develop their understanding of how science works as well as enabling them to see the relevance of their learning in real world situations. Taking time to think about how our ideas about science have changed over time, by exploring the work of notable and current scientists, provides many opportunities for children to develop their science capital. There are other advantages in exploring stories that make up the history of the development of science; the fascinating lives of historical characters help bring science learning to life and often make learning more memorable. In addition to this, research tells us that children start developing their future career aspirations while at primary school; for them to say, 'science is for me', it is essential that they learn about strong role models. This should include a representation of all genders, races and backgrounds, and should look at modern day scientists and how their work fits in with the historical development of ideas.

Big questions

Here are some examples of 'big questions' that can explore the work of scientists through ideas over time enquiries in KS1 and KS2.

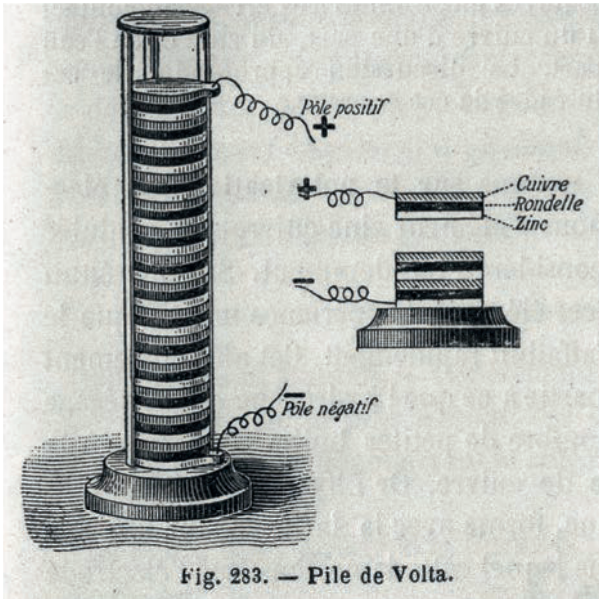
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
How did Beatrix Potter help our understanding of mushrooms and toadstools?	How did George Washington Carver use science to improve farming in America?	How did chemist, Marie Maynard Daly, use science to help us improve our diets?	How did Jane Goodall learn about the habits and behaviours of chimpanzees and why does she still need to work to protect their habitat?	How did the experiments and ideas of Jan Ingenhousz help improve our understanding of plants?	How did Carl Linneaus' ideas help us to group plants?
In the 1500s, tobacco plants were grown in Britain for medicine. How have our ideas about these plants changed?	How did Florence Nightingale use maths to help her come up with ideas to improve nursing?	How did James Lind explain the cause of scurvy and what was his evidence?	How has a visit to the dentist changed since ancient times?	How and why has life expectancy in the UK changed since the Middle Ages?	What ideas did Edward Jenner have about small pox and how did he test them?
What strange ideas did Italian scientist Luigi Galvani have about animals in 1780? Why did he think that?	When the first fizzy drink machine was invented in 1775, scientist Joseph Priestley said it was the cure to many health problems. What ideas do scientists have about fizzy drinks today?	What were James Hutton's ideas about how rocks were made and what was his evidence?	How have scientific tests for predicting the weather changed over time?	What did Stephanie Kwolek discover and why was it important?	What ideas did American geneticist Barbara McClintock have about genes that won her a Nobel Prize?
How did French doctor Renè Laennec's ideas improve medicine?	What ideas did botanist Arthur Tansley have about habitats in 1935?	How did Mary Anning's work help us to understand prehistoric life?	Who actually invented the light bulb, Thomas Edison or Joseph Swan?	How have our ideas about the solar system changed over time?	Cameras detect light – how has our understanding of light and its effects changed camera design throughout history?
How are building materials different now to when Queen Elizabeth I was on the throne?	How has glass making changed since it was first made in ancient Egypt?	How have our ideas about eclipses changed over time?	How has our understanding and use of ultrasound changed over time?	How is astronomer and planetary scientist Sara Seager changing our ideas about the universe?	How has our understanding of electricity changed over time?
What ideas did Chinese monks have in 800 CE that led to their discovery of gunpowder?	How have the materials that humans use for tools changed since the Stone Age?	How have our ideas about magnets changed over time?	Since the 1800s, how has science helped people who are deaf?	How have our ideas about gravity changed over time?	How have batteries changed over time?

Working scientifically skills

Within the working scientifically performance descriptors for KS2, a child has to demonstrate that they can 'explore and talk about their own and other people's scientific ideas' and 'begin to recognise how scientific ideas change and develop over time'. Evidence from moderation exercises within our Ogden partnerships tells us that this is an area of working scientifically that is rarely addressed in schools.

Ideas over time enquiries predominantly involve the development of children's research skills through the use of secondary sources of information. There are many similarities between ideas over time enquiries and research enquiries – learners will develop their use of scientific language, explain ideas using their scientific knowledge and understanding, and evaluate the significance, strengths and weaknesses of different scientists' ideas. While using secondary sources to find their information, children should be encouraged to evaluate the quality of the sources they have used.

The are many cross-curricular links between this type of enquiry and other areas of the curriculum, particularly English and history. Teachers planning a thematic approach to learning could find this type of enquiry a useful way to link learning in science to the whole class theme.



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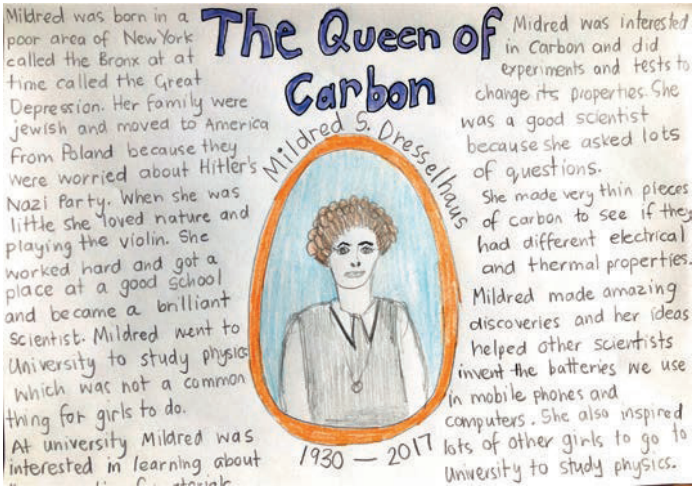


A pupil research enquiry

Resources

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

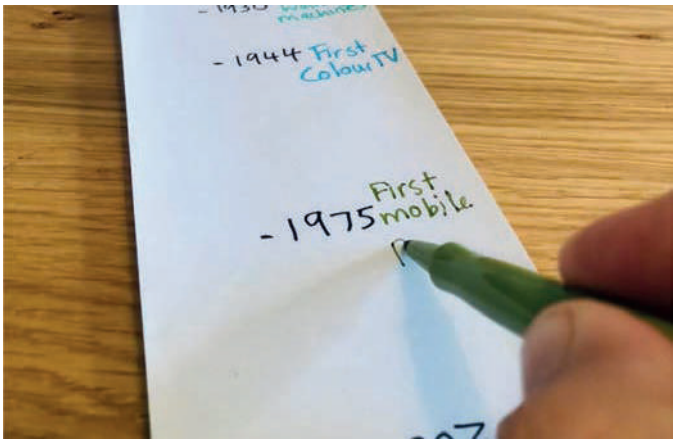
Reference books on a range of science and engineering topics	Webquests	iPads/tablets for online research
Collections of newspaper and magazine articles	Biographies of relevant scientists	Access to YouTube and BBC clips with an interactive whiteboard
Poster and leaflet-making materials	Video cameras	Line guides
String and pegs for timeline washing lines	Till roll paper	Visiting scientists and STEM ambassadors from the local community and beyond

Reporting learning

As with research enquiries, teachers can allow children to be creative in how they present their findings for this type of enquiry. Depending on what they are researching, children could create short films, podcasts or dramatic performances to describe how scientific ideas have changed over time. Alternatively, if they have focused on the ideas of one scientist, they could present their findings as posters, leaflets, newspapers, reports or letters.

Timelines are one of the most effective ways of exploring how scientific ideas are connected and have developed. Using till roll paper can allow the creation of timelines to be more mathematical with an appropriate scale between fixed events. Washing lines are also a great way to have an interactive science timeline in the classroom that can be built upon all year as children learn about different scientists – each scientist who they learn about is pegged to the line in chronological order.

It may be that children just record the notes they make while carrying out their research. Webquests are a great tool to support children in learning to use the Internet to find relevant information for their science enquiries. You can create your own webquest to scaffold children's internet searches – directing them to different websites on the hunt for specific pieces of information. As they surf the Web they can build their notes to help them answer the question they are investigating, the notes could then be used to support whole class or small group discussions.



Additional information

Below are some useful links to support ideas over time enquires.

- To see some examples of webquests that you could use in the classroom or that could inspire you to make your own, visit **https://primaryscienceweb quests.weebly.com**
- Check out the Ogden Trust resources page: **https://www.ogdentrust.com/resources**
    - There are research cards that have been created to support enquiries about how ideas in physics have changed over time and timeline learning activities.
    - Some of our Phizzi Practical activities are directly linked to the ideas of notable physicists, for example if your class is learning about electricity they could build a penny battery as Michael Faraday did in the 1800s or make their own electroscope like William Gilbert in the 1600s. Activities like this help bring learning about historical characters to life.
- To find out more about science capital visit:

  https://www.kcl.ac.uk/ecs/research/Research-Centres/cppr/Research/currentpro/Enterprising-Science/01Science-Capital

Planning

Curriculum mapping	Identify a potential ideas over time enquiry in every science unit.	Aim for each class to revisit ideas over time in science five to six times over the academic year, linking with English and history.	Plan opportunities for children to meet scientists from the local community and find out about their work and ideas.
Progression planning	Using National Curriculum documents map out age-related expectations (ARE) for ideas over time enquiries.	Establish age specific success criteria for ideas over time enquiries that are also in line with English and maths expectations.	Develop a collection of exemplar outcomes to support consistent expectations (WAGOLL).
Resource audit	Take stock of resources to support ideas over time enquiries including research packs, library books, tools to carry out online searches, etc.	Create a contact list of members of the local community who work scientifically and would come and talk to children about what they do.	Identify local museums and places of interest that could support this type of enquiry.
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 - classroom displays, writing frames, sentence starters, etc.	Teachers develop extension tasks for gifted and talented science learners that 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 an ideas over time enquiry - identify good practice and highlight areas for development.	Lead pupil voice work that focuses on aspects of pupils' science capital.
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 ideas 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.