Epistemic Insight

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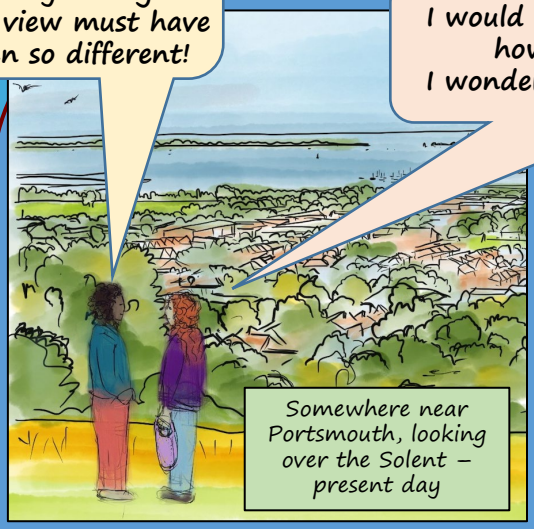
Exploring ways we can investigate Big Questions about ourselves and the world around us

Why do things change?

Imagine what England might have been like 500 years ago! This view must have been so different!



Somewhere near Portsmouth, looking over the Solent – present day

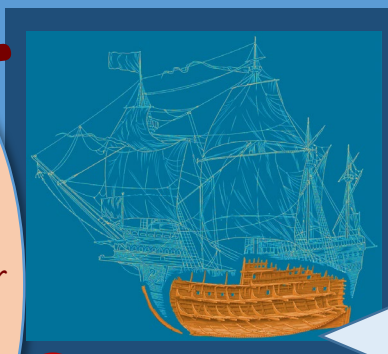
I would like to understand more about how people lived in the past. I wonder how and why things change?

Let's explore by investigating what happened to an ancient ship called the Mary Rose.

1 King Henry VIII's favourite ship was the Mary Rose... this ship sailed for over 30 years. During a battle at sea the ship was damaged and sunk.

2 The Mary Rose lay in the sand and clay at the bottom of the sea for centuries. Eventually, it was discovered by divers in 1965.

3 The Mary Rose was built mostly from wood and some metal. Half of the ship had rotted or been washed away because it was in sea water for a very long time.



4 This is the only section of the Mary Rose that has been found so far– it had been protected from rotting because it was buried in clay and sand.

5 What could be done to protect the Mary Rose from further damage so that people could learn from this ancient ship?

6 Fred is a scientist at Diamond Light Source who helped research ways to preserve the Mary Rose.

In this zine we will...

...be exploring the work of scientists who observe particles (parts of matter that we cannot easily observe)

...find out how and why scientists work with archaeologists, historians and others

...wonder about the kinds of questions that arise when investigating puzzles about the world around us

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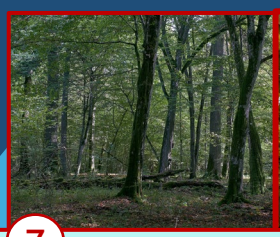
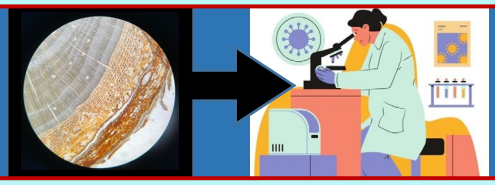
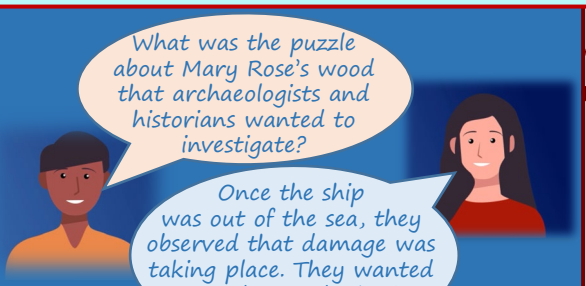
More about the Mary Rose....



7 The Mary Rose was built with oak and elm (timber planks), using wooden pegs and iron bolts. Pine resin helped keep it dry inside.

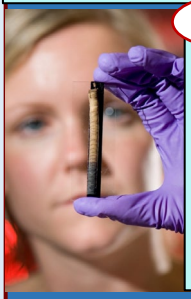


8 This is what wood looks like through a microscope

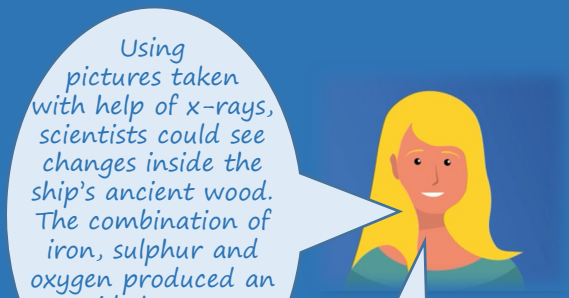


9 The ship was raised from the sea water in 1982. The ship had to be cleaned with water, then sprayed with wax.

10 Scientists observed that the timber planks that have been in contact with iron were becoming more damaged over time.



11 By taking tiny pieces of wood from the Mary Rose, Fred and other scientists at Diamond Light Source were able to use x-rays to investigate what was happening to the cells in the wood when it began to dry out.



Key words

Particle a very small piece of matter

X-Ray this form of light cannot be seen or felt – it is powerful enough to pass through most things, and is used to find out more about the structure of matter

Synchrotron works like a giant microscope, using the power of electrons to produce bright light (x-rays) that scientists can use to study anything from fossils to jet engines to viruses and vaccines

Scholar A scholar is like an investigator, using questions to think about puzzles and try to understand more about our world

Archaeologist a person who studies objects used by people in the past to try to understand the ways they lived and what was important to them

Artefact an object made by a human that has historical or cultural value

Try these activities

1) Can you make a penny shiny again?

When a penny is newly made, the metal (copper) is shiny. Over time, the penny becomes dull because it is exposed to oxygen, dirt and oils from people's hands. The interactions between these particles on the surface of the penny changes its appearance. What would make it shiny again?

a) Wash the penny with **soap and water,** and rub with a piece of cotton wool or cloth. Observe – are there any changes?

b) Soak the penny in **lemon juice,** and rub one side with a piece of cotton wool or cloth ***(hint: use a fork to scoop the penny out)*** Observe – compare the two sides... are there any changes? Why? How?

The scientists at Diamond Light Source use the synchrotron to observe and test changes that occur in matter. (For example, to see how and why acid can affect surfaces and structures).

2) Make a mini-magnifier (with your teacher) Use a ruler or clear plastic and a drop of water to make things appear bigger

What are X-Rays, and why are they used?

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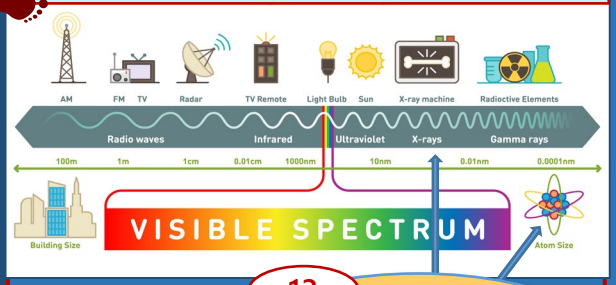
Using light to observe things that cannot be seen using magnifying glasses or most microscopes:

12 When we look around us and see colours, we are seeing energy that is invisible to our eyes. We cannot see or feel the energy in x-rays. Using x-rays, however, we can learn more about the structures within objects.



13 To see very small things (much thinner than a strand of hair), scientists at Diamond Light Source use an x-ray beam... this beam is brighter than our sun!

This is what human hair looks like through a microscope

When we are doing research using the equipment at Diamond Light Source, we are working with particles so small it would take **80 pieces** to be as thick as this **one** strand of hair.

Why might people want to find out more about ancient artefacts?

14 The Mary Rose had a crew of over 400 men.

Buried with the sunken ship were objects that can help us learn more about what was important to people who lived long ago.

Artefacts found on Mary Rose include:

- two brick ovens,
- wooden bowls, a wooden drinking cup and spoons,
- A bone object carved with angels on it (that might have been used during prayer),
- and the ship's bell.

15 **Diamond Light Source's synchrotron has been used to investigate and understand changes in the structures of objects that take place over weeks, months and years.**

This knowledge can help us understand why changes might take place inside the cells of plants and the human body.

Observe, Compare, Record

Scientists like Fred understand that some changes (reactions) may take time to become observable.

Try this in your classroom (with an adult's help to keep you safe).

You will need:

- some metal objects
- Some salt water and some plastic or glass containers

Method:

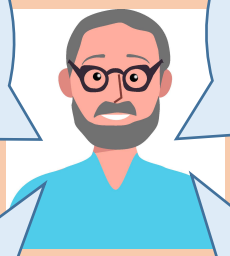
- Place a metal item and salt water into each container
- Observe each day, over seven days, and record if any changes occur to the metal objects
- Test ways to stop changes (nail varnish, wax, petroleum jelly)

For reflection:
If you were to build a structure using metal, what might you need to think about in your planning?

Scientist Profile: Fred

If someone had asked me as a child if I planned to be a scientist, I would probably have said "no!".

Using x-rays helps me to understand how atoms behave. I am amazed at how the world around us is so complex!



In school I was good at maths – this helped me when I studied science at university.

My research on the Mary Rose has helped my investigations into other areas and puzzles I am working on.

Find out more about how Diamond Light Source has worked with researchers to preserve the Mary Rose and its artefacts by watching a family webinar - search for MARY ROSE WEBINAR in the Learning-Resources/events area in www.diaomond.ac.uk

'Thinking like a scholar' Activity

This is a 'Discipline Wheel' – it includes some examples of 'ways of knowing'. Using these 'ways of knowing' can help us understand more about being human and the world around us.

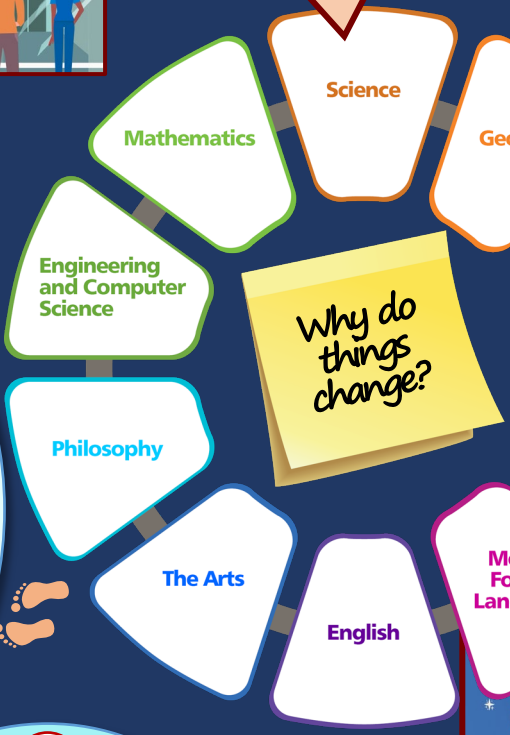
Investigate the Big Question in the middle through some of these different 'ways of knowing' (disciplines)

a Scientists' research helps to find ways to slow down changes that may damage structures (like the ancient artefacts found in the Mary Rose).

b Scientists might investigate by observing patterns in nature. This can help them understand what happens to particles when materials change.

c What kinds of questions might scientists ask when investigating?

d Why might scientists work with historians, archaeologists and others to find out more about ancient artefacts?



e What kinds of questions might historians want to ask and investigate?

f People can use disciplines to gain a fuller 'picture' of the world around us. Looking through these lenses helps us on a journey of discovery.

g When exploring the world around us, scientists and other scholars often find their discoveries lead to more questions about the world around us.

h What Big Questions do you like to think about?

Big Questions are questions that explore being human and the world around us

The Power of Light
a UKRI funded project
co-creating resources with schools, scientists and CCCU
https://www.epistemicinsight.com/about-the-project/

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This zine has been co-created with the help of STFC, Diamond Light Source, primary school teachers, the Epistemic Insight team at the Lasar Centre @ Canterbury Christ Church University, and the Mary Rose Trust. (2022)