

Lesson 4 and 5 teacher notes

'Because I said so!' covers two lessons. There is a starter at the beginning of lesson 4 and a plenary at the end of lesson 5. The lessons could be used flexibly to allow teachers to use any activity which is appropriate to the pupils ability.

The first of the two lessons 'Because I said so!' concentrates on evaluating written evidence from a variety of sources. The second lesson focuses on listening skills. The video biographies of space scientists at the CCLRC Rutherford Appleton Laboratory show how contemporary space research is carried out.

Starter

Canals on Mars

The 'Is there water on Mars?' sheet shows the surface of Mars and the lines of the canals Lowell thought he could see.

Percy Lowell (1855-1916), a wealthy US businessman, was fascinated by Mars. He set up his own observatory in Flagstaff, Arizona, especially to study the red planet. He believed he could see a network of lines across the surface and he interpreted them as big canals built by an intelligent civilisation to carry water. This captured the public imagination and for many years people believed Mars was inhabited.

Although the canals seem fanciful nowadays, it is very possible that there was once water on the surface on Mars. Comparing the images on the sheets 'Water on Earth' and 'Surface of Mars' could be used to extend the discussion in the starter activity. Missions to Mars, including Mars Express, may help us to find out what happened to the water that was once on the surface of Mars, as well as answer questions about life on Mars.

The intervention material produced by DfES as part of the Key Stage 3 National Strategy has a very useful section called 'What do we mean by evidence?' in mini-booster 3.

Main

The two halves of the postcard can be cut out and the picture stuck back-to-back with the text to make a postcard. There is an English version and a version using Greek letters.

The audio CD is a 15 minute conversation between Aristotle, Copernicus, Galileo, Caroline Herschel and Clyde Tombaugh who have all contributed significantly to our knowledge and understanding of the Solar System. Clyde Tombaugh, as the most recent astronomer, takes the chair and poses the question 'Who should be President for the Year?'

The tape could be used in sections with the question sheet to enable pupils to be focussed. A written script of the audio conversation is provided in case you would like the pupils to act it out.

The five astronomers talk about their ideas, how they have been influenced by others and about the scientific methods they used. You may want to stop the CD about halfway through (after Galileo says that we all make mistakes) to review what has been said. The tape moves on to talk about gravity (which is not covered in this topic).

Possible questions to ask include:

- Who do you think should be the President of the group and why?
- What scientific methods did each of the scientists use?
- Did the scientists work on their own or in teams?
- What was their equipment like?
- Did other people happily accept their ideas?
- Was it easy being an astronomer when they were alive?

You could also look at the similarities and differences between being a scientist now and then.

Resources needed

- Image 'Is there water on Mars?'
- Audio machine
- Audio tape or CD
- Video biographies of space scientists at the CCLRC (on the CD-ROM)

Worksheets

Newspaper articles, website extract, page on Copernicus, diary, postcard, astronomers from the past, space scientists today.

Homework

Log onto the CCLRC website www.seeingsscience.cclrc.ac.uk choose an astronomer from the site and write his or her biography. Try not to include any bias.

Extension materials

Identify different scientific methods used by astronomers from the past and present (worksheets 'Astronomers from the past' and 'Space scientists today').

Support information

Citizenship - understanding and empathising different social situations, at given times.

Key words

bias	
hypothesis	reliable
evidence	observation
experiment	prediction

Scientific method

Scientific method is the process by which people collectively, over time, try to construct an accurate, reliable and consistent picture of the world. It is an iterative and creative process which includes:

Observation	for example, the changes in the orbit of Neptune.
Hypothesis	invention of a possible explanation (hypothesis) which is consistent with the observation. For example, the changes in the orbit of Neptune are caused by the presence of another planet.
Prediction	using the hypothesis, predictions can be made. For example, based on calculations, scientists identified a region of space where the planet would be.
Experiment	the prediction is tested by experiment and data are collected. For example, Tombaugh spent many years collecting images from the specified region of the sky until he found Pluto. Experiments are usually set up in a laboratory, some on a big scale such as in particle physics, some on a much smaller scale.

Based on the results (data, observations) of the experiment the hypothesis is modified and then the process repeated until the observations and predictions are consistent. Then the scientists form a theory which explains the observations.

On the tape

Galileo - claims to be the father of the scientific method because he experimented rather than just thinking.

Aristotle - his conclusions were based on observation. Aristotle set up a school (we would call it a university) of mathematicians and thinkers, the Lyceum, in Athens where the members would teach and learn.

Copernicus - observation, hypothesis. Copernicus was first to be sure that the Sun, rather than the Earth, is the centre of the Solar System, but this was so revolutionary he was afraid to publish his ideas.

Herschel - observation, experiment. Caroline made accurate observations and recorded these in detail. The Herschels assumed that stars of equal brightness were the same distance away, but Caroline showed this couldn't be so when she discovered binary stars which are at the same distance but are not of the same brightness.

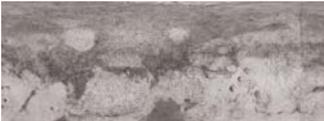
Tombaugh - observation, hypothesis, prediction (from calculation), experiment. This all led to the theory that Pluto is, indeed, out there.

Plenary

If time permits, this can be extended by giving pupils extra information cards which include the names of the people and the date to which the statements relate. They then attach these to the timeline.

This provides an opportunity to extend the activity further by including the cultural diversity of the developments of scientific ideas about astronomy.

Useful images and video for these lessons:

FILE NAME	IMAGE/MULTIMEDIA	WHAT THIS SHOWS
Because I said so!	CD audio	A conversation between Aristotle, Galileo, Copernicus, Caroline Herschel and Clyde Tombaugh about scientific discoveries and the scientific method.
Is there water on Mars?	Evidence 	This was the image that Percy Lowell looked at and decided that there was evidence for water on Mars because he could see a canal system.
	Conclusion 	This is the system of canals that Lowell drew, based on his interpretation of the original picture.
Video biographies	Video	Space scientists at the CCLRC Rutherford Appleton Laboratory talk about what they do.