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Your understanding and attitudes to science

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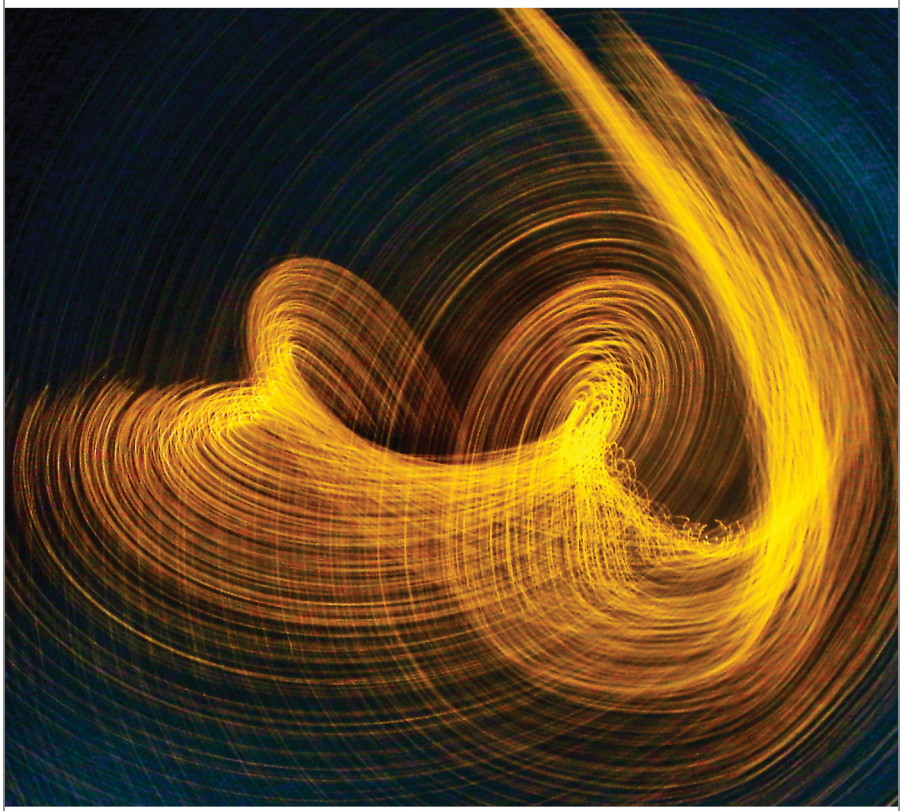

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About this free course

This free course is an adapted extract from the Open University course E207 *Subject knowledge and professional practice in primary schools* www.open.ac.uk/courses/modules/e207.

This version of the content may include video, images and interactive content that may not be optimised for your device.

You can experience this free course as it was originally designed on OpenLearn, the home of free learning from The Open University: www.open.edu/openlearn/education/professional-development-education/your-understanding-and-attitudes-science/content-section-0.

There you'll also be able to track your progress via your activity record, which you can use to demonstrate your learning.

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Contents

Introduction

In this course, which is aimed at primary school teaching assistants and early years practitioners, the focus is on your own experiences and knowledge of science. In order to support children's learning and transitions effectively, it is important that you examine your own understanding and attitudes to this subject. In this course, we ask you to consider whether the way you were taught science at school has affected your approach to the subject now. You will explore what is meant by 'science', how scientists are portrayed in the media and elsewhere, and how political, philosophical and religious beliefs affect the contexts in which scientific discoveries develop.

This OpenLearn course provides a sample of level 2 study in Education, Childhood & Youth

Learning Outcomes

After studying this course, you should be able to:

- reflect on personal attitudes to, and understanding of, science
- identify the application of science knowledge in practical contexts
- consider how scientific knowledge influences support for children's learning
- consider the impact of political, philosophical and religious beliefs on science teaching and learning.

1 Science in your life

Many adults claim that they did not like or understand science at school. It is still, in fact, quite acceptable to say, ‘I’m hopeless at anything to do with technology or scientific things’. Why do people feel this way about these subjects?

Some people may feel that science does not actively influence their lives. They may remember doing experiments at school and having fun with chemicals, while not really understanding what they were being asked to find out or what connection these had to ordinary life. They simply get on with life, switching on the television or computer, or turning on the oven or microwave, without understanding how these work so long as they get the job done. It is only when these things malfunction that they take notice, maybe with anger or frustration!

Others may consider science as a subject for high-level specialists who research cures for illnesses, explore space, discover new materials and devise new ways of doing and making things.

What is your attitude to science?

Where did we come from? Where does everything come from? What are we made of? You may not know the answers to these kinds of ‘big’ questions, and scientists are trying to find many of the answers. Have you come across these kinds of questions when working with children in school? Do you think children may feel differently from you about these types of questions? Do you feel that children are, in some ways, more open to discovery than adults?

Activity 1

Part 1

Before looking at how science teaching today affects children’s awareness and curiosity, let’s look at your own experiences of science in school.

Do you recall doing science in primary school? If so, what form did it take?

Provide your answer...

Part 2

When you first went to secondary school, which subjects excited you? Was science one of these? If yes, why did you find it exciting? If not, why not?

Provide your answer...

Part 3

What are your positive memories of your science education?

Provide your answer...

Part 4

What areas did you find difficult, and why?

Provide your answer...

Part 5

How much investigative or practical work did you do in science lessons in school?

Provide your answer...

Part 6

When did you give up science?

Provide your answer...

Part 7

With hindsight, what more could the school and teachers have done to make science more meaningful and engaging for you?

Provide your answer...

Part 8

Do you think children's experiences of science in primary school today are very different from yours? If so, what are the reasons for this? If not, why not?

Provide your answer...

Comment

You might like to post some of your responses to these questions in the Comments section below to find out if others have had similar experiences to you, and how these have influenced their attitudes to science and to supporting children's scientific learning.

A member of the E207 course team remembers 'nature' at primary school. She never saw this as having any connection with science. There was a nature table, and sometimes she went out for a walk to collect leaves and plants to put on the table, or picked up and examined the shells or feathers to display there.

Another course-team member, looking back on her time in secondary school, now realises that much of the physics and chemistry presented there could have been relevant to everyday life if the teacher had made the connections. She remembers doing – and the word 'doing' seems to indicate that she had very little understanding – something called 'coefficient expansion'. Later on in life, she realised that this was very useful: if you want to take the metal lid off a jar and it won't budge, you put it under the hot tap and the metal expands so that it loosens!

Another member of the course team recalls working in a group to dissect a frog in a secondary-school biology class, and trying to get through the lesson as quickly as possible, but cannot remember anything else connected with that lesson.

Many of our apprehensions about supporting primary children in science are often related to the lessons we experienced at school. There may have been a strict emphasis on safety, stressing the notion of danger. You may have been presented with a new vocabulary at the same time as you learned some very unfamiliar ideas. Yet science is all around us and, perhaps more than any other time, there are opportunities for the general public to discuss and explore issues such as medical discoveries, technical advances in communications and changes in the environments we live in. You are quite likely to feel confident about your views on some of these particular issues.

Activity 2

Consider these questions:

Question 1

What scientific ideas interest you now?

Provide your answer...

Question 2

What kind of science television programmes do you watch?

Provide your answer...

Question 3

Are there any scientific discoveries and ideas that you feel have affected your life or others close to you?

Provide your answer...

Question 4

Over the course of a normal day, how many references to science do you think you hear on the radio or television, or read in a newspaper or magazine (printed or online)?

Provide your answer...

Comment

We asked some primary school teaching assistants to respond briefly to these questions. Here is what they said:

> 'I have become very interested and worried about global warming and climate change, especially after seeing news reports of flooding in Bangladesh and Australia. Nowadays I know all about natural disasters around the world because of 24-hour news.'
>
> 'I watch nature programmes on television. There are some really fun ones about star-gazing and animal-watching here and in places like Africa. I do love any programme about animals because I find their behaviour so fascinating. I know a lot of children in my classroom watch animal rescue programmes.'
>
> 'Cancer used to be a death sentence – now there are many cancers which are curable. I have several friends who have had chemotherapy and reconstructive surgery for breast cancer and now lead completely normal lives.
>
> 'This week, off the top of my head, I remember reading or hearing about: the local weather, floods in Australia, a solar eclipse, the discovery of the oldest human skull, the invention of a new kind of solar-fuelled machine, and a software bug which caused Skype to crash.'

1.1 Who is a scientist? What is science?

Scientists are still often caricatured as 'boffins' – bespectacled men with wild curly hair, dressed in white coats and exhibiting eccentric behaviour and mannerisms – in fact, rather like the character depicted in Figure 1, which was drawn by some primary student teachers.

1 Professor Boff

Stereotypes remain to this day, but the image of the scientist is changing (see Figure 2). Think of celebrities such as David Attenborough, Professor Brian Cox – formerly a member of the rock band, Dare – and television science correspondents, many of them women.

2 Scientist at work

People's images of scientists often depend on their experience of mixing with those working in 'scientific' jobs and their understanding of what such jobs involve. Scientists have been described as 'rational, logical, open-minded and intellectually honest individuals who are required to adopt a disinterested, value-free and analytical stance, and who readily share their procedures and findings with each other' (Hodson, 1998, p. 9). But do you think this is an accurate description? Are scientists always disinterested and value-free, and ready to share their research with others? What might influence them? Science and technology are major factors in our lives. It is important, therefore, that you reflect on your perception of science and how you relate this to your understanding of the processes involved in thinking and acting scientifically.

1.2 Definitions of science

Activity 3

First, jot down a list of words or phrases that you think best describes your understanding of what science is about. If you can, talk with colleagues, friends and family about how they define science, and see how much their ideas agree or clash with your own, and why.

When you have finished your list, try to distil your thoughts into a sentence or two that clearly articulates what your definition of science would be.

Provide your answer...

Comment

Whatever words or phrases you used, your list probably contained some of the following ideas or threads of thinking on the nature of science:

- a body of knowledge and facts that are proven
- research and exploration of new ideas and hypotheses
- a special way of looking at the world that includes looking at what things are made of, how things work and how they can be used
- systematic study of phenomena, driven by curiosity about the world
- the different subjects within the discipline, e.g. biology, physics, chemistry, astronomy and geology.

Defining science in one or two sentences is not easy. Debate has gone on throughout the ages and has resulted in some common ideas regarding the nature of science, but many questions still remain. It is often described in terms of 'seeking to develop knowledge of, and explanation for, phenomena in the physical and natural world' (OU, 1996, p. 16). In fact, in some areas it may not be possible to achieve complete knowledge and explanation, nor will there be agreement among scientists or non-scientists on how this could be achieved. Lewis Wolpert (1992), an eminent biologist, writer and broadcaster, suggests that science is not a natural mode of thought; rather, it is a way of thinking that has to be learned and developed. It can therefore be hard to convince people that a scientific fact is true. Even today, there is a society for people who still believe the earth is flat. Wolpert suggests that science requires imagination and creativity – and, we would add, a sense of curiosity.

Activity 4

Click on the link below to watch a video clip which shows an experiment that uses everyday materials. The video is about three minutes long. When you have finished, you can return to this web page using the 'Back' button of your browser.

EepyBird.com: The extreme Diet Coke & Mentos experiments

Having looked at this video, would you call this science, technology, art, performance or a combination of all of these? Does it matter? What was happening here?

There is a chemical reaction and a physical phenomenon too. Make sure that you understand the explanation for this: follow the link next to the video which asks 'How does this work?'

Comment

A member of the E207 course team once attempted a modest re-enactment of this experiment with a combined Foundation Stage and Year 1 (4–6 year olds) group of fifty children. The result was that most got very wet and sticky, learned a lot and had an experience they will probably never forget!

2 Developing scientific knowledge

School tests and examinations for science and technology tend to be based on **knowing 'that'** – that is, knowing specific facts about particular subject areas. If you think back to the last science examination that you took, you might remember how the questions required you to recall facts, categories and processes relating to specific topics in biology, chemistry or physics. In everyday life, however, we are usually dealing with knowledge that relates to several school subjects at once. Science and mathematics, for example, are often inextricably linked, while language features in scientific thinking, exploring and understanding.

A social constructivist perspective of science and technology regards learning and knowing these subjects as processes that take place within social and cultural contexts – for both adults and children. This idea of constructing knowledge and understanding on the basis of the experience of interaction with events, people and things is central to this view of science and technology learning. The scientific processes of linking new ideas with old, and adapting and modifying ideas in order to inform your thinking and ways of working, are all in keeping with social constructivist thinking.

Building up knowledge through shared experiences needs time to develop. You may or may not remember having opportunities in your own science education to linger over and play with ideas. As a child, you may have enjoyed and have been encouraged to ask questions or observe how things worked. How much opportunity do you think you had to ask questions so that you really understood a problem? How confident did you feel about asking questions? What helped or hindered you in your understanding?

2.1 Science and communication

The role that communication plays in learning science has become widely accepted, having been greatly influenced by the work of Lev Vygotsky and Jerome Bruner. Bruner stressed the importance of language as a way of learning how to think. If we are given opportunities to communicate our ideas, we begin to examine and perhaps to question our preconceptions.

Sometimes it is the everyday language we use that leads to scientific misconceptions. For instance, does the Sun really 'disappear' at night? Many words we use have a place both in the language of science and the language of everyday life. Consider the everyday meanings and the scientific meaning of these words:

mass	**atmosphere**	**dense**	**space**
reaction	**star**	**solution**	**reflection**
resistance	**cells**	**tissue**	**force**

Talking to children within a scientific context, we need to be aware of these different meanings. Children's ideas may be partly or completely misconceived and have arisen because of confusion about vocabulary, receiving inaccurate information or as a result of their own theories. Exploring these misconceptions through talking and observing can help to dispel some of their confusion or half-formed ideas.

2.2 Science and beliefs

To understand science, it is important that we appreciate the contexts in which discoveries are made or suppressed. Religion, philosophy and politics all play major roles in scientific discoveries. For instance, Galileo's observations of the universe in the seventeenth century drew the wrath of the church, which saw his ideas as heretical. In the nineteenth century, Charles Darwin struggled with his religious faith as he developed his theory of evolution. It is acceptable today to say that the Sun is just one of many stars in the universe, and is about 4,500 million years old and approximately 333,400 times bigger than the earth (SSS, 2004), because no one will be burnt at the stake for saying such things.

Nevertheless, debate continues. Think about the political, philosophical, ethical and religious arguments around issues such as greenhouse gases, licensing new drugs, the use of embryonic materials, and how much and to whom government and other public bodies or philanthropists choose to give to research. Think for a moment about any recent arguments you have come across in which science features in the debate.

Some scientists have religious faith, others do not. Richard Dawkins, for example, is an outspoken atheist and scientist, and makes his position very clear in his writing and frequent interviews: he sees religious faith as 'a cop-out' because, he suggests, people believe despite a lack of evidence. On the other hand, Kenneth Miller, a Christian, evolutionist and professor of biology, sees no problem in believing both in a supreme being and in evolution; God, in his view, exists outside of nature.

Activity 5

Before you consider your own views, read a short online interview with Kenneth Miller by clicking on the link below. Then watch a short video clip of David Attenborough discussing the way he sees religion in relation to science.

Kenneth R. Miller: Science and religion, an ActionBioscience.org original interview

Sir David Attenborough ' s view on science and religion

Video content is not available in this format.
Sir David Attenborough's view on science and religion

How do you think the political, religious and philosophical beliefs of adults in school or in the wider society affect the way that children are taught science in primary school?

Provide your answer...

Comment

Beliefs can have an impact on the way children are taught. When you thought about this question, you may have considered some of the following:

- Science is a required subject of the primary curriculum – it is mandatory to teach and learn it.

- Science is seen as an area for ‘brighter’ children.
- In some schools in the USA, evolution is not taught because the local school board or the private company running the school emphasises the absolute truth of the Bible.
- Some parents object to children being introduced to reproduction in plants and animals, or to human sex education.
- As David Attenborough suggests in the video clip, the emphasis in science is often on what is beautiful in nature, and it is questionable how far children should be introduced to nature’s cruelty. For example, in one school, children were allowed to watch the school cat eat a mouse. In another school, the children were moved away from a dead frog in the playground.
- Health and safety rules and regulations often stop children having first-hand experience and experiments.
- Most scientists see global warming as an urgent concern, but some scientists and members of the public are sceptical.
- Some schools make sustainable development a key part of the curriculum, but there is no requirement for them to do so, and some schools leave their lights on all night.
- In primary schools, religious education (RE) is not usually a cross-curricular topic within science, except for the topic of light during the winter festivals of Christmas and Hanukkah. But some faith schools incorporate RE across the whole curriculum.

2.3 Subjective and objective knowledge

In practice, everything we know is constructed through our senses. We perceive the world around us and, through our senses, we construct meaning – a process that will always involve an element of subjectivity. Scientific method tries to eliminate biases and idiosyncratic ideas from its body of knowledge and produce an objective paradigm or theory. But scientific theories are not infallible. Science’s very strength, suggest Wenham and Ovens (2010, p. 9), lies in the fact that it is open to ‘criticism and correction’. And, as you were reminded in the section on science and beliefs, there are competing views, and sometimes we are left to judge which are valid and which are not. We also need to take into account that individuals and organisations may have vested interests in the outcome of scientific enquiries.

Activity 6

Question 1

Who do you feel may have vested interests when promoting a scientific theory or idea, and why? Can you think of a current example of this?

Provide your answer...

Question 2

How do you make up your mind whether a scientific theory is valid or not? What factors influence you?

Provide your answer...

Comment

Here are some suggestions:

- Companies and industries fund research and therefore wish to prove that their products are good ones.
- An ambitious individual may want to make his or her name through research, and may therefore disregard criticism.
- Politicians do not want to create panic, or they do not want to be associated with a cause that is unpopular or costly.
- The media report the bits that they think will capture the public's imagination, and do not always tell the whole story.
- Religious groups may dispute a theory because it does not fit with their beliefs.
- In 2010–2011, people have been concerned about the world economic recession. They have been less concerned about global warming being created by their own habits.

We would like you now to make notes on your responses to the following questions:

- What are the main strengths I can bring when supporting children in primary science?
- What might get in the way of my contributions to supporting children in science? (This could be a practical school issue or an aspect of yourself.)
- How can I improve my skills, knowledge and experience in supporting children in science?

Conclusion

This free course provided an introduction to studying education, childhood & youth qualifications. It took you through a series of exercises designed to develop your approach to study and learning at a distance and helped to improve your confidence as an independent learner.

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Acknowledgements

This free course was written by Mary Stacey.

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This free course is adapted from a

former Open University course

called 'Primary subject knowledge

and practice (E207)'.

This course has been replaced with ‘

Developing subject knowledge for the primary years (E209)’.