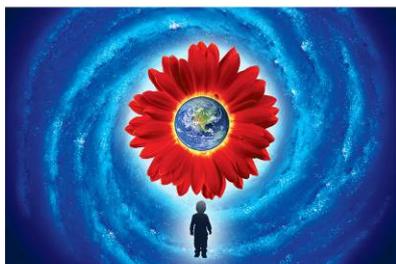


# **Growing Up** **in the Universe**

RICHARD DAWKINS



**What is Science *for*?**



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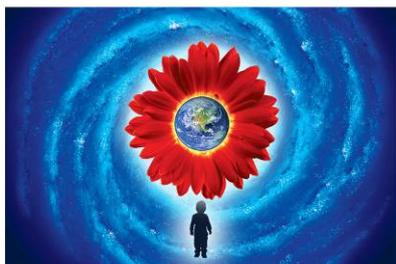
## In this unit students can learn:

- That science is a tried and tested method of learning true facts about the reality around us and gaining knowledge;
- About the awe and wonder which can be aroused in human beings as we explore the natural world;
- About the satisfaction that human beings can have in the enterprise of science – being curious and finding things out about the world around us.

## How this learning fits into the national curriculum

Learning around these themes can support the overall aim of the national curriculum for secondary education in developing 'successful learners who enjoy learning, make progress and achieve' by helping to inspire students with the enjoyment of finding things out which the study of science can encourage. According to the secondary national curriculum, 'The study of science fires pupils' curiosity about phenomena in the world around them and offers opportunities to find explanations', and learning around these themes can help support the development of scientific thinking as well as contributing to students' overall 'social, moral, spiritual and cultural' development by allowing them to reflect on the meaning and purpose that human beings can achieve by exploring the world around us, and reflecting on the awe and wonder that the natural world can inspire in us.

Learning around these themes develops understanding of the context for scientific thinking (Key Stage 3 1.1 – Key Concepts: Scientific thinking) and develops skills of communication in 'discussions about scientific issues' (Key stage 3 2.3 – Key Processes: Communication) either in class discussions or in writing.

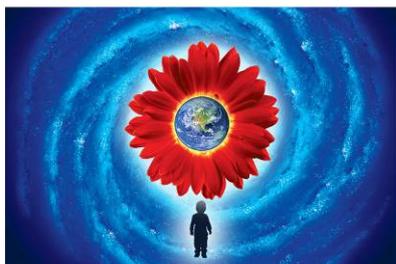


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## Notes for teachers

<i>Activity</i>	<i>Extra information and guidance</i>	<i>Video clips</i>
<p><b>Why doesn't my mobile phone work?</b></p>	<p>This activity works well as a starter before the key ideas about the scientific method are introduced. It should show that we use the scientific method in everyday life, even if we don't always realise it.</p>	
<p><b>What is the Scientific Method?</b></p>	<p>This summary diagram shows one possible representation of the processes associated with the scientific method.</p> <p>It could be used to review students' responses to the 'Mobile phone' activity.</p>	<p>This brief extract illustrates the formation and testing of a scientific hypothesis.</p> <p><i>Waking Up in the Universe</i> (from 54:29 'there's nothing wrong with having faith in a proper scientific prediction...' to 55:46, the Medawar quotation)</p>
<p><b>Which card wins?</b></p>	<p>Each group of five will need a pack of playing cards for this activity.</p> <p>This exercise illustrates the usefulness of the scientific method in problem solving and how adopting a rational, scientific approach means that puzzles can be solved more efficiently.</p> <p>You will need to make up a rule for each game (e.g. highest red card wins, or lowest black card etc) which should only be given to the dealer.</p>	



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<p><b>What is Science for?</b></p>	<p>These comprehension exercises help pupils to learn more about how the practical application of the scientific method has helped improve the wellbeing of people in the past and today.</p>	
<p><b>Science in words</b></p>	<p>These passages could be read together as a class or individually. They describe the sense of awe and wonder associated with the study of Science.</p>	
<p><b>What do you think about Science?</b></p>	<p>The video clip describes two reasons for supporting science. (1) science gives us a way of finding out true facts about the universe that surrounds us, (2) the pleasure and fulfilment that can come from exploration and the satisfying our curiosity by learning about the universe around us. These two reasons are linked together.</p> <p>How do your students feel about science? Richard Dawkins says that the public funding of science should be justified in the same way as public funding of the arts – do your students agree? What are some of the reasons people may do science? What are some of the reasons why we should give public support to science?</p>	<p>In this extract Richard Dawkins asks us to imagine that we have travelled through space, in deep sleep and have eventually reached a wonderful new world. He compares this experience with each of us being born into just such an amazing world and introduces science as the way by which we can understand the world around us.</p> <p><i>Waking Up in the Universe (from 15:14 'Now imagine a spaceship...' to 19:44 '...spend your short time in the spotlight.')</i></p>

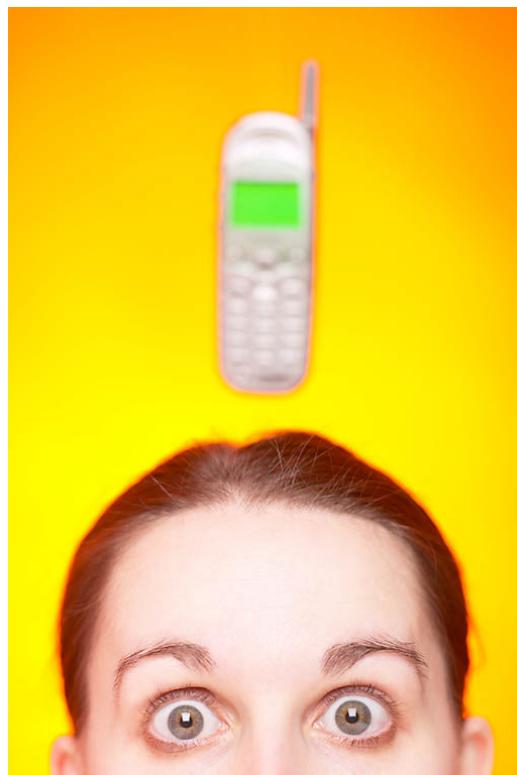


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## Why doesn't my mobile phone work?

Imagine that a mobile phone has suddenly stopped working.



### Why might the mobile phone have stopped working?

- Think of as many possible reasons as you can. Make a list.

### How could you make the mobile phone start working again?

- Describe, for each possible reason, how you could check to see if it was the true reason for the phone not working? Write a few words to describe how you could check.



# Growing Up in the Universe

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## What is the Scientific Method?



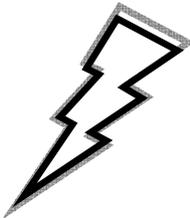
Make an **observation** that is interesting, unusual or otherwise raises a question



Based on your observation, think of a **question** to be answered which can be used a focus for your investigation



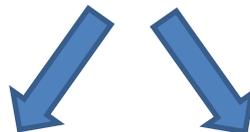
Think up a **hypothesis**— an educated guess at the answer based on what you already know about the subject. The hypothesis should be a statement which can be tested by an experiment and then shown to be either valid or false.



Design and carry out an **experiment** to test if your hypothesis is valid or false. This doesn't have to be something done in a science lab but it must be a fair test (only change one factor at a time, keeping everything else the same) and you should check that the results are reliable by doing



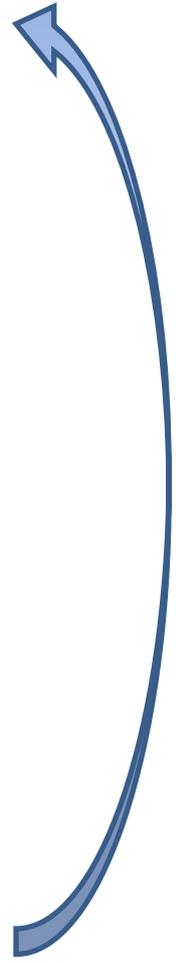
The results from your experiments will need to be **analysed** and interpreted. You may then be able to draw a **conclusion** and state if your hypothesis is valid or false

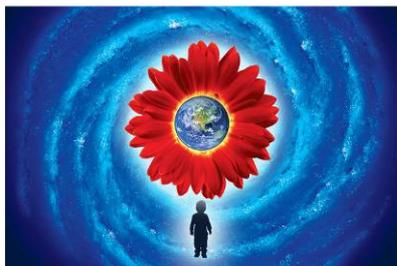


If your **hypothesis is shown to be valid**, you can accept it but you could also improve your confidence in it by doing more repeats or even designing different experiments to test the same hypothesis



If your **hypothesis is shown to be false** (or not completely valid) you will need to come up with a new hypothesis





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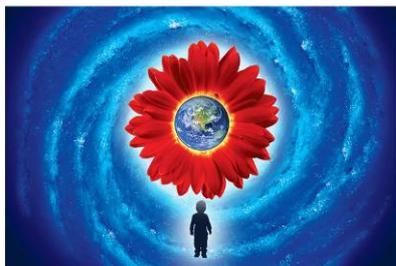
## Which card wins?

In this activity you are going to use the scientific method to work out the rules of a card game. You will work in groups of five and each group will need a pack of playing cards. In each group, four people will play the game and the fifth person will deal the cards.

### What to do

1. The dealer should deal out all of the cards from the pack, not including the Jokers.
2. Each player picks up their cards. They can look at their own cards but not other people's.
3. The dealer then asks the teacher for the game's rules. Only the dealer should know this, not the players.
4. The player to the dealer's left plays one of their cards by placing it face up on the table. They can play any card from their hand.
5. The other players in turn then play one of their cards, in the same way.
6. Once all the players have played one card, the dealer will say which player has won that round (according to the game's rules) but without saying what the rule is.
7. The players play further rounds of the game by repeating steps 4-6, with the dealer saying who has won each time.
8. The players should treat each round of the game as an experiment. They should note down the result of each experiment (which card wins) in a table.
9. Once a player has spotted what they think the rule is (their hypothesis) they can try to predict which card will win a round.
10. If a player predicts the rule correctly, a new game can start with a different person acting as the dealer. The new dealer should ask their teacher for a new rule.





# Growing Up in the Universe

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## What is Science for?

### CASE ONE: Cholera

*Read the article and the background information. Answer the questions below.*

#### DEADLY DISEASE IN CENTRAL LONDON

*3 September 1854*

THE serious outbreak of cholera which has befallen the Soho district of Central London these past days has worsened. This dreadful disease, whose symptoms include severe diarrhoea, continues to claim victims.

The death toll from this outbreak has now reached five hundred and shows no sign of slowing down. Why has this disease struck? Some say that there is something in the air...

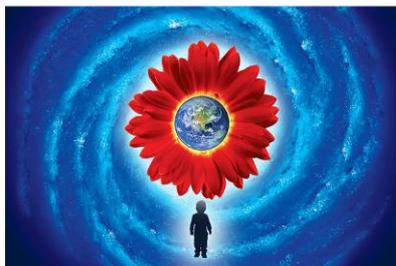
#### **Background information**

At this time buildings in the area did not have water supplied through pipes into each home. Instead, people would go to water pumps in the street which were connected to an underground well. They would pump water into buckets and take this back to their homes and use it for washing, drinking and cooking.

A doctor, John Snow, was appalled by the cholera outbreak. He visited the area affected and talked to the people that lived there about the disease. He discovered that a large number of people who had died of the disease lived near a water pump on Broad Street and that they had taken water from this pump.

John Snow persuaded the local authority to close the pump and soon the number of cholera cases fell dramatically. It was later found that the well that gave water for this pump was near to an underground cesspit full of human sewage which had started to leak out.

- *What is the hypothesis given in the newspaper article for the cholera outbreak?*
- *What was John Snow's hypothesis for the cholera outbreak?*
- *Give three pieces of evidence from the information above which suggest that John Snow's hypothesis was valid.*
- *Describe an experiment which could have given further, direct evidence to back up John Snow's hypothesis.*



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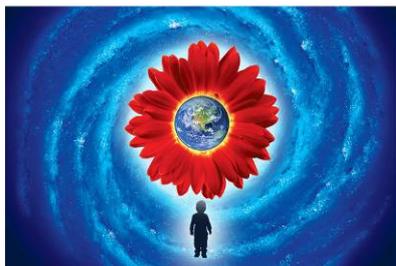
## CASE TWO: AIDS

Read the datasheet and then answer the question below.

### **DATASHEET: AIDS and childbirth**

1. AIDS is a set of symptoms caused by the HIV virus which attacks the human immune system.
2. This means that body cannot defend itself effectively against infections and diseases which eventually lead to death.
3. The HIV virus is transmitted through bodily fluids (such as blood, semen, breast milk) that are infected with HIV.
4. Between 25% and 35% of babies born to mothers with HIV are themselves infected with the HIV virus.
5. Studies of blood in the umbilical cords of babies showed that those with HIV had their mother's blood mixed with their own.
6. If pregnant women with HIV give birth by caesarean section *before* they go into labour (and are given medicine to reduce the speed that the HIV virus multiplies), only 1% of babies are then infected with HIV.
7. If pregnant women with HIV give birth by caesarean section *after* they go into labour (and are given medicine to reduce the speed that the HIV virus multiplies), their babies still show an increased risk of HIV infection.

- *How does the evidence show that giving birth by caesarean section before going into labour helps to reduce the risk of HIV infection being passed from mother to baby?*
- *How has the scientific method been used to find how HIV is passed from mother to baby?*
- *What else can scientists do to try and reduce the risk of HIV infection in childbirth now that this study has been done?*



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## Science in words

*From Unweaving the Rainbow, by Richard Dawkins (Penguin 2006):*

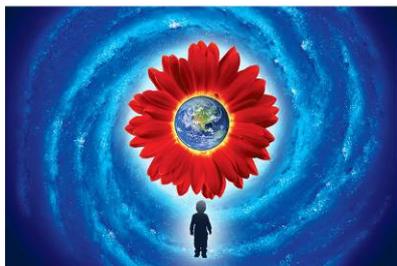
After sleeping through a hundred million centuries we have finally opened our eyes on a sumptuous planet, sparkling with colour, bountiful with life. Within decades we must close our eyes again. Isn't it a noble, an enlightened way of spending our brief time in the sun, to work at understanding the universe and how we have come to wake up in it? This is how I answer when I am asked – as I am surprisingly often – why I bother to get up in the mornings. To put it the other way round, isn't it sad to go to your grave without ever wondering why you were born? Who, with such a thought, would not spring from bed, eager to resume discovering the world and rejoicing to be a part of it?

*From the coda to Science: A History, 1543-2001, by John Gribbin (Allen Lane 2002):*

It is because there are ultimate truths out there that science hangs together so well. And what motivates the great scientists is not the thirst for fame or fortune (although that can be a seductive lure for the less-than-great scientists) but what Richard Feynman called “the pleasure of finding things out”, a pleasure so satisfying that many of those great scientists, from Newton to Cavendish and from Charles Darwin to Feynman himself, have not even bothered to publish their findings unless pressed by their friends to do so, but a pleasure that would hardly exist if there were no truths to discover.

*Neurologist Oliver Sacks, in his autobiography, Uncle Tungsten (Picador 2002), remembers how inspired he was as a boy by chemistry. He is describing one of his Uncle Dave's heroes, the 18<sup>th</sup> century Swedish chemist Scheele:*

Scheele, it was said, never forgot anything if it had to do with chemistry. He never forgot the look, the feel, the smell of a substance or the way it was transformed in chemical reactions, never forgot anything he read, or was told, about the phenomena of chemistry. He seemed indifferent, or inattentive to most things else, being wholly dedicated to his single passion, chemistry. It was this pure and passionate absorption in phenomena – noticing everything, forgetting nothing – that constituted Scheele's special strength. Scheele epitomized for me the romance of science. There seemed to me an integrity, an essential goodness, about a life in science, a lifelong love affair.



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## What do you think about Science?

What do you think about science? Richard Dawkins says that the public funding of science should be justified in the same way as public funding for works of art, museums, libraries or theatres. Do you agree? Why do people become scientists? What are some of the reasons why we should give public support to science?

*Using the ideas in the paragraph above and video clips you may have seen from Richard Dawkins' lecture choose one of the following tasks:*

- **Write an article for a newspaper or magazine arguing in favour of greater public funding for science**
- **Write a letter to a newspaper or a Member of Parliament (MP) arguing in favour of greater public funding of science.**
- **Why would you become a scientist? Explain why you would, starting 'If I were to become a scientist it would be because...'**