PEOPLE IN SCIENCE

Health and Disease

Peter Ellis

Pearson Education
Edinburgh Gate
Harlow
Essex
CM20 2JE
www.peopleinscience.co.uk

Immersive Education
The Old Malthouse
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OX1 1LD

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Peter Ellis has been teaching science for 27 years and has an M.Phil in Chemical Education. He served a term as Chairman of the Education Section of the British Society for the History of Science.

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Contents

A Introduction

People in Science – Health and Disease is one of a series of six CD-ROMs each with accompanying support materials. They are designed to help teachers deliver the Ideas and Evidence strand of Sc1 in an interesting and motivating manner, and to develop students' thinking and literacy skills at the same time. The series is accompanied by a companion website at www.peopleinscience.co.uk.

Kar2ouche®

People in Science uses Kar2ouche® – an innovative software product that allows students to read and/or listen to text, and to create storyboards which describe a sequence of events or present arguments, debates, or factual information. Suggestions for different ways of using Kar2ouche® to teach science and to develop thinking and literacy skills are given in Sections B and C (pages 8–11). A 'Quick Start' guide to using Kar2ouche® is provided at the back of this file, and a full instruction manual can be downloaded from the website at www.peopleinscience.co.uk.

Ideas about health and disease

This CD-Rom covers a variety of topics based around the central theme of health and disease. Students investigate changing ideas about heart and circulation helped by scientists such as Aristotle, Galen and William Harvey. This topic is then extended into modern heart transplants and students consider the factors behind heart disease and the ethics of using animals to provide organs for transplants. Also covered is the development of ideas about the spread and prevention of disease. This includes deficiency diseases (as illustrated by the work of James Lind), the germ theory of disease, the discovery of penicillin, the development of vaccination and Edward Jenner's experiments. Students are then given information on modern medical issues such as the MMR vaccination, the link between smoking and lung cancer and the spread of AIDS.

An outline of the scientific developments covered by *Health and Disease* is given in Section D (page 12), and short biographies of the characters are included in Section E (page 17).

Section F (page 21) provides matching charts to map the Themes to:

- the National Curriculum for England
- the National Curriculum for Wales
- the 5–14 Guidelines for Scotland
- Scottish Standard Grade specifications.

In addition, matching charts are available on the website for the following:

- the QCA Scheme of Work for England
- GCSE specifications from AQA, Edexcel and OCR
- National Literacy Strategy.

The Themes

The material provided on this CD can be used to cover a number of themes; either specific discoveries or ideas (e.g. the germ theory of disease) or ways of doing science (e.g. the importance of evidence in the development of ideas). This pack includes 7 suggested Themes, covering different aspects of ideas about *Health and Disease*.
For each Theme there are two suggested activities (of varying difficulty), a set of teacher's notes, a classwork sheet and a homework sheet. The CD includes two partially completed storyboards for each Theme, to help students to get started on the activities.

The activities and storyboards

In writing the activities we have attempted to provide a variety of tasks as well as looking at different scientific ideas. The suggested activities vary from creating straightforward storyboards to describe a sequence of events, to constructing a museum exhibit or a television debate. We have provided two activities for each Theme, with the first activity generally being easier than the second. The suitability of each activity for KS3 and KS4 students is indicated in the teacher's notes. Each activity is further differentiated into Sections A, B and C. Students should all start on section A.

A storyboard is provided for each activity (for Activity 2.1, 4.2 and 6.2 a Word document is provided as well). The information about each scientist can be accessed via the text/audio window by clicking on the blue book symbol. The storyboards have some frames already created, and prompts or questions in the comment window below the frame. The classwork sheets give students a brief outline of the activity and suggestions for completing the storyboard.

The activities suggested in this Teacher's File are intended to help teachers and students new to working with Kar2ouche® – there are many other possible activities that can be carried out using the text and characters provided. A few more suggestions are given in Section H (page 64).

Kar2ouche® allows teachers to personalise various settings, determining which characters, backgrounds and props students have access to. Further details on this facility can be found in the user manual.

The Homework Sheets

A homework sheet is provided for every Theme. The sheets are intended to be 'stand-alone', in that they do not rely on students having completed all of the corresponding activity, and they do not require students to have the software at home or to take home printed versions of their classwork activities. They are intended to consolidate ideas introduced via the activities.

We have provided a range of questions on each homework sheet. Teachers may like to select which questions students are to answer for homework depending on the ability of the class.

One question on each sheet is a research question indicated by this symbol: . These questions require students to use books or the Internet. Suggested web links are given on the *People in Science* website at **www.peopleinscience.co.uk**.

The Teacher's Notes

The Teacher's Notes for each Theme include the following information:

- a box indicating which students the activities are suitable for. 'All' means that all students at that Key Stage should be capable of carrying out the activity successfully; 'Most' means that most students should be able to carry out the activity, but that it is not suitable for the least able (or the least able will need considerable help); and 'Some' indicates that the activity is suitable for more able students only at that Key Stage

Activity	KS3	KS4
1.1	Most	All
1.2	Some	Most

- learning objectives
- learning outcomes
- an indication of any prior knowledge that students will need before starting the activities
- a list of National Curriculum statements that can be covered (or partially covered) using the activities
- a brief background summary of the scientific developments or debates covered by the Theme
- an outline of the suggested activities and the storyboards provided
- a list of the characters, backgrounds and props needed (this provides a quick reference list in case teachers wish to lock out any characters, props or backgrounds not needed for the activities)
- suggestions for organising the lesson
- answers to questions on the homework sheet.

The website www.peopleinscience.co.uk

The companion website includes:

- a full user manual for Kar2ouche®, downloadable as pdf files
- Frequently Asked Questions
- an area where teachers can submit or download ideas or storyboards, to share teaching ideas with other schools
- a list of weblinks suitable for students to use to answer research questions .

At the time of publication, all web addresses listed on the website have been checked for their content and suitability. However, we would advise that all web links are tested before use in class, to ensure that they are still useful and appropriate.

Customer Support

Kar2ouche® is easy to install and run, but if problems are encountered, call the Customer Support Line on 01865 811099.

System Requirements

- 50 Mb free hard drive space
- 32Mb of RAM
- CD-ROM drive
- Mouse
- 1024 x 768 or 800 x 600 16-bit video display
- Microphone and speakers *(Kar2ouche® will work without these, but users will not experience the benefits of the software without them)*

PC/Windows System Requirements

- 300 MHz or higher Pentium compatible processor
- Windows 95/98/2000/ME/XP
- Microsoft DirectX 8.0 or higher *(installed automatically if not found)*
- QuickTime 5.0 or higher *(installed automatically if not found)*

Mac OS System Requirements

- Suitable for PowerMac or Powerbook
- Mac OS 8.6 or later
- CarbonLib 1.1
- QuickTime 5.0 or higher *(installed automatically if not found)*

B Using *People in Science* in the classroom

The material provided on the *People in Science* CDs can be used in the classroom in a number of ways. This section gives a general overview of the possibilities, with more detailed suggestions for each Theme given in the Teacher's Notes and via the ready-made storyboards.

Organising the lesson

Students gain most value from the kinds of activity suggested here if they are given a general introduction to the lesson before they start using the software, and if what they have learned can be summarised and shared with others during a plenary session at the end of the lesson. Specific suggestions for starting and finishing lessons are made in the Teacher's Notes for each Theme.

Students can work alone, in pairs or even threes. For many students, working in pairs provides encouragement, an opportunity to share ideas, and a chance to clarify ideas by discussion with a partner. For this reason, it may be better to ask students to work in pairs even if there are sufficient computers for students to be able to work alone.

Storyboards

A storyboard is a series of frames that tell a story or convey a sequence of events. They can be viewed as separate frames in sequence or animated and played as a 'movie'. Storyboards are particularly useful in encouraging students to show their understanding and demonstrate their ability to extract and summarise key information.

Students can be asked to create:

- a summary of a particular event or piece of text in a specified number of frames
- a summary with speech bubbles or captions containing important quotations
- a storyboard with their own commentary or a summary in their own words
- presentations for the class to view
- illustrations of alternative points of view, or a debate
- imagined meetings between characters
- a proposal for a new documentary to be presented to a board of TV executives.

While the main ideas in a storyboard are likely to be conveyed via text (either in the text window or in speech, thought or text bubbles), students can enhance their presentations by adding sound effects, extra characters or props, all of which can be found on the CD. In addition, they can add their own digital images, or record the text in their own voices.

If time is limited, teachers can provide partially completed storyboards that students finish in the lesson. Students can also be asked to create their own incomplete storyboards for other students to complete. Partially completed storyboards may comprise, for example:

- the first and last frames – students make the frames for the central section
- storyboards that contain blank thought bubbles, blank speech bubbles and/or blank text boxes
- storyboards with questions in text boxes or in the caption window
- storyboards with text in the caption window – students create the pictures
- storyboards with odd frames missing
- sequencing activities
- a quiz – 'who says what?', or 'what happens next?'

Animations
Students who have access to Kar2ouche® out of class time enjoy creating animations. As with storyboards, animations enable students to demonstrate their understanding and ability to extract key information. Most of the activities listed below can also be created as still storyboards. Students may be told that they have been commissioned to create a programme such as:

- a news programme
- a documentary
- a TV chat show/interview
- a documentary trailer.

Publications
To summarise a topic, students can present their storyboards to the class using a data projector, interactive whiteboard, or on screen. Alternatively, they can use the print facility to create publications in Kar2ouche®, or copy images into a word-processing or desktop publishing program.

Possible publications for students to create include:

- a newspaper front page – using Kar2ouche® to produce the pictures and the text as a resource
- storybooks, with the story below the picture in the caption window (concentrating on structure or settings etc.)
- cartoon strips (or film storyboard strips)
- diary entries (with photos or pictures)
- letters (with pictures)
- photo albums
- magazine spreads.

In all of these activities students may be asked to consider audience and purpose. Teachers can stipulate this audience.

When using *People in Science* the possibilities are almost endless. As teachers get used to the software and use it within their particular area of expertise, other activities will suggest themselves.

C Developing thinking and literacy skills

Although the focus of the activities in *People in Science* is for students to learn about science, in particular the development of ideas and evidence over time, there are also ample opportunities for pupils to develop their thinking skills and literacy skills.
This section outlines some of the skills that can be developed. A matching chart is available on the website, which links the suggested activities to the National Literacy Strategy.

Information-processing skills
Students can be encouraged to:
- identify key images, text, and ideas – and extract what is essential
- sort the relevant from the irrelevant
- organise and, where necessary, prioritise ideas
- sequence events
- compare and contrast their work with the work of others.

Reasoning skills
Students can be encouraged to:
- justify opinions using evidence
- make informed choices
- consider alternative perspectives or interpretations
- articulate ideas.

Enquiry skills
Students can be encouraged to:
- work collaboratively to extract information from texts
- consider consequences
- reflect critically on written text, their own work and the work of their peers.

Creative thinking skills
Students can be encouraged to:
- offer interpretations of texts or situations
- create multi-media texts
- respond imaginatively to texts or situations.

Evaluation skills
Students can be encouraged to:
- engage in collaborative work and dialogue
- review, modify and evaluate work produced.

Communication
Students can be encouraged to:
- engage in group discussion
- present ideas to a group
- use visual aids and images to enhance communication
- listen, understand and respond critically to others.

Literacy skills

At **word level** you can draw attention to key scientific words and their spelling. Students should be encouraged to look up any unfamiliar words in the glossary provided on the CD, and to compile their own lists of new words. Alternatively, lists of new words can be made into posters and used in a wall display. When introducing new vocabulary, encourage students to draw on analogies to known words, roots, derivations, and familiar spelling patterns.

In creating a range of storyboards, students can be encouraged to pay attention to **sentence level** literacy skills. In particular they should pay attention to sentence structure and the consistent use of tenses. At a more advanced level they should be encouraged to consider the differences between written and spoken language in terms of degrees of formality and the techniques that speakers employ to persuade an audience to their points of view.

Work at a **text level** can be varied. As far as the students' **reading** skills are concerned the activities require them to develop a range of research and study skills, including locating information from the given text through skimming, scanning and search techniques. At a more advanced level they are required to bring in information from a range of sources, and to evaluate and re-present this for a specific audience. Some students may need clear directions that will help them to develop these skills.

The **writing** demands of the activities are varied from virtual performances and debates to newspaper reports. Students should be shown how to take effective notes, organise ideas and use evidence.

The software is particularly suitable for pair and small group work and thus for facilitating the development of **speaking and listening** skills. When working in pairs, students can be given instructions to use talk as a tool for clarifying ideas by discussing, hypothesising, citing evidence and asking questions. In many of the activities students are required to promote, justify or defend a point of view using supporting evidence, example and illustration. During plenary sessions students will be required to listen, ask questions, comment, and possibly evaluate the presentations they have viewed. With teacher direction, students can be allocated different roles in their groups to practise different skills. The storyboarding activities allow pupils to engage in virtual role-play, therefore developing their drama techniques in a variety of situations and in response to a range of stimuli.

D The development of ideas about health and disease

There are two strands to the development of our understanding of health and disease. These are firstly, discoveries about how the body works, including the sciences of anatomy and physiology, and secondly recognition of the causes of disease.

The Hippocratic oath

At the time of Hippocrates (460–377 BCE*), and indeed for many centuries afterwards, most people blamed the gods for the ills that afflicted them. Hippocrates and his followers took a different view and suggested that disease was a natural consequence of food that had been eaten, the weather or other factors. These causes produced an imbalance in four humours (blood, phlegm, black and yellow bile) that controlled the metabolism. Hippocrates suggested using various plant remedies, such as the opium poppy and willow bark for pain relief. He also urged those who treated the sick not to cause harm and asked his followers to take an oath to this effect. A form of the Hippocratic oath is still taken by most doctors today as they graduate.

The anatomists

The best known of the classical physicians was Claudius Galen (130–201 CE). Records of his work influenced western medicine for centuries. A Greek born in what is now Turkey, he became famous in Rome. As well as treating eminent Romans, including the family of the Emperor, he also made new discoveries about the anatomy of the human body. His conclusions were made only from observations of animals and occasional glimpses of human bones in tombs because the culture of the time forbade the dissection of human bodies. Thus Galen saw the heart as merely a junction for the food-carrying blood from the liver and the air-carrying blood from the lungs. From the heart the two types of blood were distributed to the rest of the body where they were used up. In Galen's model there was no circulation and blood could cross the central division of the heart.

Until the time of Vesalius (1514–1564 CE) no one questioned Galen's conclusions, at least in Europe. This was partly because of the restrictions on human dissection and partly because the teachers in the medieval universities would not dirty their own hands and so were unable to make original observations. Vesalius, a keen young scholar in Padua, changed that. He obtained bodies from various sources and carried out his own dissections. His detailed diagrams were used as a teaching aid for those who followed him.

The Arabian connection

As in other sciences, the scholars of the Arab world adopted Greek knowledge of natural philosophy but were more prepared to experiment. The work of many Arabian scientists eventually filtered through to Europe, but strangely the work of Ibn al-Nafis (1213–1288 CE) did not. Born in Damascus, he worked in Egypt and discovered the circulation of the blood between the heart and lungs. He looked for but could not find the holes in the heart that Galen envisaged. Ibn al-Nafis' work was not rediscovered until the early twentieth century.

*In non-Christian contexts, the abbreviation BCE (for Before Common Era) is used instead of BC, and CE (for Common Era) is used instead of AD.

The King's physician

Two centuries after Ibn al-Nafis, two Europeans discovered the pulmonary circulation. They were Realdo Colombo (1510–1559) and Michael Servetus (1511–1553). Colombo influenced the work of William Harvey (1578–1657). Born in Kent and trained in Italy, Harvey gained fame and fortune as the physician to King James I and then King Charles I. The kings encouraged Harvey's studies by allowing him to work on royal deer. Nevertheless, Harvey delayed publishing his anatomical work on the circulation of the blood for some years. He knew that Galen was still held in high esteem by most physicians and his work demolished many of Galen's ideas. Harvey's book was usually abbreviated to *De motu cordis* (which translates as 'On the motion of the heart') and its appearance created quite a stir. Opposition was eventually overcome and Harvey was hailed as the discoverer of the circulation of the blood. Meanwhile, his life was going through a stormy patch as his patron fought desperately to hold onto his crown. When King Charles I was deposed Harvey was allowed to slip into retirement.

While Harvey had observed the motions of the heart and the flow of blood in arteries and veins, he had only deduced that there must be a circulation. He could not see the connections between the arteries and veins in the tissues. This is because the capillaries are too small to be seen with the naked eye. It was one of the first microscopists, Marcello Malpighi (1628–1694) who confirmed Harvey's suggestions.

Germs of life

While the study of anatomy developed rapidly in the seventeenth and eighteenth centuries, the four humours and divine intervention remained the best explanations for ill-health. For Christians and Jews God had created all living things and the mystery of creation was experienced daily. Maggots and grubs appeared in dead flesh within days of the death of an animal. Microscopists such as Robert Hooke (1635–1703) observed tiny creatures in decaying matter, and it was thought that these organisms appeared spontaneously. People such as John Needham (1713–1781) performed experiments that purported to prove that matter was permeated with a 'vegetative force' that generated life.

Some scientists, however, had other ideas. Francesco Redi (1626–1697) and Lazzaro Spallanzani (1729–1799) showed that life did not appear when organic matter was isolated from its surroundings. It was not until the nineteenth century that the evidence was gathered that finally overturned the spontaneous generation theory and it came from a variety of sources.

Louis Pasteur's (1822–1895) work at the brewery in Lille showed that microbes existed in the air, water and on every solid surface around us. He showed, too, that introducing these microbes into organic matter initiated decay. Pasteur's 'germ theory' was not accepted without a fight. Felix Pouchet, a respected member of the French Academy of Sciences, led the last supporters of spontaneous generation.

It was actually the British physicist and chemist John Tyndall (1820 – 1893) who provided evidence to support Pasteur. He found that in central London it took him longer to sterilise broth samples than in the comparatively clean environment of Kew Gardens. He realised that this must mean that dust caused decay. He built a dust-free environment to show that decay could be delayed by excluding microbes.

Fighting disease

Filth and foul smells that diffused from polluted rivers and industrial sites had long been associated with diseases. In 1854 John Snow (1813–1858) observed an outbreak of cholera in London. He suspected that the cause was the local supply of drinking water, but Pasteur's germ theory of disease was still in the future and he had little to base his suspicions on. Snow isolated the water pump in Broad Street as the centre of one area of infection. His action in shutting off the pump may or may not have ended the epidemic in that area, but his paper on the causes of cholera alerted his peers to the need for clean water for drinking and washing.

Carlos Finlay (1833–1915), a Scottish-French Cuban, did have the benefit of Pasteur's theory of microbes, but he still met opposition to his suggestion that mosquitoes carried the pathogen responsible for yellow fever. It took him nearly 20 years to have his explanation accepted.

Prevention and cure

While the causes of diseases remained unclear, some doctors had sought ways of protecting their patients from infection. Smallpox was a frequent scourge across the world and had destroyed whole populations in the Americas when carried there by Spanish conquerors. Turkish doctors had found a partially successful way of protecting people by inoculating them with pus from smallpox blisters. The technique was brought to England by Lady Mary Wortley Montagu. Unfortunately, some of those inoculated went on to catch the disease and fear deterred many from having the treatment.

Edward Jenner (1749–1823) discovered that vaccination with cowpox provided much more reliable and risk-free protection against smallpox. However, his use of a young healthy boy for his experiments would certainly be a questionable example of medical ethics today. Pasteur took the science of inoculation further with his work on anthrax and rabies. Finlay used a similar technique of using weakened microbes in his yellow fever vaccine.

Another doctor who experimented with cures on his patients was William Withering (1741–1799). He had no more idea about the cause of 'dropsy' than Jenner had of smallpox, but he found that extract of foxglove, digitalis, eased the symptoms. Tests on over 150 patients determined the size and form of the dose necessary to provide relief from heart disease.

By the 1920s Alexander Fleming (1881–1955) knew what he was looking for – something that would kill bacteria. His experiences with wounded soldiers in the First World War had revealed that infection was the most common cause of death. He had some success with the discovery of lysozyme, a mild antibiotic found in saliva and tears. It may have been luck that provided him with his first observation of the antibacterial action of the *Penicillium* mould but it was good science that pursued the clue. Difficulties in obtaining the active chemical, penicillin, led Fleming to put aside the research. This did not deter Howard Florey (1898–1968) and Ernst Chain (1906–1979) ten years later. Their development of penicillin arrived just in time for the allied invasion of Nazi-occupied Europe. Dorothy Hodgkin's (1910–1994) deduction of the structure of penicillin opened the way for drug companies to synthesise and modify antibiotics.

Eating for life

Hippocrates' suggestion that food had a link with health and disease had little influence on medicine for centuries. Food was a necessity but few people had the opportunity to modify their diets. Long sea voyages undertaken by explorers and adventurers such as Anson took their toll of ships' crews. Some officers began to suspect that the sailors' diet might be responsible for diseases such as scurvy. Others simply thought that the sufferers were lazy. James Lind (1716–1794), surgeon aboard *HMS Salisbury*, carried out tests and found that citrus fruits were effective at both curing and preventing the disease. It was some decades before his suggestions were adopted and British sailors earned their nickname 'limeys'.

During the nineteenth century the role of carbohydrate, protein and fats in diets was determined but the cause of diseases such as scurvy was still a mystery. The germ theory of disease became popular in the late nineteenth century and Christiaan Eijkman (1858–1930) first thought the cause of the disease beriberi was a microbe that contaminated the rice that was the staple diet of sufferers. When he failed to find the expected microbes he decided that the processed rice must lack some nutritional element. (He was right – the rice lacked one of the B vitamins.) Frederick Gowland Hopkins (1861–1947), one of the founders of the science of biochemistry, confirmed that a healthy diet must contain minute amounts of molecules called vitamins. Harriette Chick (1875–1977), one of the first women scientists to be appointed to a salaried position, spent her career at the Lister Institute investigating diets for preventing deficiency diseases such as scurvy, rickets and pellagra.

Surgery

Detailed knowledge about human anatomy developed in the eighteenth and nineteenth centuries but surgeons were unable to do much more than amputate limbs. The use of anaesthetics, by John Snow amongst others, and the adoption of aseptic conditions, did enable surgeons to be more daring. But the heart remained sacrosanct until the twentieth century. Open-heart surgery developed after the Second World War with the development of heart bypass machines. It was Christiaan Barnard (1922–2001) who took the bold step of transplanting a heart in 1967. His first patient died soon after, not from heart problems but from pneumonia. The problem was that drugs taken to stop rejection of the organ suppressed the immune system and made patients liable to infection. Barnard persevered and overcame the problems.

Epidemiology

John Snow's study of cholera was one of the first and most influential statistical studies of disease. In the last half of the twentieth century the science of epidemiology became very important in tracing the links between diseases and environmental factors. Richard Doll's extensive work on the effects of smoking in the 1950s was perhaps the most startling of these.

Issues

By necessity, we have merely dipped into the history of medicine and human health. There are many more people who should have been mentioned and many other strands linking the past to the present. The medical traditions of the Far East have not been discussed nor the recent growth of alternative therapies. Nevertheless, the background to some of the important medical issues of today have been touched on, namely:

- the future of organ transplantation
- the testing of drugs and treatments
- the problem of antibiotic resistance
- the importance of diet and lifestyle in prevention of disease.

E The characters

Hippocrates of Cos (460–377 BCE)
Greek philosopher. Hippocrates was the son of a healer–priest on the island of Cos. He studied with philosophers on the Greek mainland and then returned to Cos where he was joined by many students. A large number of medical works were written in his name by his followers, so it can be difficult to sort out truth from myth. Hippocrates suggested that illnesses were caused by imbalances in the human body and not by the wrath of the gods. His works give rational and sensible suggestions for medical treatment, including the Hippocratic oath and suggestions for the use of various drugs as painkillers.

Galen (130–201 CE)
Greek doctor. Galen was born in Pergamon in Turkey. He travelled widely learning about medicine and was surgeon to the gladiators in his home town. After his father's death he decided to settle in Rome, where he gathered followers for his medical and surgical ideas. The taboo on human dissection meant that most of his ideas on anatomy were gained from work on animals. He suggested that there were two types of blood – one that came from the liver and carried food and the other which came from the lungs and carried air. He also suggested that there were holes in the middle of the heart so that blood could flow from one side to the other. His ideas were hugely influential for many years.

Ibn al-Nafis (1213–1288)
Syrian doctor. Born in Damascus, he spent his working life in Cairo. He wrote an encyclopaedia of medicine and disputed Galen's anatomical work. He discovered the circulation of the blood between the heart and lungs and the blood supply to the heart itself.

Andreas Vesalius (1514–1564)
Belgian doctor. Vesalius trained as a doctor in Paris and in Padua. It was in Padua that he made his advances in anatomy, by carrying out his own dissections on human bodies – which was unusual for the time. Vesalius disagreed with Galen's ideas because they did not match the observations that he made during his dissections.

William Harvey (1578–1657)
British doctor. The son of a Kent farmer, Harvey received a gentleman's education but decided to follow a career in medicine. He went to Padua to complete his training and then returned to London to set up in practice. He became physician to King James I and to Charles I who both encouraged his work. He carried out many experiments, dissections and vivisections. He came to the conclusion that the blood travelled through the heart twice in each complete circuit of the body: once as it was pumped to the lungs and once as it was pumped to the rest of the body. He waited until 1628 before publishing his findings because he knew that they disagreed with Galen's well-established ideas. His royal connections ensured that his work was noticed.

John Turberville Needham (1713–1781)
British priest. Born into a Catholic family in London, Needham became a priest in Belgium. He devoted his life to the study of miracles and nature. He supported the traditional view that new life could develop from inanimate matter and performed experiments to confirm his ideas.

James Lind (1716–1794)
British naval doctor. Born in Edinburgh, Lind was apprenticed as a surgeon in 1731 and began his naval career in the

Mediterranean. In 1747 he was posted as surgeon to *HMS Salisbury*. Although his ship was on duty largely in the English Channel, sailors still suffered from scurvy and Lind experimented with diets that might relieve the symptoms. He discovered that scurvy could be prevented and cured by the addition of citrus fruits to the sailors' diet. In 1748 he returned to land to teach medicine, first at Edinburgh and then at the naval hospital in Portsmouth. He wrote about his work on scurvy in 1754 but little notice was taken of his suggestions for some years.

Lazzaro Spallanzani (1729–1799)
Italian biologist. Spallanzani studied in Bologna, became a priest and in 1768 was appointed to the professorship at Pavia University. In the same year he was made a fellow of the Royal Society. Spallanzani questioned Needham's experiments that seemed to prove the spontaneous generation of life. He performed his own experiments, which suggested organisms could not spontaneously develop and may be air-borne.

William Withering (1741–1799)
British doctor. Withering studied medicine in Edinburgh and then settled in Staffordshire where he married one of his patients. Through his interest in botany, which he gained from his wife, he discovered that foxglove extract could be used to relieve the symptoms of dropsy (heart disease). He was a meticulous worker who, over many years, worked out the optimum doses of foxglove extract.

Edward Jenner (1749–1823)
British doctor. Jenner was a vicar's son in Berkeley, Gloucestershire and studied medicine. Despite the opportunity for a distinguished career in London he settled back at Berkeley where he made observations on the life cycle of the cuckoo. He noticed that milkmaids who had contracted cowpox did not contract smallpox. He developed an inoculation for smallpox and introduced the word 'vaccination'. Jenner tested his first vaccine on a local boy by infecting him with cowpox and then with smallpox. The ethics of this experiment would be questioned these days! His work brought him international fame and a pension from a grateful British government.

John Snow (1813–1858)
British doctor. The son of a Yorkshire farmer, Snow was apprenticed to a surgeon in Newcastle where he experienced a cholera epidemic. He trained further in London and became a noted surgeon. His studies of cholera outbreaks led him to the theory that they were caused by a contamination in drinking water. He tested his ideas during the 1854 epidemic in London by removing the handle of the water pump in Broad Street because he was convinced that the water was contaminated. The cholera did stop in that area of London but many people were not convinced.

Louis Pasteur (1822–1895)
French scientist. Pasteur studied chemistry in Paris. In 1856 he started work on fermentation and became interested in the origin of microbes. His 1862 paper on microbes in the air provided convincing evidence against the theory of spontaneous generation of life. Following his successful work on diseases in silkworms he suffered a stroke which left him partially paralysed. However, he continued to work and subsequently developed vaccinations for anthrax and rabies, which brought him fame. For the

last seven years of his life he was Director of the Pasteur Institute which was set up in his honour.

John Tyndall (1820–1893)
British physicist. Born in Ireland, Tyndall first worked as a surveyor for the Ordnance Survey and then moved to Manchester and worked as a railway engineer. He studied in Germany before returning to work at the Royal Institution in London. His research was largely in physics but he provided evidence to back up Pasteur's theory on microbes. He also discovered that decay could be delayed by preventing the entry of microbes. He was happily married but his wife killed him accidentally by giving him a fatal dose of a sleeping drug!

Carlos Juan Finlay (1833–1915)
Cuban doctor. Born in Cuba to Scottish and French parents, Finlay trained as a doctor in France and the USA. He suffered from cholera which left him with some disabilities and he also caught typhoid. He returned to Havana to practise medicine and began a study of yellow fever, which he showed was carried by mosquitoes. He developed a vaccine and spent many years trying to convince the American authorities of the reliability of his results.

Frederick Gowland Hopkins (1861–1947)
British biochemist. After school Hopkins alternated between study and work as an analytical chemist. In 1889 he came into an inheritance which gave him the freedom to study medicine and to devote his life to research. In 1898 he was invited to Cambridge University where he set up the first department of biochemistry. He showed that diets required small amounts of substances that became known as vitamins and he was awarded the 1929 Nobel Prize for Medicine.

Harriette Chick (1875–1977)
British biochemist. Born and educated in London, Chick first worked in Munich and Vienna before applying for a post at the relatively new Lister Institute. It was unusual to appoint a woman to a salaried position, but the Director overcame the opposition of some of the employees. Chick spent the rest of her career at the Institute largely working on diseases related to diet. In particular she worked on cures for rickets, scurvy and pellagra.

Alexander Fleming (1881–1955)
British chemist. Son of a Scottish farmer and one of nine children, Fleming followed his older brothers to London. In 1902, an inheritance allowed him to train as a doctor at St Mary's Hospital, London. He spent the whole of his career there, apart from a time during the First World War when he worked in a field hospital in France. His experiences with wounded soldiers inspired his research on antibacterial agents and he discovered lysozyme, an enzyme in tears which has a mild antibiotic activity. The discovery of penicillin was accidental, but he followed up the observation with great care even though he did not foresee the importance of his discovery. He was awarded the Nobel Prize for Medicine in 1945, jointly with Florey and Chain who developed penicillin as an antibiotic.

Dorothy Crowfoot Hodgkin (1910–1994)
British chemist. Hodgkin gained a scholarship to Somerville College, Oxford and, following her degree in chemistry, went to Cambridge to learn about X–ray crystallography. She

returned to Oxford to set up her own X–ray department. Her first important success was determining the structure of penicillin but she was awarded the Nobel Prize for Chemistry in 1964 for her work on vitamin B_{12}.

Richard Doll (b.1912)
British epidemiologist. Doll at first wanted to study mathematics against his father's wishes, but when he failed a Cambridge scholarship exam he decided to become a doctor, as his father wanted. In fact he combined the two fields by entering the field of epidemiology – the application of statistics to medicine. His early work involved establishing a link between smoking and lung cancer. Later, he investigated the risks to health of radiation, the contraceptive pill and diet. Long after the age at which most people have retired Doll continues to pursue research at the Cancer Research Institute in Oxford.

Christiaan Barnard (1922–2001)
Barnard studied medicine in Cape Town and settled with his first wife into general practice. He wanted to become a surgeon, however, and won a scholarship in the USA. He returned to Cape Town eager to pursue research into heart surgery and performed the first transplant in 1967. Despite setbacks he went on to perfect the technique.

Other characters with no associated text:
James Phipps
The eight-year-old boy on whom Jenner tested his first vaccine.

An eighteenth-century sailor with scurvy.

Contemporary fictional characters

Mohammed Ishmael (age 45)
A heart surgeon working at a major British heart transplant hospital.

Jack Taverner (age 52)
A patient suffering from heart disease caused by smoking.

Moira MacDonald (age 32)
A geneticist working for a biotechnology company.

Sonia Kelly (age 28)
An Australian nurse working in an English NHS hospital.

Seth Oakdale (age 40)
An American biochemist working for a multinational pharmaceutical company.

James Pitt-Barclay (age 56)
A doctor working for the British government as a medical officer of health.

Myfanwy Thomas (age 38)
A GP who is concerned with MMR vaccination.

Nomsange Batakati (age 22)
A care worker in a southern African country. Born in a small village, she now works for an AIDS clinic in a city and hopes to train as a nurse.

Busi Fugewane (age 45)
A junior health minister in a country in southern Africa.

A TV presenter and three teenage characters are also provided, but have no associated text.

F Matching charts

Matching chart for English National Curriculum and *Health and Disease*

Key Stage 3 Sc1 Scientific enquiry

		Statement	Activity
1	**a**	About the interplay between empirical questions, evidence and scientific explanations using historical and contemporary examples (for example, Lavoisier's work on burning, the possible causes of global warming).	1.1, 1.2, 3.1, 3.2, 7.1, 7.2
	b	That it is important to test explanations by using them to make predictions and by seeing if evidence matches the predictions.	1.1, 1.2, 3.1, 3.2, 5.1, 6.1, 6.2
	c	About the ways in which scientists work today and how they worked in the past, including the roles of experimentation, evidence and creative thought in the development of scientific ideas.	1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.2, 6.1, 6.2, 7.1, 7.2

Key Stage 4 Sc1 Scientific enquiry

		Statement	Activity
1	**a**	How scientific ideas are presented, evaluated and disseminated (for example, by publication, review by other scientists).	4.1, 7.1
	b	How scientific controversies can arise from different ways of interpreting empirical evidence (for example, Darwin's theory of evolution).	1.1, 1.2, 3.1, 3.2
	c	Ways in which scientific work may be affected by the contexts in which it takes place (for example, social, historical, moral and spiritual), and how these contexts may affect whether or not ideas are accepted.	3.2, 5.1
	d	To consider the power and limitations of science in addressing industrial, social and environmental questions, including the kinds of questions science can and cannot answer, uncertainties in scientific knowledge, and the ethical issues involved.	2.1, 2.2, 4.1, 4.2, 5.2, 6.1, 6.2, 7.1, 7.2

Matching chart for Welsh National Curriculum and *Health and Disease*

Key Stage 3 Sc1 Scientific enquiry

		Statement	Activity
1		**The Nature of Science**	
	2	To consider different sources of information, including that obtained from their own work and information from secondary sources.	1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 7.1, 7.2
	3	How creative thought as well as information may be required in arriving at scientific explanations.	1.1, 1.2, 3.1, 3.2, 5.1
	4	About the work of scientists and the role of experimental data, creative thought and values in their work and in developing scientific ideas.	1.1, 1.2, 2.1, 3.1, 3.2, 4.1, 6.1, 6.2, 7.1
2		**Communication in Science**	
	4	To search systematically for, process and analyse information for a specific purpose, using ICT to do so on some occasions.	1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 7.1, 7.2

Matching chart for Welsh National Curriculum and *Health and Disease*

Key Stage 4 Sc1 Scientific enquiry

		Statement	Activity
1		**The Nature of Science**	
	2	To use and consider a variety sources of information, both that obtained from their own work and secondary sources, including ICT.	1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 7.1, 7.2
	4	To recognise that scientific controversies arise from different interpretations and emphases placed on information.	1.2, 3.1, 5.2
	5	To consider the ways in which scientific ideas are affected by social, political and historical contexts in which they develop, and how these contexts may affect whether or not the ideas are accepted.	2.1, 2.2, 4.1, 4.2, 5.1, 7.1

Matching chart for Scottish Certificate of Education, Standard Grade in Biology General and Credit levels, and *Health and Disease*

Topic number	Topic title	Statement number	General Statement	Credit Statement	Activity
5	*The body in action*				
		10	Identify the four chambers of the heart		1.1, 1.2
			Describe the path of blood flow through the heart and its associated blood vessels.		1.1, 1.2
			State that the heart obtains its blood supply from coronary arteries.		2.1
		11	State that blood leaves the heart in arteries, flows through capillaries and returns to the heart in veins.		1.1, 1.2
7	*Biotechnology*	*22*	State that an antibiotic is a chemical which prevents the growth of micro-organisms.	Explain why a range of antibiotics is needed in the treatment of bacterial diseases.	4.1, 4.2

Health and Disease **also covers the following statements:**

ENGLAND
Sc2 Life process and living things

Statement covered	**Key Stage 3**	**Key Stage 4**
	2a, 2i, 2l, 2n	2b, 2c, 2k, 2p, 2q

WALES
Sc2 Life process and living things

Statement covered	**Key Stage 3**	**Key Stage 4**
	2.6, 2.19, 5.7	2.14, 2.15

SCOTLAND
5-14 Environmental Studies: Science

	Statement covered	**Activity**
Variety and characteristic features		
Level F	Describe the harmful and beneficial roles of micro-organisms	3.1, 3.3, 4.1, 4.2

NORTHERN IRELAND
Living organisms and life processes

	Key Stage 3	**Key Stage 4**
Nutrition	e, f	
Transport	m, n	j, k
Reproduction		m

1 The heart of the matter

Learning objectives

Students have the opportunity to learn:

- about the work of William Harvey and how it has influenced our understanding of the heart
- our modern view of the heart and circulation
- about the work of other anatomists and how they disagreed with each other
- that scientists gather evidence for their ideas and experiment to prove or disprove theories
- that scientists sometimes need to predict things that they cannot observe for themselves (e.g. Harvey and capillaries).

Learning outcomes

Students:

- answer questions by extracting information from text provided (Activity 1.1, Activity 1.2)
- continue and elaborate storyboards about the heart and circulation (Activity 1.2)
- extract information from other sources (Activity 1.2).

Activity levels

Activity	KS3	KS4
1.1	All	All
1.2	Most	All

NC Statements

	Sc1	Sc2
KS3	1a, 1b, 1c	2l
KS4	1c	2b, 2c

Background information

Reference to the heart as the centre of emotions began with the Ancient Greeks. However, religious and legal restrictions limited the amount that early anatomists, such as Galen, could determine about the action of the heart. It was not until the sixteenth century that attitudes to dissection (and vivisection) allowed for work directly on human and animal hearts. Harvey stands on the bridge between old ideas and new methods. He used dissection on corpses, vivisection on dogs, and experiments on himself to identify the role of the heart as a pump in the double circulation of the blood.

Prior knowledge

It will be helpful if students know a little about the structure and function of the circulation. For Activity 1.2 they will need textbooks to look up modern ideas about circulation.

Activity 1.1 Heart searching

This activity looks at the work of William Harvey and how these ideas are still accepted today. Pupils answer questions which are based around a television programme format. They are asked to extract information from the text, which looks at Harvey's ideas and also at the experiments that Harvey did to prove his theories.

Activity 1.2 Alternative theories

This activity traces the history of ideas about the heart, starting with Hippocrates. It ends by asking pupils to use textbooks to extract information about our ideas today and to contrast them with earlier theories. It also looks at the importance of individual experimentation and exploration in science.

Characters: Harvey, Ishmael, Hippocrates, Galen, Ibn al-Nafis, Vesalius, TV presenter.

Backgrounds: Harvey's study, Greek house, Galen's house, Ibn al-Nafis' house, Vesalius' classroom, modern operating theatre, TV studio.

Props: posters of Galen's ideas about the heart, Harvey's ideas about circulation, modern ideas on circulation of the blood, dissection tools, Barbary ape, deer.

Lesson ideas

- Teachers could start the lesson with a brainstorm. Suitable questions to ask students include: What do you know about the heart? How do you know this? What would you know if you could not see inside the body?
- Teachers could also show students a picture of a wax preparation of an organ. In this, wax or plastic is pumped into the blood vessels of the organ and the tissue is dissolved away. It will give pupils some idea of the complexity of the blood vessels. It could be pointed out that the capillaries are missing and that these complete the circuit of the blood.
- The circulation diagrams that we use are simplified versions of the reality. To explain this you could compare a map of the London Underground to a real map of the system layout – local examples could be found.
- A plenary activity could be the following 'odd one out' exercise:
  Harvey, Galen, modern doctors; arteries, valves, veins; capillaries, heart, arteries.
  Students must pick an odd one out and give a reason for their choice. There are no right answers for this exercise, it is the justification that is the important skill.

Answers to homework questions

1 a) Timeline

b) Her father was doctor to Elizabeth I.

c) The King gave him money so that he could continue his studies.

d) Galen's ideas were accepted by most people and Harvey knew that his ideas would not be popular.

2 a) His observations were very limited – he did no experiments.

b) Your heart beats faster when you are frightened or angry and therefore seems to be linked to emotions.

c) Harvey thought that the blood circulated through the whole body – Galen thought that there were two types of blood. Harvey thought that the blood passed through the heart twice – Galen thought that blood flowed across the heart.

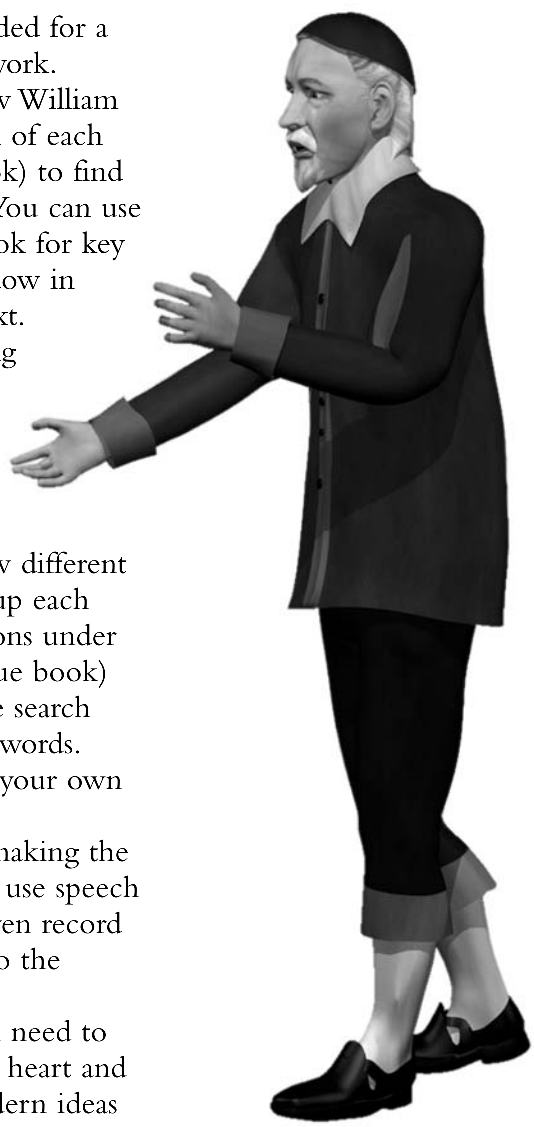
d) He needed to be able to see the heart beating so that he could understand how it works.

e) This depends on the student's opinion.

3 Burke and Hare operated in Edinburgh in 1827. The price for bodies was high but the supply was limited. Rather than rob graves (which had been the favoured supply route up to this point), Burke and Hare murdered people and sold their bodies to Dr Knox.

1 The heart of the matter

William Harvey investigated the heart and circulation and most of his ideas are still used today. However, the heart had interested scientists for many thousands of years before that.



1.1 Heart searching

You are going to put together the information needed for a television programme on William Harvey and his work.

A Open storyboard 'Activity 1.1'. The frames show William Harvey. There are some questions at the bottom of each frame. Use the text/audio symbol (the blue book) to find the answers to the questions in frames 2 to 11. You can use the search box at the top right of the text to look for key words. Type your answers into the bottom window in your own words, or copy and paste from the text.

B Make the frames look more interesting by adding props. For example, you could add some of the posters explaining Harvey's ideas. You can add sound effects as well.

1.2 What does the heart do?

A Open storyboard 'Activity 1.2'. The frames show different scientists who had ideas about the heart. Look up each scientist in the text, and then answer the questions under each frame. Click on the text/audio symbol (blue book) to look at and listen to the text. You can use the search box at the top right of the text to look for key words. Type your answers into the bottom window in your own words, or copy and paste from the text.

B Make the TV programme more interesting by making the various people explain their own ideas. You can use speech bubbles, use audio from the text provided, or even record your own sound track. You can also add props to the frames.

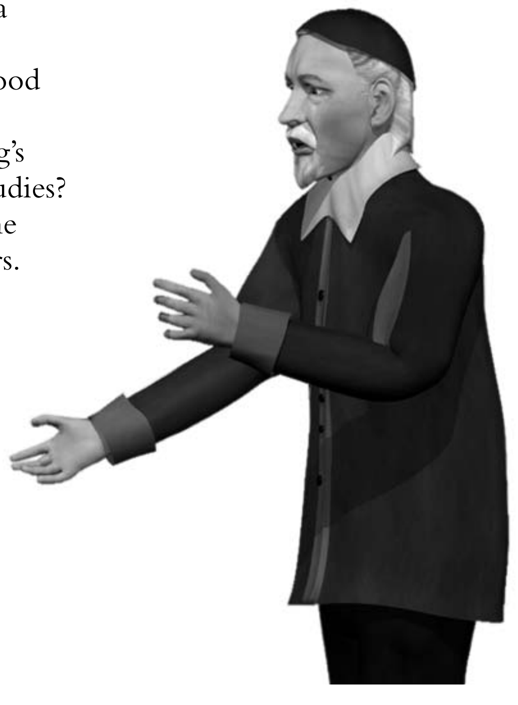
C Continue the storyboard from frame 8. You will need to use a textbook to look up modern ideas on the heart and circulation. Add new frames to explain our modern ideas and how similar they are to William Harvey's.

1 The heart of the matter

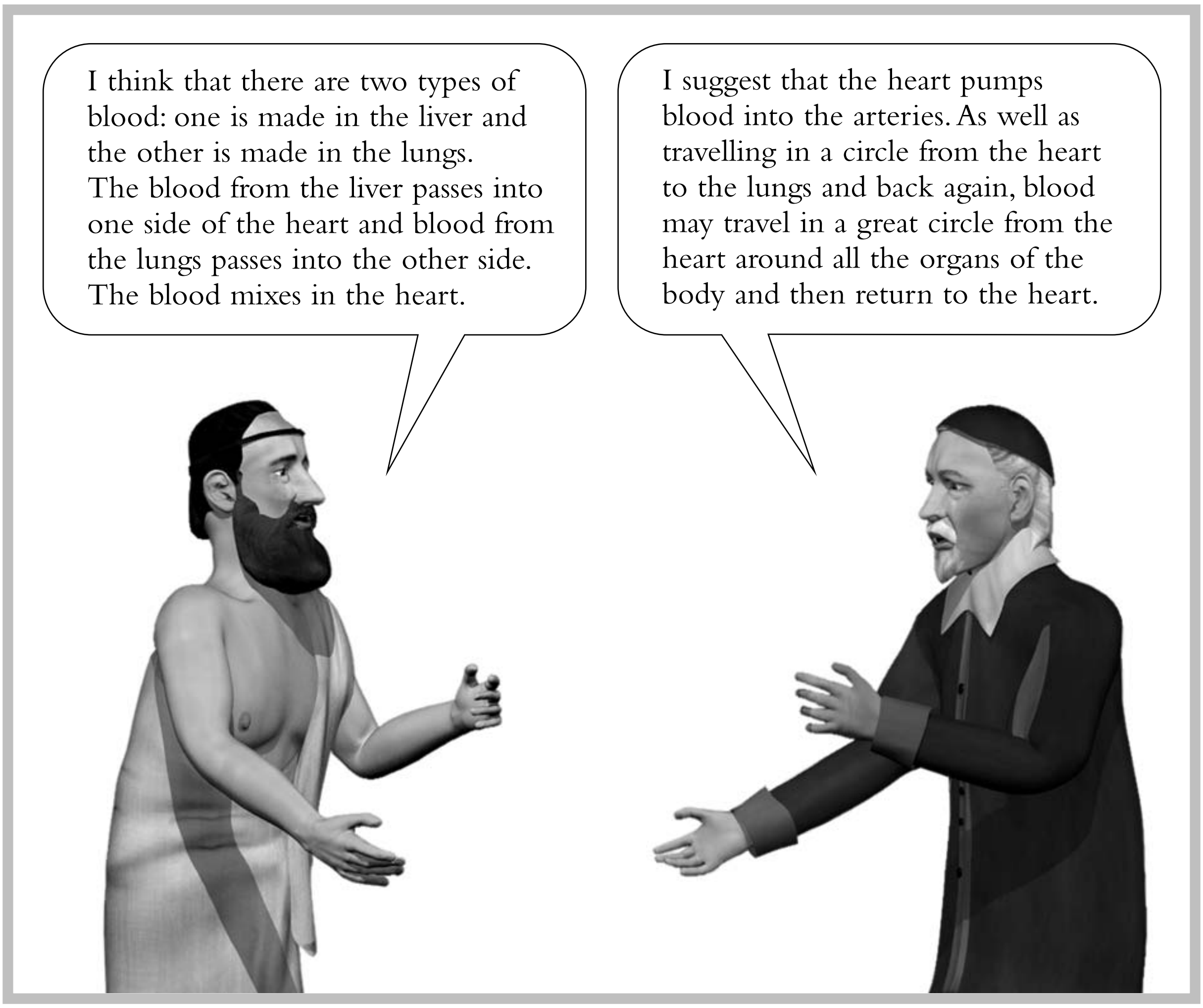
1 William Harvey lived from 1578 to 1657. He studied the heart and circulation and experimented to test his ideas. His theories were not popular at the time because doctors had relied upon the ideas of Galen (a Roman doctor) for over 1600 years.

William Harvey	**Other dates**
1578 – Born in Kent.	
	1588 – Spanish Armada defeated.
1599 – To Padua, Italy to study medicine.	
1602 – Begins practising medicine in London.	
	1603 – Queen Elizabeth I dies, King James I crowned.
1604 – Marries Elizabeth Browne, daughter of the doctor to Queen Elizabeth I.	
	1606 - Shakespeare writes Macbeth.
1607 – Elected to Royal College of Physicians.	
1609 – Starts working at St Bartholomew's Hospital, London.	
1618 – Appointed as doctor to King James I.	
	1625 – King James dies, King Charles I crowned.
1628 – Publishes *De Motu Cordis.*	
	1642 – Civil war begins.
1646 – Retires.	1646 – Oxford falls, King Charles taken prisoner.
	1649 – King Charles executed.
1657 - Dies.	

a) Use the information in the table to draw a timeline of William Harvey's life.
b) Why was marrying Elizabeth Browne a good move for Harvey?
c) In what ways do you think being the King's doctor helped Harvey in his career and studies?
d) Harvey delayed writing up his work on the circulation of the blood for about ten years. Why do you think this was?



1 The heart of the matter (cont.)



2 a) Galen, a citizen of Rome, was not allowed to dissect human bodies. How do you think this affected his study of human anatomy?
   b) Some Greek and Roman doctors thought that the heart was where emotions and feelings were formed. Why did they have this idea? (Think about what happens if you are frightened or embarrassed.)
   c) How do Harvey's ideas differ from Galen's?
   d) Harvey observed the movements of the heart in living animals such as dogs and apes. This is called vivisection. Why was it important for Harvey to see a living heart working?
   e) Some people 'leave their bodies to medicine' when they die. Dissection of these bodies is still used to train medical students – do you think that this is a good idea?

3 In the nineteenth century, anatomy was a very popular area of study but there was a shortage of bodies to dissect (only criminals who had been hung could be used for dissection). Find out who Burke and Hare were and how they made money out of this problem!

You can find some website addresses at **www.peopleinscience.co.uk**.

2 Broken hearts

Learning objectives
Students have the opportunity to learn:
- about the science behind the first heart transplants and the difficulites that had to be overcome
- about heart disease and its causes
- about the different ways of treating heart disease
- that there are ethical issues involved in tissue cloning and using animals to provide organs for transplant.

Learning outcomes
Students:
- answer questions by extracting information from text provided (Activity 2.1, Activity 2.2)
- write a leaflet for a doctor's surgery on how to avoid heart disease (Activity 2.1)
- give their opinion on the best way to treat heart disease (Activity 2.2)
- try to understand issues from other points of view (Activity 2.2).

Activity levels

Activity	KS3	KS4
2.1	All	All
2.2	Some	Most

NC Statements

	Sc1	Sc2
KS3	1c	2l
KS4	1d	2b, 2c

Background information
Knowledge of human anatomy improved steadily once dissection became acceptable but it was not until the twentieth century that surgeons dared to interfere with the workings of the heart. In order to replace a diseased heart with a healthy one a number of medical advances were required. First, heart bypass machines were required to maintain the flow of blood to other organs. Secondly, the surgeons had to learn the necessary skills to link up the blood vessels and essential nerves. Thirdly, the problem of tissue rejection had to be answered if not actually solved. The problem is that the immune system attacks the new heart because it recognises that it is foreign tissue. The breakthrough came with the invention of immunosuppressant drugs which slow down the immune system.
Around the world there were a number of teams preparing for the first heart transplant but it was Christiaan Barnard in South Africa who took the step first and gained the publicity.
A shortage of donor hearts has resulted in a search for alternatives – mechanical hearts, animal hearts and tissue culture are all possibilities.

Prior knowledge
Students will gain most from this activity if they have a basic knowledge of how the heart works. It may also be a good idea to discuss the problems of tissue matching in terms of a tissue match needing to be made before a transplant can take place.

Activity 2.1 The first heart transplants
Pupils answer questions on the work of Christiaan Barnard and look at the factors which cause heart disease. They then design a leaflet on heart disease using information from the text and from other sources if necessary.

Activity 2.2 The problems with heart transplants

Pupils are introduced to a patient suffering from heart disease and a contemporary doctor. These characters discuss the problems of heart transplants, including the lack of suitable donors. The activity then goes on to look at the possibility of using tissue cloning and xenotransplants to solve the donor shortage. Pupils are encouraged to think about the ethical implications of all these decisions.

Characters:	Barnard, Taverner, Ishmael, MacDonald, TV presenter.
Backgrounds:	Modern operating theatre, hospital ward, biotech lab, TV studio.
Props:	Surgical tools, oxygen trolley and mask, grapes, bottles and test tubes, poster of artificial heart.

Lesson ideas

- We have provided two homework sheets. The first is easier and looks at heart disease and heart transplants. It requires students to know a little about the structure of the heart. The second homework sheet is more difficult and is suitable as a literacy activity.
- The idea of the heart as a pump needs to be established. This may be done by considering that a pulse can be found at various places in the circulation. It can be useful to get students to take pulses on left and right sides of their bodies. The results can give rise to discussion about experimental procedures, reliability, precision and accuracy.
- The whole idea of organ transplantation could form the basis of the introduction to the lesson or the plenary. Possible questions to pose are listed below. Students could be put into groups initially, each with one question to discuss. They could then report back to the class as a whole.

1 At the moment you have to give your permission for your organs to be used after your death. Should people have to 'opt out' of allowing their organs to be used for transplantation when they are dead?
2 Is 'living donation', when people can sell their organs, acceptable?
3 Should a parent who has two children, both with kidney failure, be allowed to donate both kidneys – one to each child? The parent would have to be put on a kidney machine for the rest of their life.
4 If a sister dies and the surviving sister needs a heart transplant, should the fact that they are sisters override all the transplant rules of a hospital, e.g. there were people higher up the priority list?
5 Do you think that the original heart transplant operations, where people died very soon after having them, would be a good thing for hospitals to do today, when there are league tables which rank hospitals according to their operation success rates?
6 Transplants are expensive operations. Could the money be better spent on, say, finding a vaccine against malaria?

- As a plenary to the discussion, students could be asked to draw up a series of guidelines for use by doctors in a hospital when they have to decide who gets an organ. Or write a job description for the post of transplant co-ordinator, which exists in hospitals.
- Another idea might be to show clips from 'The Simpsons, Season 4, Episode 11: Homer's Triple Bypass' as stimulus material.

Answers to homework questions

Homework sheet 2a

1 W to c, X to b, Y to a, Z to d.

2 Nerves need to be reconnected as well.

3 Donors are rare, there needs to be a healthy heart to implant, there needs to be a match to the tissue type.

4 Heart transplant patients must not catch any kind of infection because their immune systems are being suppressed by drugs and they cannot fight diseases.

5 The blood passes through the heart twice in any one circuit of the body.

6 The fetus gets its oxygen from its mother – not from its lungs. It therefore does not matter if blood from both sides of the heart is mixed.

7 The baby looks blue because oxygenated and deoxygenated bloods mix in the heart. The baby does not get sufficient oxygen and starts to look blue.

8 a) D is most at risk because he is overweight, smokes and is older.
b) B needs to take more exercise, stop smoking, eat less fat and lose weight.
c) There is a genetic link as well.

9 Coronary heart disease is caused when the arteries that supply the heart itself with blood become blocked. Most often this is caused by a build up of cholesterol, which can then cause clots or blockages. When the heart muscle is starved of blood it cannot beat properly and the heartbeat may become irregular.

Homework sheet 2b

a) Short report summarising the methods of heart transplants, in student's own words.

b) Will depend on student's opinions – opinions should be backed by reasons.

c) Heart transplants have a high success rate. 73% of patients live at least three years after the operation. It is estimated that the operation costs £137 000 with aftercare costs of £9800 per year.

2 Broken hearts

2.1 The first heart transplants

The first heart transplant was carried out by Dr Christiaan Barnard in 1967. Although many heart transplants are carried out these days it is still a difficult operation.

A Open storyboard 'Activity 2.1'. The frames show Dr Barnard. Answer the questions at the bottom of the frames. Click on the text/audio symbol (blue book) to look at and listen to the text. You can use the search box at the top right of the text to look for key words. Type your answers into the bottom window on frames 2 to 7 in your own words, or copy and paste from the text.

B Add props to the storyboards to make them more interesting.

C Look at frame 8. It asks you to put together a leaflet about heart disease. Use the information in the text to help you, or use other sources such as textbooks and the Internet.

Activity 2.2 The problems with heart transplants

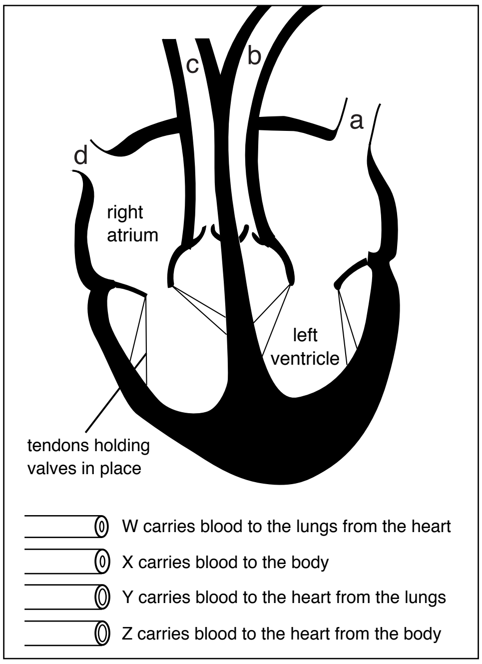
Heart transplant operations are difficult but one of the biggest problems is obtaining suitable donor hearts. There are other ways to treat heart disease without using transplants.

A Open storyboard 'Activity 2.2'. Answer the questions at the bottom of the storyboards up to frame 9.

B Look at frame 9 and answer the question. You may need to add more frames.

C Set up a TV debate between Moira MacDonald and someone who does not think that using animals for transplants is the right thing to do. You could use one of the teenagers to argue against her. Then get Jack Taverner to give his view.

2a Broken hearts



Hearts that are not working properly can now be replaced. The first heart transplant was carried out by Christiaan Barnard in 1967. To transplant a heart the doctor must be sure of the following things: the heart is healthy, has been removed from the donor only a few hours ago, has the same blood type and tissue type as the patient; the patient is strong enough to undergo the surgery and will take drugs for the rest of his or her life to slow down the immune system and make sure that the body does not reject the heart.

Christiaan Barnard needs your help in performing the first heart transplant!

1 Look at the diagram of a heart. There are four main blood vessels. Which blood vessels should be joined to each part of the heart?
2 What other connections need to be made to ensure that the transplanted heart works well?
3 It took a month before Barnard found a suitable donor heart for his patient, Louis Washkansky. Why is finding donor hearts so difficult?
4 Louis Washkansky died 18 days after receiving his new heart. The cause of death was an infection – pneumonia. Why are heart transplant patients worried about catching infections?
5 Look at the picture of the heart. We have a double circulation – what does that mean?
6 When a baby is in the womb it has a hole between the two sides of its heart. Think about where the oxygen for the fetus comes from and explain why the hole is not a problem.
7 Normally the hole closes when the baby is born but sometimes this does not happen. The first indication of this is that the baby starts to look blue and does not grow as quickly as it should. Why do you think the baby looks blue?
8 Heart transplants are sometimes needed for people who have suffered a heart attack. Look at the following table:

	A	**B**	**C**	**D**
Age	25	35	45	55
Weight	low	overweight	medium	obese
Smoking	none	15 a day	none	15 plus a day
Diet	low fat	high fat	medium	high fat
Exercise	1 hour a week	none	1 hour a week	none

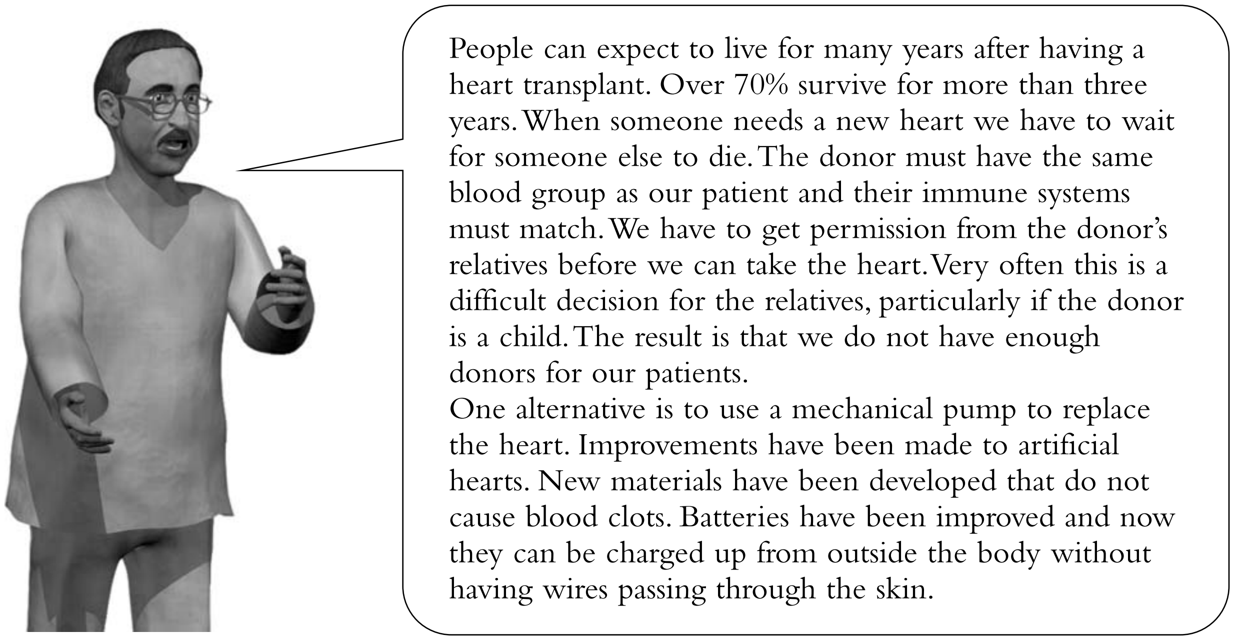
a) Who is most likely to have a heart attack? Explain your answer.
b) Explain to B how they can cut the risk of having a heart attack.
c) What factors, other than those in the table, can increase the risk of a heart attack?

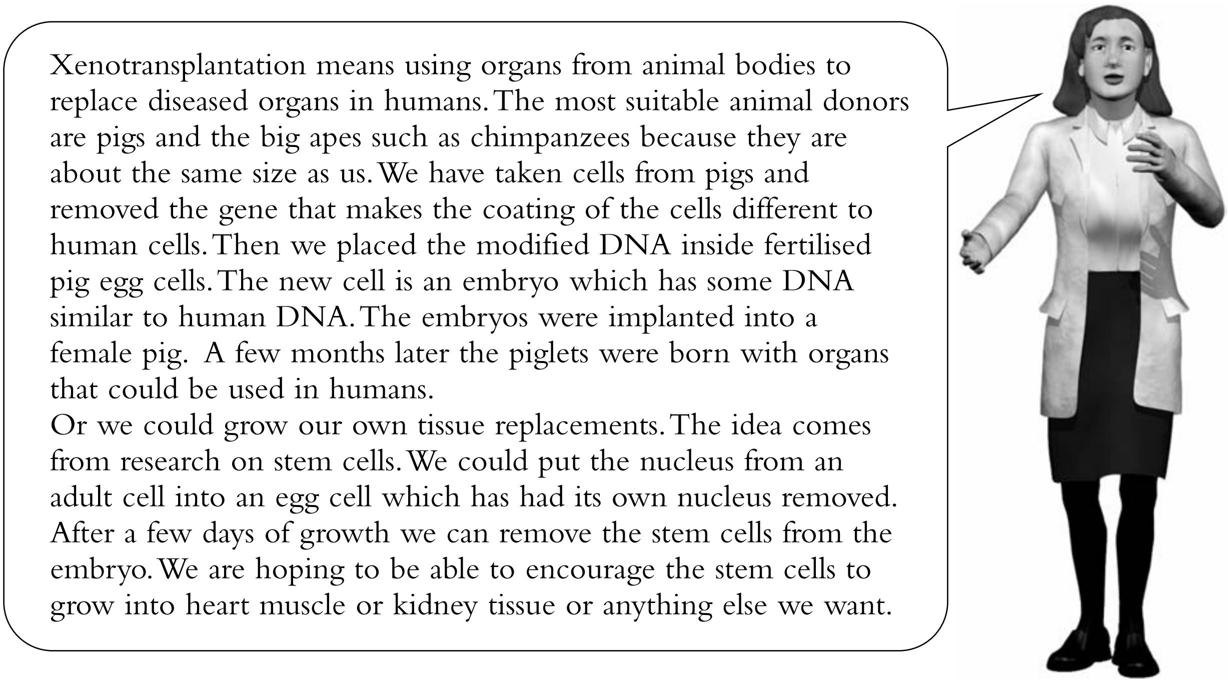
9 Find out more about coronary heart disease. What causes it and what happens when you have a heart attack?

You can find some website addresses at **www.peopleinscience.co.uk**.

2b Broken hearts

There are not enough donor hearts to ensure that everyone who needs a heart transplant gets one. Here are suggestions for the future of heart transplantation.





1 Write a report on the four possible methods of replacing hearts mentioned by Mohammed Ishmael and Moira MacDonald. Discuss the advantages and disadvantages of each method.
2 Donor hearts and mechanical hearts are being used now but the methods described by Moira MacDonald are still in the future. What reasons can you give for or against continuing research into Moira MacDonald's methods?
3 Find out about heart transplants – how successful are they and how much do they cost?

You can find some website addresses at **www.peopleinscience.co.uk**.

3 That's life

Learning objectives

Students have the opportunity to learn:

- about the ideas which developed around the generation of life and which led to the germ theory of disease
- that experimentation and experimental design are an essential part of science
- how to apply their knowledge to another historical situation
- how to write with a specific audience in mind (younger children).

Learning outcomes

Students:

- answer questions by extracting information from text provided (Activity 3.1, Activity 3.2)
- think about experimental design in terms of Pasteur's experiments (Activity 3.1)
- apply their knowledge of the germ theory of disease to Edward Jenner's work on vaccination (Activity 3.2)
- create a worksheet for younger pupils on disease and vaccination (Activity 3.2).

Activity levels

Activity	KS3	KS4
3.1	Most	All
3.2	Most	Most

NC Statements

	Sc1	Sc2
KS3	1a, 1b, 1c	2n
KS4	1b	-

Background information

John Needham supported the theory of spontaneous generation of life through a series of experiments. These seemed to prove to him that any organic material could give rise to life if left for a while. This could be seen in broth that started to teem with life, or pieces of meat that gave rise to maggots. Spallanzani, Pasteur and Tyndall disagreed with this theory and carried out their own experiments to provide evidence against it. (Details of these experiments are given on the CD-Rom.) Despite their evidence, some scientists were not immediately convinced.

Then Pasteur discovered tiny rod-shaped creatures in beer that had gone off and made the link between bacteria and decay. It was then a small step to link the bacteria to disease. John Snow was unaware of the cholera bacterium, although he was convinced that the disease resulted from drinking contaminated water. Carlos Findlay, however, followed the trail of the microbes and their hosts to isolate the cause of yellow fever.

Prior knowledge

Some background information on the debate about spontaneous generation of life would be useful to students. This should enable them to link this debate to the discovery of bacteria and the germ theory of disease. (The germ theory of disease states that some diseases are caused by bacteria too small to be seen with the naked eye.)

Activity 3.1 Spontaneous generation

The activity takes the form of a debate between various scientists about the origins of life. Students follow the various theories, ending with Pasteur's discovery of microbes and the impact of this discovery on food storage and our understanding of disease. Students are asked to comment on the design of Pasteur's experiment and then to put together a timeline of discoveries.

Activity 3.2

This activity looks at the different theories there have been about disease, starting with the ancient Greeks. It also looks at the discovery of bacteria, and the shift from the cure of diseases to their prevention. Pupils are then asked to design a worksheet for younger children – teachers may want to specify the age range.

Characters:	Needham, Spallanzani, Tyndall, Pasteur, Hippocrates, Snow, Finlay, Jenner, teenager, TV presenter.
Backgrounds:	TV studio, Spallanzani's lab, Needham's study, Tyndall's lab, Pasteur's lab, Hippocrates' house, Broad Street pump, Finlay's plantation, Jenner's house.
Props:	microscope, swan-necked flask, map of cholera outbreak, buckets of water, posters of bacteria.

Lesson ideas

- To start the lesson Pasteur's experiment can be easily replicated as a demonstration in the laboratory. Instructions may be found in many practical guides, e.g. Nuffield guides. The swan neck can be replicated by just using a bent piece of glass tubing. The idea that some of Pasteur's original flasks in the Pasteur Institute still have clear nutrient broth in them usually interests students.
- The idea of visual representation of data is also important here, as Snow's success was due to making maps of the outbreak area. Florence Nightingale is popularly credited with the idea of displaying data. She was not the first to use graphs and visual representations of data but she did use them to great effect. (You will find a weblink on the People in Science website which gives details.) Students could collect examples of data display – atlases are often good sources. Modern data collection could be exemplified by reference to the report on the recent foot-and-mouth outbreak or to the legionnaires' disease outbreak. It is worth bringing home to students that lack of clean drinking water is still the major killer of people in the world.
- Reading from *The Microbe Hunters* by Paul de Kruif is often a good way of getting students interested.
- A man called Pouchet was involved in the debate with Pasteur and students could be asked to research Pouchet's contribution.
- The yellow fever story is elaborated in *Mosquito* by Andrew Spielman and Michael D'Antonio. It also gives a reasonably up-to-date account of West Nile virus; students could involve themselves in research on this modern detective story.
- As a plenary activity students could be asked to think about the role of glass in Pasteur's experiments. A book called *The Glass Bathyscaphe* puts forward this idea – no glass, no Pasteur experiments, no work on anthrax and so on.

Answers to homework questions

1 a) Needham thought that the animals had spontaneously appeared in the jar.

b) We would say that the water or the walnut contained microbes which multiplied in the water.

c) You would have to boil the water and the walnut and make sure that the jar is sealed.

2 a) In a flask that has been heated, air can get in but the microbes settle out in the bottom of the neck of the flask. This means that the broth stays clear. When the flask is tilted the broth comes in contact with the microbes that have collected and it goes off.

b) If the spontaneous generation theory was true, then the broth would go off in the first flask as well.

3 a) The water.

b) The water company.

c) There were 14 times the number of cases in the area of London that was served by the Southwark and Vauxhall Company.

d) People catch cholera by using water that has been contaminated by other people who have the disease.

e) Microbes are the missing link. Pasteur's work connected bacteria and disease. It was the bacteria in the water which carried the disease.

4 Meningitis C or Group C meningococcal disease is caused by bacteria. It is carried in the throats of around one in ten adults – although they do not show signs of the disease.

It is transmitted by droplets in the air, so can be caught when an infected person coughs or sneezes. It is more common in winter.

Children under one, 15 to 17 year-olds and young people in their first year at college are at greatest risk of catching it.

Symptoms

The important signs to look out for in older children are:

- red or purple spots that do not fade under pressure
- stiffness in the neck
- drowsiness or confusion
- a severe headache.

These signs can appear in any order.

3 That's life

At one time people thought that life would form in any material. They did experiments like hanging a piece of meat outside and watching the results. When maggots appeared people thought that the maggots had come from inside the meat. It was thought that all life was capable of just appearing like this. Many people did experiments to test this theory.

3.1 Spontaneous generation

A Open storyboard 'Activity 3.1'. The frames show scientists such as John Needham and Louis Pasteur. The characters are each going to tell you their ideas and the evidence that they have for their ideas. Use the text/audio symbol (the blue book) to find the answers to the questions in frames 2 to 8. You can use the search box at the top right of the text to look for key words. Type your answers into the bottom window in your own words, or copy and paste from the text.

B Look at frame 9. It asks you to think about the design of an experiment. You may need to add extra frames to answer the question. Use props to help you illustrate your answer.

C Use the information in the text to put together a timeline to show how ideas changed and developed.

3.2 Causes of disease

The discovery of bacteria meant that scientists could think about how to prevent diseases as well as cure them.

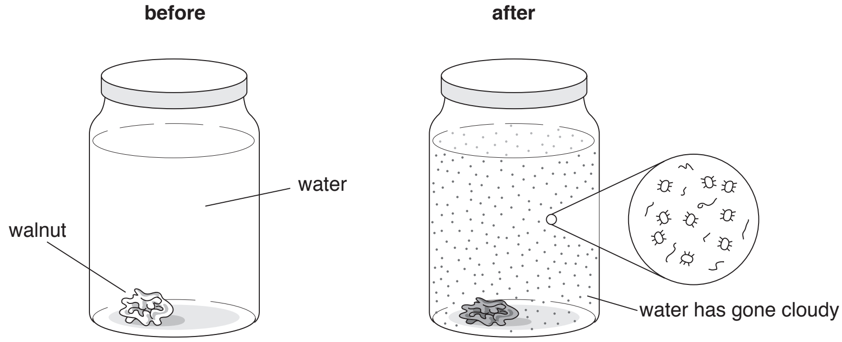
A Open storyboard 'Activity 3.2'. The frames show the start of a museum exhibit. Answer the questions at the bottom of each frame. Use the text/audio symbol (the blue book) to find the answers to the questions in frames 2 to 6. You can use the search box at the top right of the text to look for key words. Type your answers into the bottom window in your own words, or copy and paste from the text.

B Look at frame 7. You should be able to relate your knowledge on bacteria to Edward Jenner's work on smallpox. Read Jenner's story and then try to explain his work in terms of bacteria.

C Put together a worksheet for younger children who are visiting the museum on what causes disease and how we can vaccinate to prevent diseases. You should write questions that they can answer from the text on the CD-Rom.

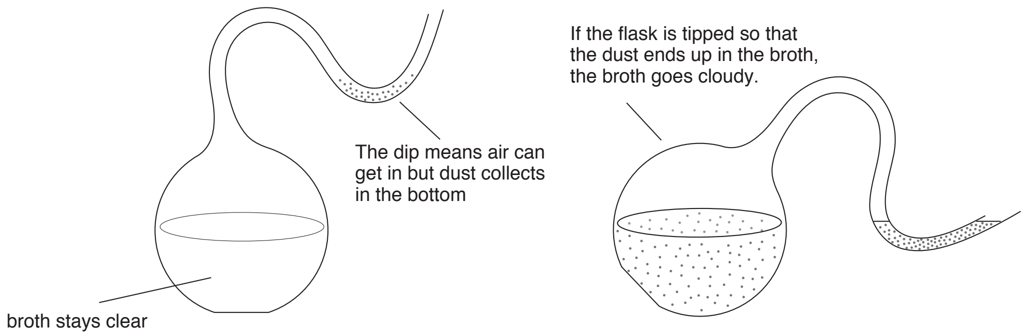
3 That's life

John Needham thought that life could develop from dead matter. This was called the theory of spontaneous generation. He sealed a walnut in a jar of water and watched it for a few days. This is what happened:



1 a) What did Needham think had happened?
b) How would we explain what had happened?
c) How would you prove your ideas? Design an experiment to show that you are right.

Pasteur had discovered bacteria by looking down a microscope. He thought that the bacteria could make food and drink go off – this was called the germ theory. He did an experiment with broth that had been heated in swan-necked flasks. This is what happened:



2 a) Explain Pasteur's results.
b) How does this disprove the theory of spontaneous generation?

3 That's life (cont.)

Cholera is a disease caused by bacteria. It spreads in dirty water. There were several large cholera outbreaks in London in the 1800s. Some time after a cholera epidemic of the early 1850s, doctor John Snow reported to an enquiry on the causes of the disease. This is what he said:

3 a) What does Snow think is the cause of cholera?
  b) Who does he think was responsible for the epidemic?
  c) What is his evidence?
  d) What is Snow's explanation for the spread of the disease?
  e) The enquiry questioned Snow closely and was not convinced by his argument. Why do you think this was? (Hint: Pasteur's work had not yet been published.)

4 Cholera is not a problem in Britain these days but we may still be vaccinated against it when we visit some places abroad. You will be vaccinated against another bacterial disease while you are at school – meningitis C. Find out about meningitis C – what are the symptoms and why is it dangerous?

You can find some useful website addresses at **www.peopleinscience.co.uk**.

4 The cure

Learning objectives

Students have the opportunity to learn:

- about the discovery of penicillin and the importance of that discovery
- about the problem of antibiotic resistance
- how penicillin is mass-produced in modern industry
- how to write with a specific audience in mind (tabloid newspaper).

Learning outcomes

Students:

- answer questions on the discovery of penicillin and its isolation (Activity 4.1)
- find out about modern industrial production of penicillin (Activity 4.1)
- write a newspaper article on the problems of antibiotic resistance (Activity 4.2).

Activity levels

Activity	KS3	KS4
4.1	Most	All
4.2	Most	All

NC Statements

	Sc1	Sc4
KS3	1c	1n
KS4	1a, 1d	2q

Background information

After the acceptance of the germ theory of disease in the 1860s, scientists looked for ways to overcome bacterial diseases. The big breakthrough was the discovery of penicillin. This story illustrates the role of good fortune, keen observation, meticulous experimentation and determined development to produce a scientific discovery. Alexander Fleming was the discoverer of penicillin but it was Florey and Chain and their team who turned it into a viable antibiotic. Dorothy Hodgkin's work in determining the structure of penicillin by X-ray diffraction pointed the way to synthesising the drug and to developing useful derivatives. However, evolution and bacterial genetics mean that the problem of antibiotic resistance is growing in importance.

Prior knowledge

Students should understand that antibiotics work only on bacterial infections and that before antibiotics there were many deaths from relatively minor infections.

Activity 4.1 The penicillin story

Students answer questions on the discovery of penicillin as part of Dorothy Hodgkin's autobiography. This activity also discusses the work of Alexander Fleming and the discovery of the structure of penicillin. It then goes on to look at the modern problem of antibiotic resistance.

Activity 4.2 The return of the superbugs!

This activity is based on Word documents. The document 'Activity 4.2a' provides more help than 'Activity 4.2b'. Students are asked to complete a newspaper report on the problem of antibiotic resistance. They can illustrate their report by accessing *People in Science* and using the copy and paste facility to add illustrations.

Characters:	Hodgkin, Fleming, Kelly, Oakdale.
Backgrounds:	Hodgkin's lab, Fleming's lab, hospital ward.
Props:	mice, bottles, syringes.

Lesson ideas

- At the beginning of the lesson students could be shown pieces of Stilton, Gorgonzola or Roquefort cheese as all of these are made with a culture containing a *Penicillium* mould. Remind students that *Penicillium* is the mould that produces penicillin.
- Students could be given information about the range of antibiotics which are available today and the target organs/infections they are used for. The latest edition of the *British National Formulary* (BNF) will help with this. The web address is to be found on the People in Science website and please note that you will have to register to be able to use the site. Alternatively, groups of students could be asked to research this information and then contribute to a display of a body with diseases and the antibiotics that cure them.
- Students could research the number of prescriptions issued for antibiotics and their cost.
- As a plenary activity students could be given a statement such as, 'Penicillin is the most important medical discovery ever made', or 'Accidental discoveries are very important in science', and asked to write a paragraph agreeing or disagreeing. They should give their opinions.

Answers to homework questions

1 Flow diagram.

2 The other four mice were the control.

3 Although Florey had a 100% success rate the sample size was very small and it may work on mice but not on humans. However, students may point out that he was dying and may have decided to take the risk.

4 He would need to do more tests on a larger sample of mice and then give controlled doses to humans.

5 Abstract should summarise the experiments and the results and then come to a conclusion.

6 Bacteria mutate and become resistant. The resistant ones survive antibiotics and then multiply.

7 Make sure that we take the full course of antibiotics, don't put them in animal food, ensure that doctors prescribe them only when necessary.

8 There is no way of dealing with these infections. In a hospital they spread rapidly and patients are weak anyway.

9 Lister introduced the use of carbolic acid as an antiseptic. Before this there were no precautions taken during surgery to prevent infections.

4 The cure

Penicillin is an antibiotic, which means that it kills bacteria. Penicillin was discovered by accident but has become one of the most important drugs that doctors use.

4.1 The penicillin story

A Open the storyboard 'Activity 4.1'. The frames show Dorothy Hodgkin who is writing her autobiography. Use the text/audio symbol (the blue book) to find the answers to the questions. You can use the search box at the top right of the text to look for key words. Type your answers into the bottom window in your own words, or copy and paste from the text.

B Find out more about penicillin and how it is produced today – you will need to use your textbook or the Internet.

C Explain what you have found out to Dorothy Hodgkin, using Kar2ouche®.

Activity 4.2 Return of the superbugs!

Scientific stories are often reported in newspapers or scientific magazines. Produce a newspaper report on the problems of bacteria that are resistant to antibiotics. You can find out all the information you need from the text.

A Open the Word document 'Activity 4.2a' or 'Activity 4.2b'. Your teacher will tell you which one to use. Click on the text/audio symbol (the blue book) to look at and listen to the text. You can use the search box at the top right of the text to look for key words. Remember that you are writing a report for a newspaper. You can make your report more interesting by including quotes from the scientists.

B Illustrate your report by creating scenes within *People in Science*, and using the 'copy' button to copy and paste them into your reports. Use different fonts or sizes of print to make your report look like a newspaper report.

4 The cure

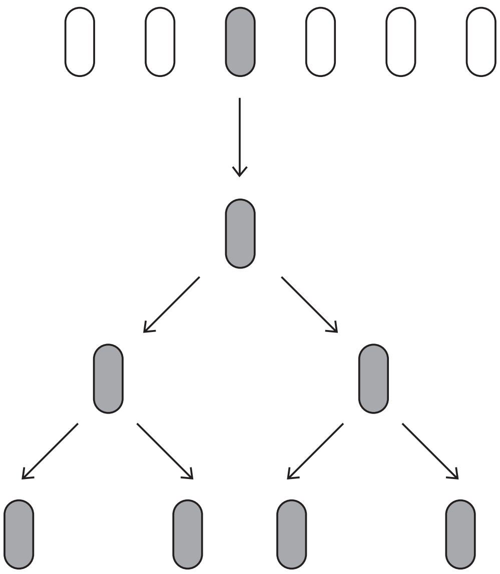
Antibiotics are drugs that kill bacteria. The first antibiotic was penicillin and it was discovered in 1939.

Florey and Chain came across Alexander Fleming's paper on penicillin, which was written ten years earlier. Together with another scientist they got the *Penicillium* mould to grow. Although they only had very small quantities it seemed that penicillin was a powerful antibiotic. Florey decided to try it out. He first injected eight mice with a lethal dose of bacteria. A short while later he gave four of the mice a dose of penicillin. The untreated mice soon died but the others lived on healthily.

After this success they were keen to try it out on a human patient. They discovered a police sergeant in a local hospital who was dying from an infection. When Florey gave him the penicillin he started to recover but they ran out of penicillin before all the bacteria could be killed. The infection returned and the man died.

1 Draw a flow diagram showing the main events in the development of penicillin.
2 Why did Florey use eight mice but only give the penicillin to four of them?
3 Imagine that you are the police sergeant who had the infection. Would you be convinced by Florey's experiment on mice that the penicillin was safe for you to take? Explain your answer.
4 What other tests do you think that Florey had to do to make sure the penicillin was safe?
5 Florey and Chain would have written up their results in a scientific paper. Each scientific paper has an 'abstract'. An abstract is a paragraph found at the beginning of the paper which summarises the experiment, the results and the conclusions. Write the abstract for Florey and Chain's paper.

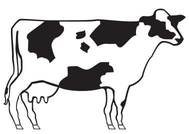
4 The cure (cont.)



Most bacteria are not resistant to antibiotics. Some mutate and become resistant.

The resistant bacteria are not killed by antibiotics. They divide and multiply.

Resistance becomes more likely when …



Farmers use antibiotics in animal feeds.

People are given antibiotics for colds – antibiotics do not cure colds but they will fight a chest-infection if the patient gets one.

People do not finish the course of antibiotics they have been given.

6 Explain in your own words how bacteria become resistant to antibiotics.
7 What can we do to stop the spread of resistant bacteria?
8 Why are resistant bacteria such a problem – particularly in hospitals?
9 Before there were antibiotics many people died from minor infections. Not long before that there were no antiseptics either. Antiseptics stop bacteria from multiplying and are very important in surgery to keep wounds from becoming infected. Find out about the work of Joseph Lister and the discovery of antiseptics.

You can find some website addresses at **www.peopleinscience.co.uk**.

5 Testing, testing

Learning objectives

Students have the opportunity to learn:

- about Jenner's work on vaccination and Withering's discovery of digitalis
- that there are ethical issues with testing new procedures and drugs on patients
- how modern drugs are designed and tested
- that there can be concerns about the safety of vaccinations
- how to evaluate the risks involved with vaccination.

Learning outcomes

Students:

- extract information from the text and answer questions (Activity 5.1, Activity 5.2)
- formulate their own ideas about the best way to test new drugs (Activity 5.1)
- write a modern Hippocratic oath enabling them to look at the relationship between doctors and patients (Activity 5.1)
- take part in a debate about MMR vaccination (Activity 5.2)
- formulate their own opinion about MMR and try to look at the situation from other points of view (Activity 5.2).

Activity levels

Activity	KS3	KS4
5.1	All	All
5.2	Most	All

NC Statements

	Sc1	Sc2
KS3	1b, 1c	1n
KS4	1c, 1d	2p

Background information

To show that a drug is effective against a disease the drug has to be tested. Today clinical trials take years and involve teams of doctors and large numbers of volunteer patients. Edward Jenner's first test of a smallpox vaccine involved just one small healthy boy who probably did not know what was happening. At about the same time, William Withering was carrying out tests of digitalis on over 150 of his patients who suffered from the symptoms of heart disease. Modern clinical trials developed after such scandals as the thalidomide disaster but there is still a risk, however small, that a drug or vaccine can have unforeseen side effects. This is at the heart of the MMR triple vaccine scare.

Prior knowledge

It would be helpful if students understood how vaccination works before they did either of these activities.

Activity 5.1 Doctors on trial

Students answer questions as part of a television show on medical testing. This is then extended into testing on animals. Finally, they are asked to write a new oath for doctors, having looked at the original Hippocratic oath. This oath is still taken by 95% of medical students but there is a debate about its worth in modern society.

Activity 5.2 To vaccinate or not?

Students are given information on the MMR vaccine from two different sources. They are then asked to fill in the different viewpoints in a debate – asking them to look at one issue from both standpoints. Finally, they are asked to give and justify their own opinion.

Characters:	TV presenter, Jenner, Withering, Phipps, Oakdale, Hippocrates, Thomas, Pitt-Barclay.
Backgrounds:	TV studio, Jenner's house, Withering's surgery, biotech lab, GP surgery, Hippocrates' house.
Props:	syringes, foxgloves, scalpel, baby.

Lesson ideas

- The idea of randomised trials of drugs is an important concept for students to understand. The world's first randomised trial was for the antibiotic streptomycin in 1946.
- To start the lesson students could each pick a red or blue piece of paper from a bag. They could then be told that those with the red bits of paper have been given the latest anticancer drug but those with the blue bits of paper have been given placebos. Ask each group how they feel and why trialling must include a control group. Discuss the ethics of doing this.
- The presentation of the results of trials can be misleading and students could be given an exercise to show this. The cholesterol-lowering drug pravastatin is a widely prescribed drug. When a trial was carried out in 1995 in the West of Scotland Coronary Prevention Study, the result of using pravastatin to prevent death from heart attacks was quoted as cutting the risk of death by 22%. To most people this means that out of 1000 people taking the drug, 220 can be prevented from dying from a heart attack. The actual results were as follows:

Treatment	Deaths (per 1000 people with high cholesterol taking pravastatin)
pravastatin	32
placebo	41

Obviously 9 deaths in 1000 are prevented by taking pravastatin. The 22% is worked out by 9/41= 22%.

- Another way to explain this is to say that 1 in 25 coronary bypass operations is successful. Does this mean that 24 people must be treated for one to live? It all depends on the way that the information is presented.
- Another way to end this topic would be to invite a representative of a local pharmaceutical company to give a talk on the use of animals in research. This is a topic which will always generate interest, much of it emotional.

Answers to homework questions

1. Jenner knew that smallpox was a deadly and common disease and that smallpox inoculation was dangerous. He therefore wanted a cure. He was sure that his method would work.
2. Withering would not be allowed to do his experiments today, but we must balance the unknown effects of the drug with the symptoms of heart disease that could eventually lead to death.
3. This will depend on the student's opinion – these experiments would not be allowed today and were dangerous, but so were the diseases concerned.
4. He had no evidence that this would work.
5. He used a control group, i.e. the 25 cattle which were not vaccinated.
6. He has shown that bacteria cause anthrax but there are many other diseases that would have to be investigated.
7. Weakened bacteria are attacked by the immune system. The immune system learns how to overcome the disease and develops the correct white blood cells. When the full dose of bacteria enters, the body can use the white blood cells developed in the past to fight and overcome the disease quickly.
8. In natural immunity the process is the same – when you have caught the disease and fought it off once, then the white blood cells to fight that disease remain in the bloodstream. (The difference is that you actually catch the disease first time round.)
9. Trials suggest that the symptoms of autism appear at the same time as children are given the MMR vaccination – this does not mean that MMR causes the autism. Various studies have cleared the MMR vaccination but there are other opinions too. There is, however, no doubt that catching measles or mumps can lead to serious complications, as can passing rubella to a pregnant woman.

5 Testing, testing

Many of the medical drugs that we take for granted today have been developed and tested very carefully by drugs companies. However, before we had modern testing doctors still needed to experiment with new cures. Some doctors tested things on themselves or their close family – others used patients.

5.1 Doctors on trial

This activity starts as a TV show on doctors who have tested new medicines on their patients.

A Open storyboard 'Activity 5.1'. The storyboard shows you a series of characters. Click on the text/audio symbol (the blue book) to look at and listen to the text. You can use the search box at the top right of the text to look for key words. Type your answers to the questions into the bottom window. Stop when you have answered the questions on frame 9.

B As part of testing new drugs, trials sometimes use animals. Do you think that this is right? Explain your answer to Seth Oakdale using Kar2ouche®. Think carefully about your answer – many of the tests are unpleasant but if they were not carried out what would we do instead?

C Look at frame 10 and answer the questions – the last one asks you to write a modern version of the Hippocratic oath.

5.2 To vaccinate or not?

In Britain there is a programme of vaccination for children. You should have been vaccinated against measles, mumps, rubella, polio and whooping cough – and that was just before you started school! Vaccinations are important, but recently there have been some questions raised about the safety of one vaccination.

A Open storyboard 'Activity 5.2'. Use the text provided to answer the questions. Stop when you get to frame 5.

B Edit your storyboard by putting the answers as labels or speech bubbles on the pictures.

C Frame 6 onwards is a debate about the MMR vaccination. Fill in the answers from different points of view. Then explain what *you* think.

5 Testing, testing

Edward Jenner and William Withering were both doctors working in the second half of the eighteenth century. Smallpox was a deadly disease that was very common at that time. Jenner tested his smallpox vaccine on a healthy 8-year-old boy. He injected him with cowpox, then tried to give him smallpox. The experiment was a success and Jenner had worked out how to vaccinate people against smallpox.

Withering investigated the use of digitalis from foxgloves on 150 of his patients who were already ill. He didn't ask whether the patients were willing to take part in his experiment.

1 Imagine that you are Jenner. What are your reasons for carrying out the experiment?
2 Some of Withering's patients died, although not necessarily from foxglove poisoning. What do you think would be the relatives' response today if a doctor tried a similar experiment?
3 Do you think that Jenner and Withering were right to carry out their experiments? Explain your answer.

Louis Pasteur also worked on vaccination.

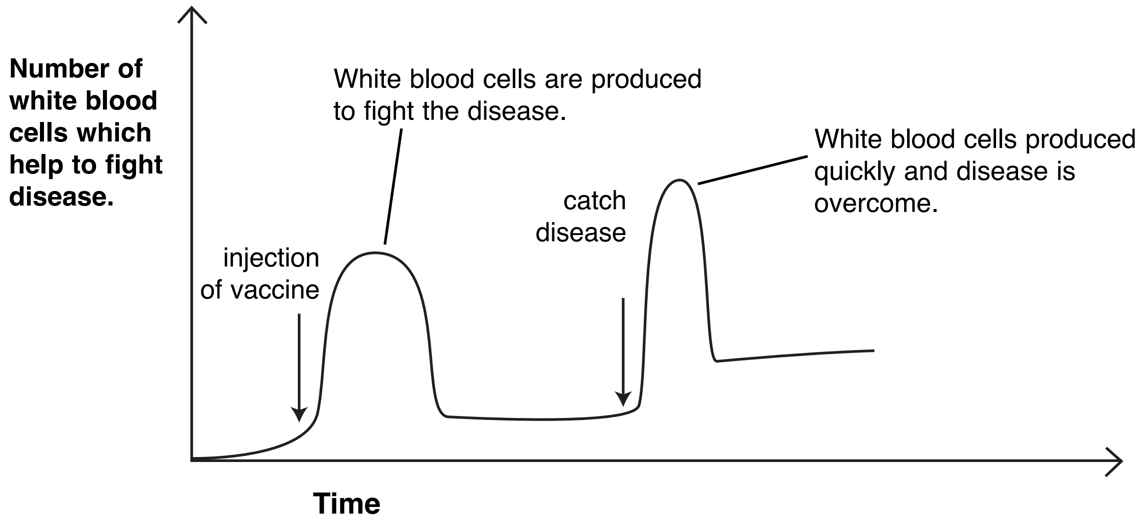
A farmer placed a bet that I could not prevent his animals from dying of anthrax. My colleagues were doubtful that I could do it but I took the bet. I divided 50 animals into two groups. I had prepared a vaccine that was made with weakened anthrax bacteria but had not tested it. One group was injected with my vaccine. Two weeks later all the animals were injected with fresh anthrax bacteria.

Within days, all the unvaccinated animals were dead or dying while the others remained healthy. I had shown that not only do bacteria cause diseases but that the disease can be prevented by vaccination with weakened bacteria.

5 Testing, testing (cont.)

4 Why do you think some of Pasteur's colleagues were doubtful at first?
5 How did Pasteur make his experiment a fair test?
6 Is Pasteur right to say that he has shown that bacteria cause disease? Explain your answer.

Artificial immunity



7 Explain in your own words how Pasteur's vaccine worked.
8 Some diseases, such as measles, can only be caught once. This is called 'natural immunity'. Think about artificial immunity and then explain how natural immunity works.
9 Find out more about the MMR debate. What do you think parents should do? Find out some more about the diseases.

You can find some website addresses at **www.peopleinscience.co.uk**.

6 Healthy life

Learning objectives

Students have the opportunity to learn:

- about deficiency diseases, the discovery of vitamins and their importance in a healthy diet
- about the role of experiments in science
- the importance of writing for an audience (encyclopaedia entry).

Learning outcomes

Students:

- answer questions on the discovery of deficiency diseases and the vitamins that prevent them (Activity 6.1)
- find out about vitamins – their sources and deficiencies (Activity 6.1)
- put together an encyclopaedia entry on vitamins (Activity 6.2)
- write an article on insulin and the importance of healthy eating (Activity 6.2).

Activity levels

Activity	KS3	KS4
6.1	Most	All
6.2	Some	All

NC Statements

	Sc1	Sc2
KS3	1b,1c	2a
KS4	1c, 1d	2k

Background information

Long sea voyages revealed unknown continents and brought wealth to European countries in the eighteenth century, but they also brought scurvy. There were thought to be many possible causes of the disease but it was ship's surgeon James Lind who showed that a diet of citrus fruits provided both prevention and cure. The cause of scurvy and other deficiency diseases did not become apparent until the late nineteenth and early twentieth centuries. Many scientists were involved in the vitamin story, but here we concentrate on the work of Gowland Hopkins, the 'father' of biochemistry, and the less well-known Harriette Chick, a pioneer in the science of diets.

Prior knowledge

Students should understand that the body requires fats, carbohydrates, proteins, vitamins, minerals, water and fibre to remain healthy. It may also be helpful to explain to them that vitamins are needed in very small amounts, and that 1 mg is 0.001 g and one microgram is 0.000 001 of a gram.

Activity 6.1 Vitamins

Students answer questions on the work of James Lind, including the experimental nature of his investigations. They also study the discovery of vitamins and further work in this area by Hopkins and Chick. The second part of the activity asks them to find out more about individual vitamins – which foods they are found in and what they do.

Activity 6.2 You are what you eat

This activity is based on Word documents. The document 'Activity 6.2a' provides more help than 'Activity 6.2b'. Students are asked to complete an encyclopaedia entry on the discovery of vitamins. They can illustrate their entry by accessing *People in Science* and using the copy and paste facility to add illustrations. This is then extended into a report on healthy eating as a whole that could also include some of the information on heart disease from the text.

Characters:	TV presenter, teenager, Lind, sailor with scurvy, Hopkins, Chick, Hodgkin.
Backgrounds:	TV studio, Lind's ship, Hopkins' lab, Hodgkin's lab, Chick's lab.
Props:	oranges, lemons, mice.

Lesson ideas

- A practical way to introduce this topic would be to set up the traditional gut visking tubing experiment, but in addition to the starch-amylase mixture inside the bag some vitamin C could be added. The vitamin C would come through the bag without digestion and could be tested for by using DCPIP.
- Alternatively, a demonstration could be put together to show the amount of vitamin C in a variety of juices. Put about 1 cm^3 of DCPIP in a test tube and add juice drop by drop. If you have to add a lot of juice before the DCPIP turns clear, it means that there is a lot of vitamin C in the juice.
- A good stimulus statement is 'People in developed countries have the most expensive urine in the world'. This emphasises that water-soluble vitamins taken in excess are just passed out of the body in the urine.

Answers to homework questions

1. Guinea pigs need an external source of vitamin C, or the lime juice would have made no difference to the rats.
2. The older the juice the less effective it is.
3. The larger doses give better protection.
4. That they needed fresh juice each day, or if that was not possible then Rose's lime juice cordial would offer the best protection.
5. Could either be the age or the preservative – it is not clear from these results.
6. Six apples to get RDA of vitamin C.
7. 200 g of potatoes to get vitamin C RDA.
8. The vitamin C breaks down as the potatoes are stored over the winter.
9. 75 yoghurts to get all RDA of vitamin A.
10. 500 ml of milk to get RDA of vitamin D.
11. If you eat a healthy diet then you will get all the vitamins you need from food.
12. Pregnant women because the baby takes lots of vitamins.
13. Vitamin K is needed for blood clotting and to help keep the liver healthy. It is made by bacteria which live in our gut but can also be obtained from green vegetables.

6 Healthy life

Vitamins are molecules that we need in very small amounts to keep us healthy. Without vitamins things start to go wrong with the body. Vitamins were only discovered about a hundred years ago – because we only need them in very small amounts, it was very difficult to discover their importance.

6.1 Vitamins

A Open storyboard 'Activity 6.1'. Answer the questions in the windows under the frames. Click on the text/audio symbol (the blue book) to look at and listen to the text. You can use the search box at the top right of the text to look for key words. Type your answers to the questions into the bottom window. Stop when you get to frame 9.

B Add suitable props to the frames. Add speech bubbles or audio to make each person explain in their own words, or record your own audio.

C From frame 9 onwards you are asked to put together some frames to explain more about vitamins A, B, C and D. You will need to use textbooks or the Internet.

6.2 You are what you eat

A Open the Word document 'Activity 6.2a' or 'Activity 6.2b', which will help you to put together an encyclopaedia entry on the discovery of vitamins. Your teacher will tell you which one to use. Click on the text/audio symbol (the blue book) to look at and listen to the text. You can use the search box at the top right of the text to look for key words.

B Illustrate your report by creating scenes within *People in Science*, and using the 'copy' button to copy and paste them into your reports. Use different fonts or sizes of print to make your report look like an encyclopaedia.

C Extend your encyclopaedia entry by looking at the work that Hodgkin did on insulin. Write an encyclopaedia entry for insulin.

D Write a paragraph on 'healthy eating' for the same encyclopaedia. You will need to bring together all in the information on vitamins and you may need to look at some of the text on heart disease as well.

6 Healthy life

The table below shows some of the results that Harriette Chick published in *The Lancet* in 1918. Her paper actually contained many more results of tests on other samples of lime juice. The animals she refers to are guinea pigs.

Source of lime juice	Dose (cm^3 per day)	Age of juice	Preservative	Result	Protection against scurvy
Army, 1916	5	unknown	rum	Animals died of scurvy	0
Bottled juice from A.Riddle & Sons, 1917	5	About 14 months	none	Animals died of scurvy	0
Cordial from L. Rose & Co. 1917	5	3–6 months	none	Scurvy, but considerable degree of protection	++
Fresh juice	2.5	0 months	none	Scurvy in all cases but some protection	+
Fresh juice	5	0 months	none	Scurvy in 4 cases out of 6	++
Fresh juice	10	0 months	none	No scurvy	+++

Key: 0 = none, + = a little, ++ = some, +++ = a lot

1 Like humans, guinea pigs need vitamin C as part of their diet. Other laboratory animals, such as rats, can produce their own. Why did Harriette Chick use guinea pigs instead of rats in her tests?

2 How does the age of the lime juice affect its ability to protect against scurvy?

3 How does the size of the dose affect the protection given by lime juice?

4 From these results, what recommendations do you think Harriette Chick made to protect soldiers and sailors from scurvy?

5 Look at the results from the Army juice – what two things could have affected the vitamin C levels?

6 Healthy life (cont.)

Vitamins are only needed in tiny amounts, but we should have some vitamins every day. The recommended daily amount (RDA) for some vitamins is given in the table below, along with some information on the vitamins in food. When you look at the table, remember that we do not only eat apples one day and potatoes the next – we get our vitamins from a variety of foods.

	Vitamin A	Vitamin B_2* (riboflavin)	Vitamin C	Vitamin D
RDA	*750 µg*	*1.4 mg*	*30 mg*	*2.5 µg*
100 g of apple	5 µg	–	5 mg	–
100 g of boiled potatoes	0	0.03 mg	15 mg	–
100 g of natural yoghurt	10 µg	0.26 mg	–	10 µg
100 ml of milk	44 µg	0.15 mg	–	0.5 µg

µg = micrograms or 0.000 001 g   mg = milligrams or 0.0001 g

* Vitamin B is made up of several different vitamins. In this case we have used vitamin B_2.

6 If one apple has a mass of 100 g, how many apples would you have to eat to get your full RDA of vitamin C?

7 What mass of boiled potatoes would you have to eat to get your full RDA of vitamin C?

8 The figure for vitamin C in potatoes is 15 mg per 100 g when they are harvested, but it drops to 4 mg per 100 g by the end of the winter. What does this tell you about vitamin C?

9 How many 100 g pots of yoghurt would you have to eat to get your full RDA of vitamin A?

10 How much milk would you have to drink to get your full RDA of vitamin D?

11 Doctors say that most people do not need to take vitamin tablets – why do you think that they say this?

12 Who do you think may need to take extra vitamins?

13 Find out about one of the more unusual vitamins, such as vitamin K. Or find out about minerals and why we need them in our diet.

You can find some website addresses at **www.peopleinscience.co.uk**.

7 Choices

Learning objectives

Students have the opportunity to learn:

- about the link between smoking and lung cancer, and how it was discovered
- about the health problems associated with smoking
- that there is an approaching AIDS epidemic in some countries
- that there is controversy surrounding the manufacture of AIDS drugs in developing countries.

Learning outcomes

Students:

- answer questions on the research into smoking and lung cancer (Activity 7.1)
- help a doctor explain to a patient why he should give up smoking (Activity 7.1)
- answer questions on the AIDS epidemic in some southern African countries (Activity 7.2)
- provide arguments for a debate about the manufacture of AIDS drugs in developing countries (Activity 7.2).

Activity levels

Activity	KS3	KS4
7.1	Most	All
7.2	Some	Most

NC Statements

	Sc1	Sc2
KS3	1a, 1c	2i
KS4	1a, 1d	2q

Background information

Epidemiology is the study of diseases in populations. John Snow was an early pioneer of the technique and used it to isolate the cause of a cholera outbreak. By the 1950s, the use of epidemiology to track down links between lifestyles and diseases was well developed. Nevertheless, the link between tobacco and lung cancer (and other diseases) was a surprise. Richard Doll had to work hard to establish the link.

Other studies in the 1980s at first linked AIDS to homosexual behaviour. However, the epidemic of the disease across the world, and especially in Africa, is the result of unprotected heterosexual intercourse. Cultural attitudes, the economy of the developing countries and the response of the multinational drug companies are factors in the growth of the disease.

Prior knowledge

Students doing Activity 7.1 should understand that we have several parts to our immune system, including white blood cells.

Activity 7.1 Smoking out the killer

Students answer questions on the work of Richard Doll, including the role of the Medical Research Council and the difficulty of medical studies such as this. They then put together some frames to help a GP explain to a patient why he should give up smoking.

Activity 7.2 The death of a generation

Students put together a storyboard for a news report on the problem of AIDS in a southern African country. They then put together the arguments for a debate about the manufacture of drugs in developing countries. They are encouraged to look at the problem from different points of view before giving their own opinion.

Characters:	Doll, Thomas, Taverner, Batakati, Fugewane, Oakdale, teenager, TV presenter.
Backgrounds:	Doll's study, GP surgery, outside AIDS hospital, inside AIDS hospital, TV studio.
Props:	syringes, cigarettes.

Lesson ideas

- We have included two homework sheets with this Theme. Activity 7a is about smoking, whilst Activity 7b looks at HIV.
- The concept of choice is tied up with how people perceive risk. (NB: Risk has also been covered in Theme 5 in relation to the risks involved in the triple MMR vaccine.) A good start is to brainstorm risky things. Students could then be asked to vote on the ones they fear the most. Research indicates that we have three main sources of fear:
  – We fear things that are not necessarily the things most likely to hurt us (e.g. it is easy to get a child to fear spiders, but not electrical sockets).
  – We fear things in which many people are killed at once rather than things which have a continuous risk of death (plane crashes v. car accidents).
  – We fear new things (GM foods v. alcohol).
- Another way to start either activity is through a card-sorting exercise. Twenty cards with information about AIDS or smoking are given to each group of students. The information need only be sentences but different groups need different pieces of information. Lots of information about smoking and AIDS is available on the Internet. (Teachers could prepare the cards or one group could prepare cards to be used by other groups.) The group is asked to sort the cards into two piles: ones they know nothing about (i.e. unable to say if they are correct or not) and ones they know something about.
  The first pile is given to the teacher. The second pile is used by the group to tell other groups about what was written on the cards.
  The group may generate other questions from this activity, which can then be used by the teacher in a plenary session along with the cards which had been given to the teacher after the initial sorting.
- It may be worth noting to students that in 2000 US experts calculated that 98 000 Americans were killed in medical accidents – more than the total number who die from breast cancer or AIDS.

Answers to homework questions

Homework sheet 7a

1 Not a health risk – b, e, f, g

Health risk – a, c, d, h

2 Studies need identically matched people, which is very difficult to do.

3 You would want to know how many tests, how many mice, how many cigarettes and if this translates into humans, i.e. does not just affect mice.

4 a) 34 216 b) 82 people a day

5 Should give an opinion with reasons.

6 Everything from nicotine patches to acupuncture can be used.

Homework sheet 7b

1 Bar chart.

2 The drugs are very expensive and they have more people to treat.

3 They did the research work and that was very expensive – in order to fund research in the future they need the money and they need to make a profit.

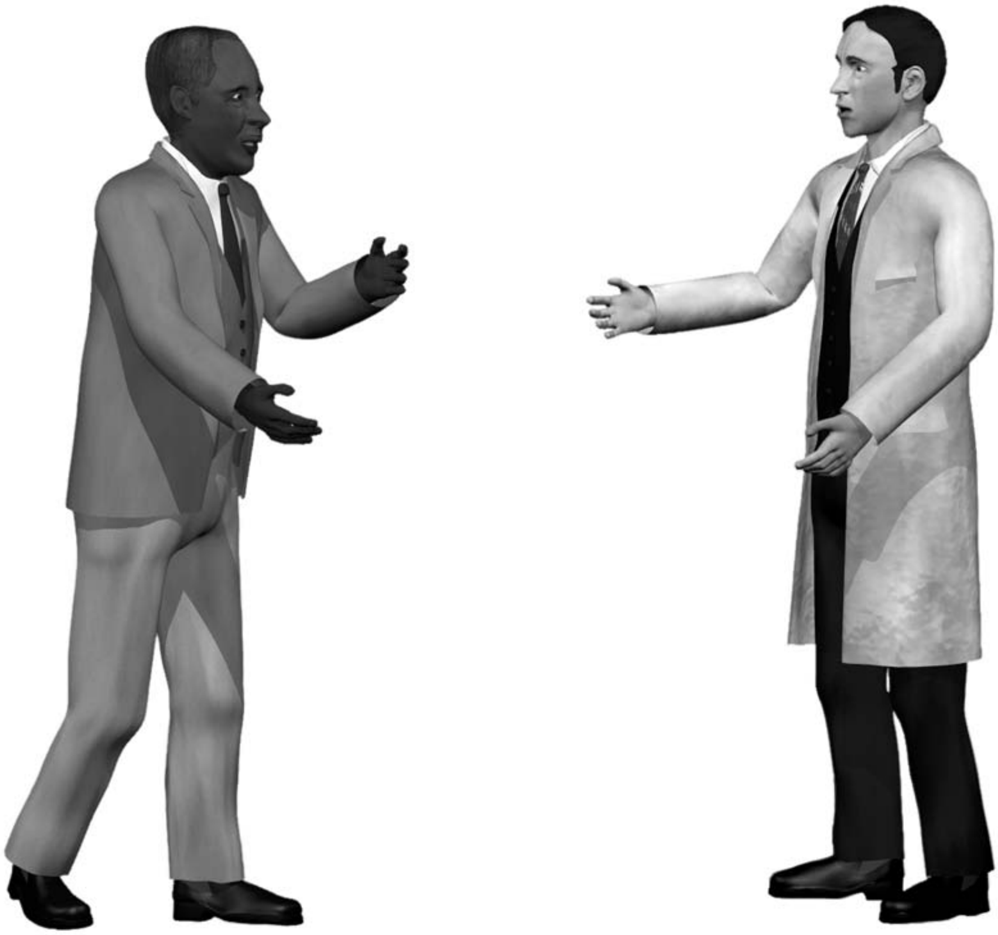
4 HIV is the virus that causes AIDS.

5 Antibiotics will not work because AIDS is caused by a virus not a bacterium. In addition, HIV hijacks our own white blood cells and therefore is difficult to treat.

6 AIDS can mainly be prevented from spreading by making sure that people use condoms.

7 AIDS is spread through the sharing of body fluids, for example, through sex or sharing needles.

7 Choices



Smoking has been linked to lots of diseases, such as lung cancer, but this was not discovered until recently. The evidence that links smoking to cancer still needs to be looked at carefully.

7.1 Smoking out the killer

A Open storyboard 'Activity 7.1'. Answer the questions in the windows under the frames. Click on the text/audio symbol (the blue book) to look at and listen to the text. You can use the search box at the top right of the text to look for key words. Type your answers to the questions into the bottom window. Stop when you get to frame 4.

B From frame 4 onwards you will need to help a doctor explain to her patient why he should give up smoking. Look at the text and then put the answers in your own words.

C Add speech bubbles or audio to make each person explain in their own words, or record your own audio.

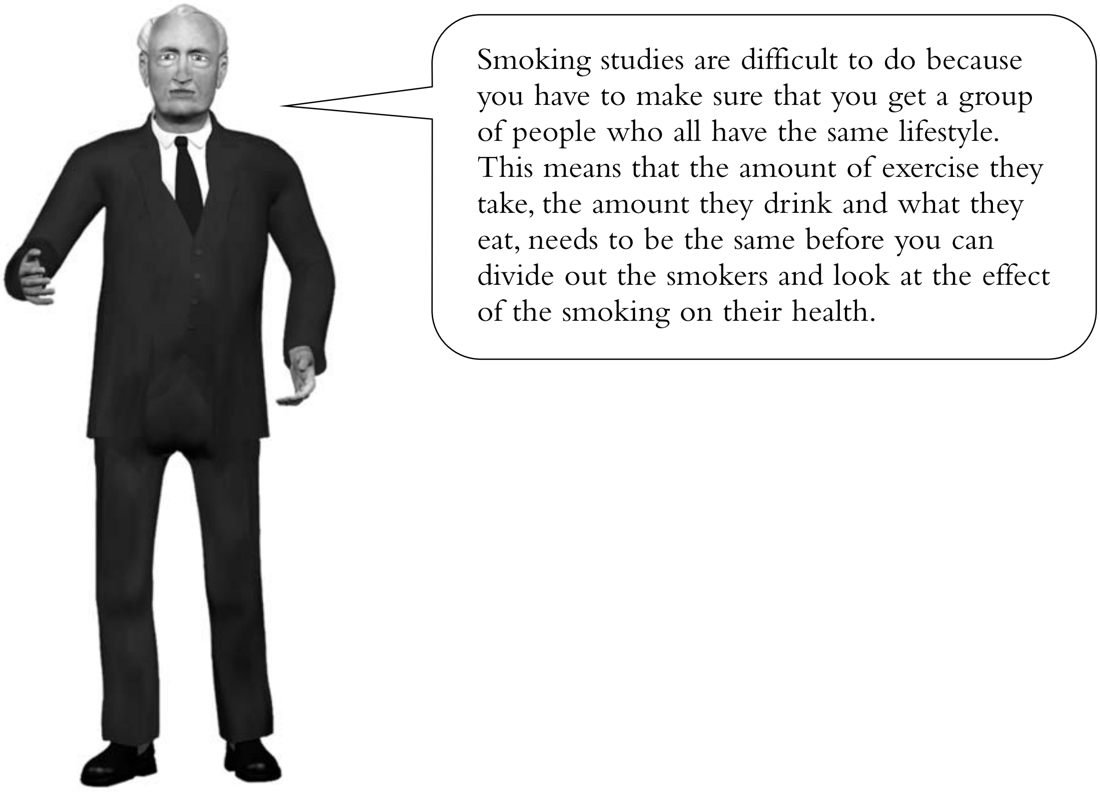
7.2 The death of a generation

A Open storyboard 'Activity 7.2'. Answer the questions in the windows under the storyboards. Click on the text/audio symbol (the blue book) to look at and listen to the text. You can use the search box at the top right of the text to look for key words. Type your answers to the questions into the bottom window. Stop when you get to frame 6.

B Put together a debate between the characters in frame 6. You can use speech bubbles or record your own audio to make the characters voice their opinions.

C Give your own opinion of the problem. Remember to give your reasons.

7a Choices



Look at these statements:

a) 1 in 5 deaths in the UK are smoking related.
b) There is no proof that smoking cigarettes directly causes lung cancer.
c) 94 people die every day from lung cancer in the UK, 90% of them are heavy smokers.
d) The main smoking-related illnesses are lung cancer, bronchitis, emphysema and coronary heart disease. These are responsible for over half of the smoking-related deaths.
e) Smoking-related deaths from lung cancer account for only about 2% of all deaths.
f) Some tests have shown that smoking cigarettes does not produce lung cancer in mice.
g) There is no evidence that smoking one cigarette a day causes any health problems.
h) One in two long-term smokers will suffer from a smoking-related illness.

1 Sort the statements into those that show that smoking is a health risk and those that do not.
2 Why are studies on smoking so difficult to do?
3 Look at statement f . What information would you want to know about this statement before you started to smoke?
4 a) How many people in the UK, who have been heavy smokers, die of lung cancer each year?
  b) 30 000 smokers die from coronary heart disease each year – how many is that a day?
5 Write a paragraph to give your opinions on smoking. You should be able to use the information above to help you give a balanced view, and then your opinion.
6 Find out which different methods can help people to stop smoking.

You can find some website addresses at **www.peopleinscience.co.uk**.

7b Choices

1 Look at this data and plot it on a bar chart.

Region	% of population infected with HIV
Sub-Saharan Africa	9
North Africa and Middle East	0.3
South and South East Asia	0.6
East Asia and Pacific	0.1
Latin America	0.1
Caribbean	2.3
Eastern Europe and Central Asia	0.5
Western Europe	0.3
North America	0.6
Australia and New Zealand	0.1

- If Zimbabwe were to provide drugs for all its AIDS patients, it would cost 2.5 times or 250% of the total income of the whole country. For comparison, Switzerland needs to spend less than 0.1% of its income on AIDS drugs.
- Drug companies in the West have invested billions of dollars in developing AIDS drugs. Research and testing of AIDS drugs has taken over 20 years.
- No AIDS drug cures the disease.
- Almost three-quarters of all AIDS deaths are in sub-Saharan Africa.

The Human Immunodeficiency Virus attacks the white blood cells in the body. These cells fight bacteria and cancerous cells. When your white blood cell count drops to very low levels, you cannot fight infections. This is when AIDS develops. Diseases like pneumonia and cancers become fatal when normally your body could fight them off. HIV is spread in body fluids, such as blood and semen.

2 Why can developing countries not afford the drugs that they need to treat AIDS patients?
3 Why do drug companies want to make sure that they are the only ones to make the drugs?
4 Explain the difference between AIDS and HIV.
5 Why is AIDS so difficult to cure?
6 Explain how AIDS can be prevented from spreading.
7 Find out how AIDS is spread.

You can find some website addresses at **www.peopleinscience.co.uk**.

H Further suggestions

This page outlines other activities that could be carried out using the text, characters and backgrounds supplied with *Health and Disease*.

Timeline
Ask students to use the characters to put together a timeline to illustrate how ideas about health and disease have changed over time. Each group could be asked to do one character and they could then be put together as class display.

Characters: All except modern characters.

Advances in medicine: Students could be asked to look at the way treatment of different diseases has changed with time. For example, in Withering's time heart disease may have been treated with digitalis, but after Barnard's work patients may undergo heart surgery. This will require a little more research but areas to focus on include the treatment of infections, the treatment and management of diabetes, and ways of protecting people from disease.

Characters: All including modern characters.

Technology: Using the props provided in the CD-Rom, students could be asked to consider the role of technology in medicine. For example, Pasteur made his own swan-necked flasks and these allowed him to experiment with microbes; microscopes allowed scientists to see microbes and disprove the theory of spontaneous generation; and X-ray diffraction allowed the structure of penicillin to be deduced.

Characters: All including modern characters.

Props: Swan-necked flasks, microscope, X-ray pictures, pig for xenotransplantation.

QUICK-START GUIDE

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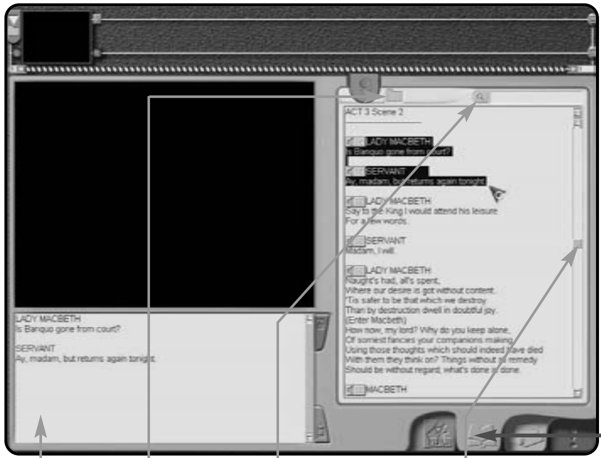
Quick-Start Guide
Getting Started

1. Adding Text



Click on the blue Text and Audio tab to see and hear the full text of the library

Select a piece of text and drag and drop into the caption window

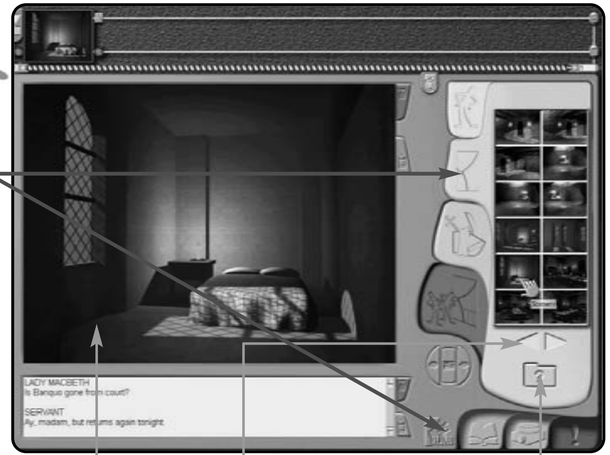
Click on the orange folder to load in your own text

Type in a word and press the Search icon to find references to it within the text

Use the scroll bar to move to the relevant part of the text

2. Adding a Background

First, click on the green Composition tab. Next, choose a background by clicking on the blue Backgrounds tab and selecting one that suits the scene you are building. It will automatically load into the Composition Window.



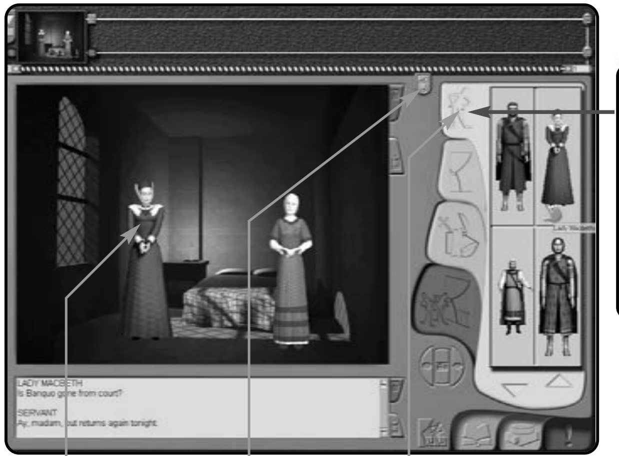
Click on the blue Backgrounds tab to see six backgrounds at a time. Click again to see 12 at once

The Composition Window

Click on the green arrows to toggle between selections of backgrounds

To load your own digital image as a background, click on the orange folder icon and choose an image file from your hard-disk or network drive

3. Adding Characters



Choose characters by clicking on them and dragging and dropping them into the 'Composition' window

To move a character, just click on it and drag it to a new location in the Composition window

To delete a character drag it into the orange waste-paper bin

Click on this green Quick Palette tab to see four characters at a time. Click again to see 16 at once

4. Adding Props

Choose from a large selection of props by clicking on the orange 'Props' tab. Drag in to the composition window

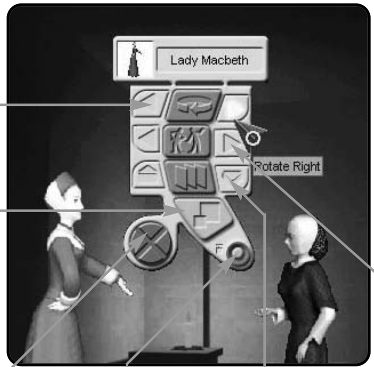
Click on the orange Props tab to see four props at a time. Click again to see 16 at once

Create copies of props by pressing Ctrl, keeping it pressed and clicking on the prop you wish to copy. Drag to a new position

Click on the green up and down arrows to move through the selection of props

5. Rotate, Pose, Layer and Scale characters and props

Select the character or prop and right click to open the Manipulator.



Rotate the character or prop by clicking on the left or right arrows next to the rotate key

Change the size of the character or prop by clicking and dragging up and down on the scale key

Click the large red cross to close the Manipulator

Click on the small red button to delete the character or prop

Move the character or prop in front or behind other objects by clicking on the left or right arrows next to the Layers key

Pose the character or prop by clicking on the left or right arrows next to the Pose key

6. Building Layers

Choose the red Layers tab to move elements in the Composition Window in front or behind each other and to access the 'special effects' menu for each element in the picture.

To layer any element in front or behind another, click on its image and drag it up or down relative to other elements

Click on the blue tab on each layer to access its 'special effects' menu

7. Adding Speech and Thought Bubbles

Select a character then click on the speech or thought buttons to type in what is being said or thought.

Move the pointer by clicking and dragging

Click on the text box button to add a text box to your frame

Move a bubble by clicking and dragging the top edge of the bubble

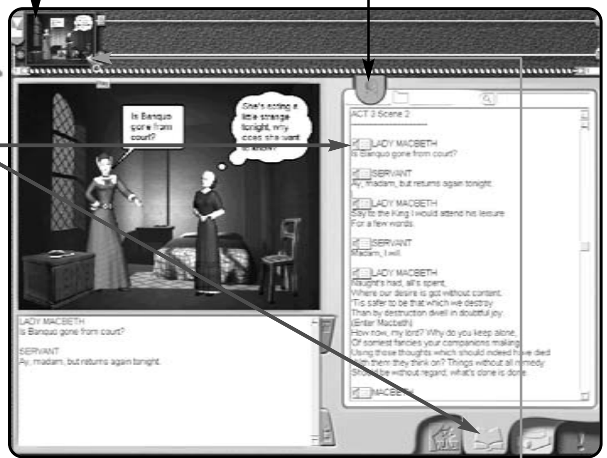
Resize a bubble by clicking and dragging on the sides or bottom of the bubble

8. Adding a Pre-recorded Audio File

To add a pre-recorded audio file, first, click on the blue Text and Audio tab then drag a speaker icon to the thumbnail of the frame. A speaker icon will appear to show that it has been attached.

Thumbnail

Open Audio controls



Click on the speaker icon once to start playing the audio file and again to stop

Click on the speaker icon in the frame's thumbnail to hear the file that has been attached

QUICK-START GUIDE

9. Playing the Frame

Click on the orange Presentation tab to access the Presentation screen.

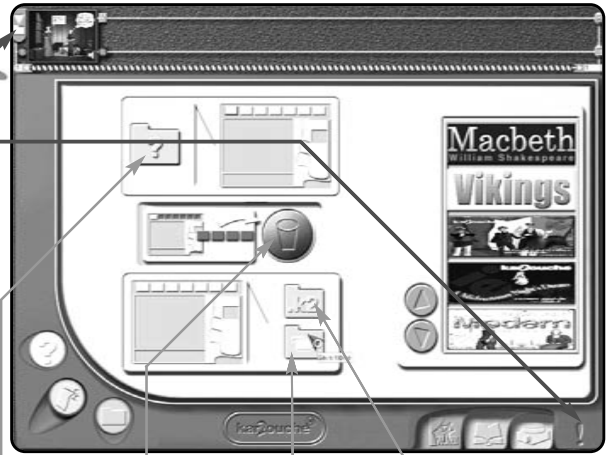
Click the Play button to see your frame shown in the presentation window, Any attached audio files will be played back.

Click on the Cycle icon for continuous looping playback

Stop or pause the frame during play back by clicking on the stop or pause buttons

Click on the Full Screen toggle button to see the frame shown as a full screen when it is played back. Click again to view play back in the Presentation Window

10. Saving and Loading Storyboards



Click on the red Utilities tab. Here you can save and load storyboards. Storyboards can be saved from any of the screens using the save button in the top left of the screen

To play back a previously created story board, click on the Load button

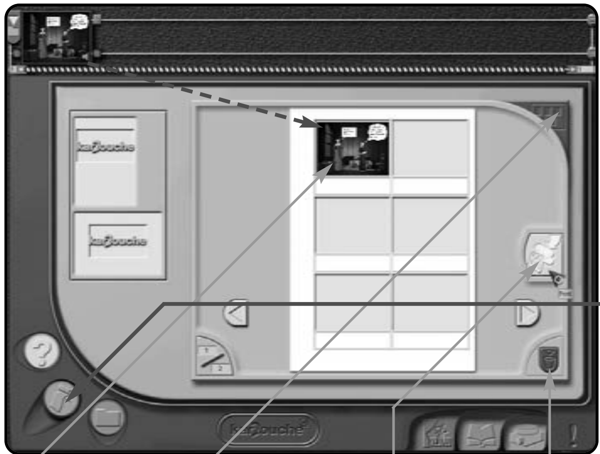
To create a new, blank storyboard, click on the New Storyboard icon

Click on the 'save movie' button to save your storyboard as a QuickTime movie

Click on the 'save .K2 file' to save your storyboard as a Kar2ouche file

Autosave will automatically save your storyboard at set intervals

11. Printing Storyboards



First, click on the orange Print button. Next, choose an orientation option by pressing on the portrait or landscape icons. Finally, select one of the layouts and drag frames of your story board into the boxes

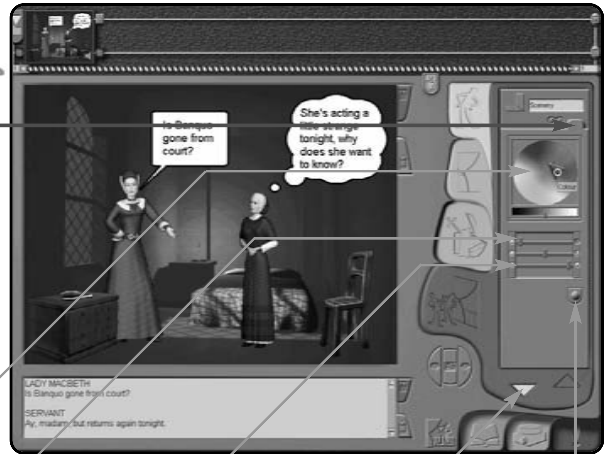
Any text in the caption window will also appear in the printed document

Return to the templates selection page by clicking on the back icon

Click on the green printer icon to print

Discard frames from the print template by dragging them into the red waste bin

12. Special Effects



To access special effects, click on the green Composition tab to return to the Composition Window and click on the red Layers tab. Next, click on the blue tab associated with the element you wish to add the special effect to.

Changing the colour can help to capture the mood of the scene

Change the transparency of a character to create 'ghostly' effects

Blur the background with the sharpness setting and create a cinematic 'depth of field' effect

Scroll through the different elements using the green arrow button

Undo any special effects you have added by clicking on the reset button

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Quick-Start Guide
Advanced Features

13. Adding Additional Frames

Thumbnail
Bead

To COPY your frame, drag the thumbnail of the frame to the red bead to the right of the thumbnail. A copy will be produced.

To create a BLANK frame, click on the red bead to the right of the thumbnail.

When you have added more than seven frames, use the blue and yellow scroll bar to scroll through the thumbnails

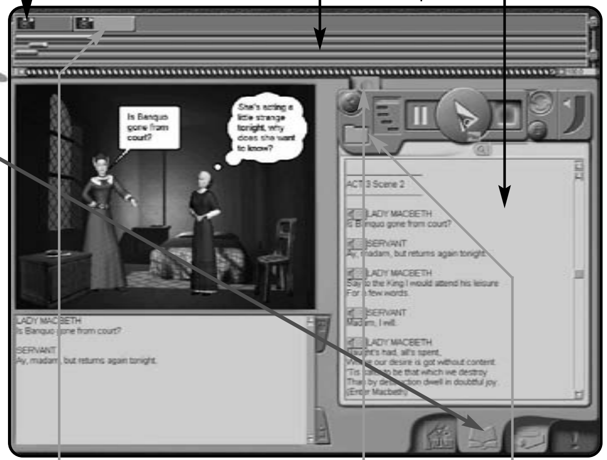
To delete a frame click on the thumbnail and drag it into the orange dustbin

14. Adding Multiple Audio Files

Thumbnail
Timeline
Script Window

First, click on the blue Text and Audio tab. Next, click on the green 'show controls' button at the top of the Script Window.

Drag audio files from the Script Window to a track on the timeline.



Change the duration of any frame by clicking and dragging on the right edge of the thumbnail

Click on the right edge of the thumbnail to view the duration of the frame in seconds

Show Audio controls

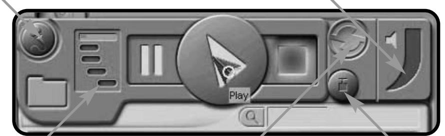
Click on the orange folder to load sound files that you have previously recorded or sound files from other sources

15. Recording your own Audio File

Use these controls to record your own audio files.

Click on the red microphone icon to start recording. Click on it again to finish recording. Name your sound file and it will appear as a sound bar under the frame that was selected on the Timeline

Adjust the sound levels of each track by clicking and dragging the blue volume bar up and down



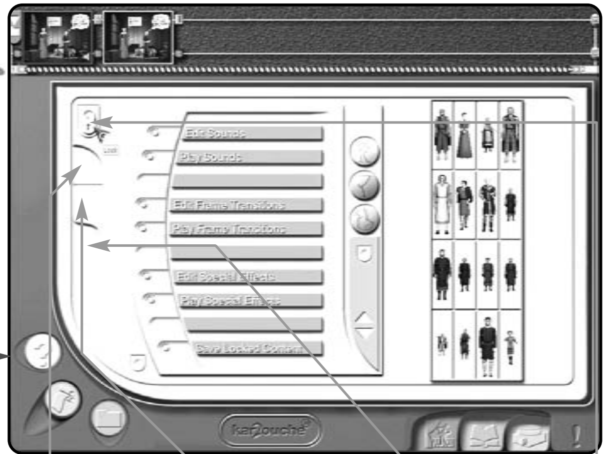
To play back sound files choose a track (for all tracks click the blue bar, for individual tracks click on of the four track bars) and then press Play

Click the Reset button to reset the sound file to its original length

To delete a sound file, select the appropriate sound bar on the Timeline and click the red 'delete' button

16. Setting your own Options

To personalise your settings, first, click on the red Utilities tab. Next, click on the green options button. To make changes you will need to enter a password. The default is 'password'.



The first options page permits changes to loading and saving files

The second options page allows specific content, sounds, transitions and text to be excluded from general access (network versions only)

The third options page controls printing and font settings

Click on the padlock to change your password

