



Science Where You Least Expect It!

Teacher's Guide

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4 SCIENCE has produced 18 assignments and a teacher's guide, collectively known as *Science Where You Least Expect It!*, to encourage non-scientists to embrace just a little bit of science – increasing students' skills while quashing a few "science is boring" stereotypes.

And, as an added incentive, 4 SCIENCE, in association with Science Year, is offering a prize to the student that produces the best assignment.

All assignments have been written so they can be used to cover the non-science AS and A level coursework requirements. In doing so, they also develop a number of key skills.

Links:

Teacher's Guide:

Assignments

Competition details

Further information

Credits

Credits

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Assignment Details

#	Title	Preparation for the teacher	Overview
01	Skin Deep	<p>For the initial presentation of the topic it would be helpful to have a wide selection of:</p> <ul style="list-style-type: none"> • Science and natural history magazines • Science text books • Illustrated popular science books • Medical text books • Books of plants, animals and micro-organisms, crystals • Astronomy books/pictures from space • Internet access • Molecular model kits • 2D and 3D images through the ages <p>Presentation of topic: 1 hour. Plus student study time and, depending on coursework requirements, at least one further session to finalise individual topics.</p>	<p>Illustrations and models have been used since the earliest civilisations to help understand and portray different aspects of science. Art can help communicate both the beauty and complexity of science. Scientists using the modern technologies of science and medicine frequently rely on images of one sort or another, to aid them in their search for understanding. The models built by Watson and Crick helped them discover that the molecular structure of DNA was in the form of a double helix; the beauty of the DNA molecule, and the way in which it carries information, has since inspired people from many different disciplines.</p>
02	Epidemics and Immunity	<p>A selection of background information will need to be available, depending on the exact nature of the coursework requirements. Suggestions include information about:</p> <p>Infectious diseases, their causes and methods of transmission. Death rates (and causes) for relevant periods and areas. Public health initiatives (UK or world-wide), particularly immunisation campaigns. The development and production of vaccines (from both scientific and economic points of view).</p> <p>One session of about an hour should be enough for the presentation of the topic to a group. Subsequently, time allocation could depend on particular coursework requirements.</p>	<p>Average life expectancy in the United Kingdom for babies born in the year 2000 is about 25 years longer than it was for babies born in 1900. A significant contribution to the increase in life expectancy has been through lowering the number of deaths in childhood due to infectious diseases.</p> <p>The late 19th century saw major epidemics of cholera, smallpox and influenza in the UK, but it also saw the development of the germ theory of infectious diseases and the beginnings of bacteriology as a science. This, together with the pioneering work on vaccination carried out by Edward Jenner a century earlier, meant that the start of the 20th century was the beginning of significant changes in medical attitudes to disease and of the science of preventative medicine.</p> <p>The 21st century poses new problems with the emergence of new diseases, inequality of access to medical care and global travel, all affecting the spread of epidemics.</p>
03	Beauty or the Beast	This topic is most suited to group work, it could be developed in several	Genetic modification of food crops has had wide and varied media

		ways by means of debates, role play or drama presentations, written articles, radio, video or web based materials. The time allocation will depend on the nature of the project, but it will involve considerable background research and planning of presentation material. It would be best suited to a project running over several weeks or even, in the case of drama, a term of activities.	coverage. Much of it has used strong and emotive language and imagery to put forward particular viewpoints. How much of the science is it necessary to understand in order to make moral and ethical judgements about the use of such scientific advances? What are the potentials? What are the risks? How should they be presented to the public?
04	Digging for DNA	A talk on DNA profiling from a visiting scientist, or an open day visit to a local research institute or company, could be a valuable part of the project, the BBSRC website (www.bbsrc.ac.uk) offers advice on such arrangements. Background materials listed within the student resource will need to be available, with the science being covered in advanced level biology textbooks. DNA profiling (see student resources) could be downloaded and printed for more details of the science and technology, with an example of its application in an archaeological investigation. One session of about an hour should be enough for the presentation of the topic to a group. Subsequently, time allocation could depend on particular coursework requirements.	Recent advances in the techniques for extraction and amplification of DNA from ancient artefacts have provided information that sheds new light on theories about human ancestry, movement of populations, agricultural practices, diets and diseases in ancient times. The impact has been so significant that a new branch of archaeology has emerged: biomolecular archaeology.
05	Sciencespeak	It would be useful to have examples culled from newspapers to set the ball rolling. Time allocation: 15-20 minutes for teacher introduction Perhaps 2-3 hours over a 2 week period for students, followed by 30-45 minutes discussion. This will be decided by the appropriate coursework requirements.	Journalists and politicians use 'scientific' words or phrases, often when trying to impress and/or to convey an impression of superior knowledge or technical understanding. Such uses are frequently misleading, but some of these words and phrases have been used for so many years that they have entered the English language with meanings far from the original...
06	Poetic Scientists/Scientific Poets	Preliminary study of the poems; choosing suitable poems. Time allocation: 15–20 minutes for teacher induction. 1–2 hours for reading/studying 3–4 of the poems; 1 hour for group discussion; 1 – 2 hours for written work. [This will all be decided by the appropriate coursework requirements]. Other poems could be introduced and studied.	Art is the tree of life... Science the tree of death" This quote is from the 18 th century poet and painter, William Blake. He expresses a view that literature has humanising aspects while the practice of science is dehumanising. This attitude to science has re-occurred so often that there has become a stereotype of scientists as people who do not care for, and are ignorant of, literary culture.
07	Behind the picture	Study of the materials provided; negotiation with students as to how best they may be used. Extremely dependent on the nature of the task involved/coursework undertaken.	When we visit an art gallery and look at an old painting we take it for granted that what we see is exactly what the artist painted a few hundred years ago. But old paintings, more often than not, look rather different now from how the artist intended. If we want to know about the real history of paintings – what the artist intended it to look like, what techniques he/she used, how it's been changed over time – then we need to look at the science. We

			need to look behind the picture.
08	Science on Stage	<p>Preliminary study of the excerpts and possibly the complete plays.</p> <p>Time allocation: 30 minutes for teacher introduction. Perhaps 1-2 hours for each play for reading and preparation, followed by about 1 hour for a directed dramatised reading and 30-45 minutes for discussion. This will presumably be decided by the appropriate coursework requirements. It may be possible to study either or both plays in full.</p>	<p>Plays in which science plays a considerable part, although not yet common, are far from unknown. Several have been critical and popular successes. Perhaps George Bernard Shaw's 'The Doctor's Dilemma' could be included in any list; certainly, Friedrich Dürrenmatt's 'The Physicists' and 'The New Men' by C.P. Snow and Roger Millar. Two extremely effective recent plays have been Tom Stoppard's 'Arcadia' and Michael Frayn's 'Copenhagen'. Any of these, and indeed others, would repay study in this context.</p>
09	Hands-on Science	<p>You might wish to get some marketing leaflets from a couple of science centres so that the students can be introduced to the concept of a science centre, particularly if there isn't one in your area.</p>	<p>Science museums have been around for a long time. However they're no longer full of dusty cabinets and obscure exhibits. Today's science centres and museums are designed around hands-on exhibits where people can explore things for themselves, with exhibitions about how science relates to our everyday lives. They market themselves as major tourist attractions and leisure activities and run wide-ranging education programmes for schools.</p>
10	Good to talk	<p>Make sure that you have copies of the Gary Younge article available for students to read. Discussion: 1-2 periods Time will then be needed for students to research and write up their work.</p>	<p>It's often said that our world is a small place, and that it's getting smaller. We can now communicate with people around the world in ways that would never have been thought of a century ago. Air travel means that we can travel around the world in a matter of days, while the telephone means that we can speak to far-flung relatives without leaving our living rooms.</p>
11	Selling Science	<p>Put together a selection of newspaper cuttings on the issue, or ask students to collect these themselves. Another source of contrasting science might be information leaflets. For example, pro and anti GM leaflets from companies and campaign groups. Time will be needed for a class discussion, research and writing up.</p>	<p>Science has an image problem. For years now, it seems to have created as many problems as it's solved. Look in the media, and you hear about GM foods, BSE, gender-bending chemicals, greenhouse gases, biochemical weapons... Scientists are either portrayed as nerdy boffins who can only communicate in equations, or mad scientists "playing God" by tampering with nature.</p>
12	Painting the Invisible	<p>A teacher-led introduction of perhaps half an hour to show images can illustrate the use of light in paintings through the last three hundred years. This should introduce students to the symbolic and representational functions. It should include works apparently attempting verisimilitude (for example, works by de la Tour, le Nain, Metsys, Wright of Derby etc) and those using symbolism (for example, Lippi). Perhaps the focus is on representation and misrepresentation. Matisse's goldfishes seem to be struggling round a bowl of jelly rather than swimming in pliant water. Some cubist works seem to view the world through a fractured</p>	<p>How have painters represented glass on canvas? They show the distortion of light that travels through the glass and the weird partial reflections on the surface. Without these effects glass would be invisible.</p>

		windscreen. Why did the painters choose this way of representing reality? After an introductory discussion it is up to the students to find works that use light and its effects in an obvious way. If the end-point is a presentation the assignment will take about a fortnight. However, if this is used as a spur to produce an original piece of work the time allocation will perhaps stretch into a term.	
13	Santa and the scientists	<p>There is minimum preparation needed. Perhaps the teacher could give an example of the sort of presentation expected.</p> <p>Time allocation: This will take some research and so a week could be used to good effect. As the main features of the Christmas stories (i.e. the Christian story and all the stuff about Santa) are well-known to the majority the teacher-input can be fairly brief. Some students may need help in choosing an area of research.</p>	<p>Scientific reasoning can be applied, or misapplied, to many situations. Christmas is no exception. This assignment gives students the opportunity to research one or more areas of the Christmas story and festivities in a reasonably light-hearted manner. The aim is to produce an illustrated talk or web page based on their research.</p>
14	Einstein's Decision	<p>This assignment is reasonably self-contained. However, a reading of Hersey's very short description of Hiroshima directly after the bomb is time well-spent. This is an emotive subject about which students may have strongly-held beliefs, however ill-founded. The challenge for the teacher is to bring these beliefs to the surface without belittling them or supporting them. The more the teacher knows about the subject matter the better. As far as the atomic bomb goes, Jungk's book is superb and balanced.</p> <p>Time allocation: This will depend on the nature of the project but it will involve considerable background research and planning of presentation material and would be best suited to a project running over several weeks or even, in the case of drama, a term of activities. A teacher- led introduction of about half an hour would be useful but not essential. This can be based around the passage 'Einstein's Decision' which is used to focus the students' ideas. This leads into a discussion of other technologies of warfare. It is a salutary exercise to list the various forms of warfare in which science has helped weapon development simply to show that scientists are needed for developing <i>any</i> technological weapon – and the list is long. Once the moral decision facing individual scientists has been introduced the students should be able to follow the guidelines below to see the project through to a finished piece of work.</p>	<p>Since the first atomic bomb was tested in 1945 the relationship between science and warfare has been closely studied. This has put great responsibility on the shoulders of scientists. Some blame the scientists for their nasty little inventions, others praise them for defending 'our' values. What is the responsibility of scientists? Does this change in times of war? Is it fair that scientists are put under a moral microscope in a way that other professions are not? This assignment encourages the student to look more carefully at these issues and produce a presentation relating to an aspect of science and warfare or a piece of creative writing focusing on the moral dilemma faced by many workers in the field of arms research.</p>
15	Science, Lies and	Examples of how science has influenced popular culture can be given in a	This assignment gives students the chance to explore the impact that

	Videotape	<p>half- hour introductory lecture. This could include video-clips, poetry, excerpts from novels, examples of art work and music. The connection should be between science and all forms of culture – not just high culture.</p> <p>Time allocation: This is a wide area that can be used in a number of contexts. About a fortnight is enough time for the students to produce a good presentation – but analysing a number of films or books is quite a time-consuming activity.</p>	<p>science has had on culture. The scope is deliberately broad, ranging from lyrics of pop songs through film and writing to the possibilities of representing ideas of science in so-called 'serious' music. The central theme of the project is that science has pervaded nearly all aspects of art.</p>
16	Mud to Make-up	<p>Cosmetics might be a product area that students do not profess to take seriously, but the reality is another matter. There are several themes that present themselves for dealing with this material. The historical account is probably the most straight forward, and cosmetics provides an effective way of looking at the past. The role of mass media and advertising in creating and selling images of beauty and the cosmetics that promise that beauty is another possible theme. The chemistry of cosmetics is an ideal way for introducing a wide range of chemical processes to an unsuspecting audience, especially as some of the techniques and products are suitable for home production.</p> <p>Time allocation: Discussion: 1-2 periods, Research – 1 hours, Write-up – 2 hours</p>	<p>Mankind has been playing around with its image ever since people became self-aware. This necessarily brief history of cosmetics stimulates the student to find out more. Although the emphasis is on history, the questions at the end invite the student to explore the chemistry, sociology and commerce associated with cosmetics, as well as delving more deeply into the history.</p>
17	Did Einstein wear Brylcream?	<p>Source material has been provided for this assignment, but can always be added to.</p> <p>Time will be needed for an initial brainstorm (approx. 15 minutes) followed by time for research and writing up.</p>	<p>Albert Einstein is many people's science stereotype - an old guy with crazy hair, sticking his tongue out in front of an equation-filled blackboard. But, as a practising scientist, Einstein was much younger. He even combed his hair.</p> <p>The perceptions we have of scientists, and science, are largely formed through the media's portrayal of science. The same applies to other stereotypes - your average cheeky cockney lives in Albert Square and drinks down the Queen Vic, doesn't he?</p>
18	Sex Sells	<p>It would be useful to collect some advertising source material as examples to fuel the discussion.</p>	<p>You don't have to be an advertising mogul to realise that sex sells. A partially naked man or woman only needs a tenuous link with the product they want us to buy. More often than not the link isn't even tenuous – it's non-existent.</p>

Links with A level coursework requirements

#	Subject	AS Level	A2 Level	AVCE Subject and Unit	Nature of Link	Potential development of Key Skills
01	Art	Art (OCR) Art and Design (AQA, Edexcel)	Art (OCR) Art and Design (AQA, Edexcel) History of Art (AQA)	Art and Design, Units 1 and 2	Possible coursework project	Communication Information Technology
02	Geography		Geography A (OCR) Geography B (AQA)		Possible coursework project	Application of Number Communication Information Technology
	General studies	General Studies A (AQA)			Possible coursework project	
	History		History (all)		Possible coursework project	
	Media studies	Media Studies (AQA)	Media Studies (AQA)	Media: Communication and Production, Unit 3	Possible coursework project	
03	Media studies	Communication Studies Media Studies (AQA)	Communication Studies Media Studies (AQA, OCR)	Media: communication and production, unit 3 and 4	Possible coursework project	Communication Information Technology
	Drama	Drama and Theatre Studies (AQA)	Drama and Theatre Studies (Edexcel)	Performing arts, unit 4 and 5	Possible coursework project	
	English	English Language (all) English Language and Literature (AQA, OCR)	English Language (all)		Possible coursework project	
	General studies	General Studies (AQA)			Possible coursework project	
04	Archaeology		Archaeology (AQA)		Possible coursework project	Communication Information Technology

	General Studies		General Studies		Possible coursework project	
05	English Language	Eng. Lang. B (AQA) Eng. Lang (Edexcel)	Eng. Lang. A (AQA)		Research Project, examples of language use.	
	Communication Studies	Comm Studies (AQA)			Oral presentation on comm'tion skills	
06	English Language and Literature	English Language and Literature B (AQA) AVS			Work and commentary for reading and reading aloud.	
07	Art	Art (OCR) A			Research programme	
	Art and Design	Art and Design (AQA)			Critical and historical study	
	History of Art	History of Art (AQA)			Project: topic of candidate's choice	
08	Drama and Theatre Studies	Drama and Theatre Studies (AQA) A	Drama and Theatre Studies (Edexcel) AS	Drama and Theatre Studies (AVCE) Units 4,5	perform part of a play practical study of plays creating work for performance, and performing	
09	Business			Unit 6: Business planning	Developing business plan for a science centre.	Communication Information Technology
	Leisure & Recreation			Unit 6: Leisure & Recreation in Action	Business plan for L&R project. Science centre as leisure activity.	

	Travel & Tourism			Unit 6: Travel & tourism in action	Business plan for T&T project. Science centre as a tourist attraction	
10	English Language	AQA (B)			Original writing	
	English Language & Literature	AQA (B)			Original writing	
	Media Studies		AQA		Response to newspaper article, looking at impact of the Internet on communication / the media.	
11	English Language	Edexcel	AQA (A & B) Edexcel OCR		Language used to report science stories	
	English Language	AQA (A & B) OCR			Writing to inform – controversial scientific issue	
	Communication Studies		AQA		Communicating a science story	
12	General studies	General Studies (AQA)			possible coursework project	Communication
	Art		Art (OCR) Art and Design (Edexcel and AQA) History of Art (AQA)		possible coursework project or starting point for a project	
13	Media studies	Communication studies Media Studies (AQA)	Communication studies Media Studies (AQA, OCR)		possible coursework project	Communication Information Technology

	English Language	English Language (B) (AQA)			Spur to creative writing assignment	
	Business			Business	Possible marketing exercise	
	General studies	General Studies (Edeccel))			possible coursework project	
14	Media studies	Communication studies Media Studies (AQA)	Communication studies Media Studies (AQA, OCR)	Media: communication and production, unit 3 and 4	possible coursework project	Communication Information Technology
	Drama	Drama and Theatre Studies (AQA)	Drama and Theatre Studies (Edexcel)	Performing arts, unit 4 and 5	possible coursework project	
	History	History (Edexcel)	History (AQA)			
	General studies	General Studies (AQA)			possible coursework project	
15	Media studies	Communication studies Media Studies (AQA)	Communication studies Media Studies (AQA, OCR)		possible coursework project	Communication Information Technology
	English Language	English Language (B) (AQA)			Spur to creative writing assignment	
	General studies	General Studies (Edeccel))			possible coursework project	
16	History	History (OCR)			Independent Investigation	
	General Studies	General studies (AQA, Edexcel)			Possible Coursework project	
	Media Studies		Media Studies (AQA)		Independent study of a contemporary media text or topic or issue arising out of a text.	

17	English Language	Eng Lang A (AQA)			comparison of different writing styles - written coursework	
	English Language	Eng Lang B (AQA)	Eng Lang B (AQA) Y		original writing to inform	
	English Language	Eng Lang (Edexcel)			study of language used in media	
	English Language	Eng Lang (OCR)	Eng Lang (OCR)		re-creative writing in 2 different genres on a common theme	
	Media Studies		Media Studies (AQA)		Study of contemporary media text - investigative and research based Test hypothesis	
				Media: Comm & prod Unit 4: produce a media product		
18	Media Studies		Media Studies (AQA)		Study of contemporary media text - investigative and research based Test hypothesis	

Further Ideas:

General Studies (AQA) AS level: The Solar Hydrogen Economy – One assignment based on this topic.

History (AQA) A level: The Entry of Women into Science and Technology: 'An analysis of a historical issue chosen from within or outside the broad content'.

The Cambridge Dictionary of Scientists (CUP, 1996) would be an excellent source.

Media Studies (AQA) A level: Are Tabloids Unable to Discuss Scientific Matters Objectively? Independent study of a contemporary topic or issue'

BSE, CJD, Anthrax, nuclear power, etc. are examples

Philosophy (AQA) A level: What is Scientific Truth? An extended essay researched in advance.

Patterns in plant structure: from Fibonacci numbers to the Eden glasshouses.

The progress of long distance communication: from smoke signals to satellite phones.

Study of a Science Centre. There would be many approaches:

- business
- tourism, leisure and recreation
- cognitive development
- design and technology
- ICT
- use of different media

Man and fermentation: the uses of yeast from ancient Egypt to genetic engineering.

The use of enzymes in industry, probably taking a particular case study for one approach:

- economics
- historical development
- environmental issues
- marketing strategies

Art: They do it with mirrors

David Hockney has recently published evidence of his theory that many of the great painters used mirrors and lenses to help with their paintings. He argues that the accuracy of the images is almost photographic, but with certain distortions which are consistent with using lenses.

- 1) Explore his theory for yourself. Do you find the arguments convincing? Are there other explanations for his observations?
- 2) Try making a drawing using a simple pinhole camera.

Places to start:

"Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters", David Hockney, pub. Thames & Hudson, 2001.
Omnibus, BBC2: transcript on www.bbc.com/omnibus/

Interview with David Hockney, reviews his book.

www.observer.co.uk/review/story/0,6903,564406,00.html

Some sceptics discuss the theory...

www.specialtyarts.com/disc2-guide.htm

Info about pinhole cameras...

<http://www.pinholevisions.org/resources>

Media studies: All around the world

One of the advantages of the Internet is the ease with which you can put information up there. (This could also be said to be one of its disadvantages...)

Take a current news story and look at how it is reported in different areas of the world. Which aspects of the story are the same, and which are different? Why do you think this is?

A good place to start is the Guardian online: www.guardian.co.uk

Their Weblog section contains links to news and opinion from around the world, focusing on current issues. See www.guardian.co.uk/weblog

Design and Technology/Information Technology: hands on science

Science centres are popping up all around the country. They work hard to communicate science by allowing visitors to experience things for themselves – hands on science, rather than the “do not touch” attitudes in older science museums.

Design a “hands on” exhibit which will allow people to explore a scientific idea or phenomena.

Alternatively, you could design a computer program to teach some aspect of science to younger students.

Examples of some online experiments www.exploratorium.org

English Language: Impact of technology on language

Language is always changing, but the advent of the internet and global broadcasting seems to have increased the rate of change.

Examples:

- 1) The rise of English as a “global” language.
- 2) Shifts in vocabulary and accent due to broadcasting – within the UK and around the world.
- 3) New words – internet vocabulary & txt msgs :-)
- 4) Americanisation of UK spelling – the impact of Microsoft Spellchecker and the internet!
- 5) Change in intonation – rising up at the end of a sentence. (as if you were asking a question).

Research one or more of these issues. Look at the changes happening, what’s causing them, and whether you think they are good, bad or neutral.

English Literature: send in the clones

Cloning used to be found only in the realms of science fiction. Then the media met Dolly the sheep, and a scientific breakthrough was sent spinning into the world of fact. Cloning of animals is now a reality, though it is horrendously difficult to do. Human cloning is a long way off, but as a precaution it has been banned in several countries. However, there are people in the world who are determined to make the attempt some day.

Imagine that scientists have found a way to clone human beings. Write a short story where at least one of the characters is a clone. How does it affect their relationship with the rest of the world?

OR:

Do you agree with scientists doing research into cloning? Why/why not? Find out a bit about what they are doing and why, and write an essay about the rights and wrongs of cloning.

Resources:

Read round the facts at www.whyfiles.org (search for "cloning")

See "Brave New World" by Aldous Huxley for a fictional take on cloning – among other things!