Unit 5: Perceptions of Science

Unit code: T/502/5545
QCF Level 3: BTEC National
Credit value: 10
Guided learning hours: 60

Aim and purpose

The aim of this unit is to enable learners to develop their knowledge of how science is perceived. Learners will consider how people, society and the media interact with science. They will also consider how scientific ideas develop and the ethical/moral issues associated with some scientific advances.

Unit introduction

This unit enables learners to explore the role of science in a wider context. How much influence does science have on society, people and politics? What influences science?

In this unit learners can use their science training and knowledge to explore the pressures on the science community. Similarly, they can investigate whether science can influence people and politicians.

Is it fair that scientists get the blame when their discoveries are misused? Should scientists withhold their knowledge in case the media get hold of it and release scare stories or misinterpret their work?

Although learners will need to do some initial research on the media, politics and society, the main thrust of this unit is the analysis of case studies. Learners will be putting forward reasoned arguments about some of the more controversial current science topics. Learners are free to choose their topics of study, providing they are relevant to the endorsed title they follow during this course. The tutor should be available for discussion and guidance in making these choices.

Learners can express their own opinions about the science topics of their choice but the final conclusions they present must be supported by factual evidence and well-reasoned arguments. This is an opportunity for learners to express their opinions in a constructive way.

This unit enables learners to consider how science industry impacts on the world we live in. It is also particularly suitable for learners who are interested in a career in science journalism.

Learning outcomes

On completion of this unit a learner should:

1 Know how scientific ideas develop

2 Understand the public perception of science, as influenced by the media

3 Be able to investigate the ethical and moral issues associated with scientific advances

4 Know the relationship between science, commerce and politics.

Unit content

1 Know how scientific ideas develop

Development of theories: ideas, discoveries; testing; evidence; hypothesis; predications; illustrative examples, eg quantum theory, evolution

Collection and analysis of data: methods of collection; use of controls, placebos, blinds, double-blinds; concordant data; repetition of experiments; validity; reliability; informed consent; ethics committees

Value and limitations of science: characteristics of a scientific question

Uncertainties: ideas develop over time; ideas acknowledged and validated by the scientific community; peer-review

2 Understand the public perception of science, as influenced by the media

Media: formats, eg newspaper, TV; target audience; influences, eg owners, hidden agenda; style of writing; science detail and accuracy; level of language used, eg technical, layman; effect of science reporting on different groups in society

Perceptions of science: film and television series, eg science documentaries, science docu-fiction; science 'scare' stories, eg MMR vaccine; exploiting public fears, eg rapid spread of viruses, DNA collection for government database

Attitudes to science: control of experimental work; safeguards for scientific research; control of research funds; allocation of public money; media representation, eg by non-science journalists, accuracy of science reporting; control of scientists' ideas; control of media output; positive attitudes, eg energy solutions, curing disease

Science reporting: specialist journals; popular science journals, eg New Scientist, Astronomy Now; newspaper articles; internet; style of writing, target audience, science detail and accuracy, level of language used; effect of science reporting on different groups in society

3 Be able to investigate the ethical and moral issues associated with scientific advances

Scientific advances: benefits; drawbacks; risks; contemporary scientific or technological advances, eg artificial intelligence, stem cell research; development of space exploration programmes; chemical weapons; genetic manipulation, eg GM crops; analysis of body fluids and materials at crime scenes; siting of radio masts

Ethical and moral issues: animals and humans as organ donors; transplants and self-inflicted illnesses, eg smoking and lung cancer; genetic manipulation, screening, eg to avoid inherited conditions; experimenting on animals, eg drug trials, long space journeys; use of scientific data obtained by dubious means, eg illegal experiments, wartime Nazi experiments

4 Know the relationship between science, commerce and politics

Society and politics: political groups, their influence on science issues; social groups in society, their influence and association with popular science; pressure groups, their influence on society, eg animal rights, civil rights groups; concerns, eg DNA databases, artificial reproduction; voluntary or statutory pressure groups; international pressures

Commerce and finance: public funding; private funding, eg financial supporters of research, vested interest; allocation of funds, eg cost effectiveness of new scientific developments in medicine; funding restraints on prescription drugs; postcode lottery of drug availability; financial rewards for donating organs; limited research resources and the cost, eg of international space stations, interplanetary explorations; development and control of science discoveries later used for non-peaceful purposes, eg chemical weapons, atomic (nuclear) bombs

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 describe the development of a scientific theory, highlighting the processes involved [IE2,3,5]	**M1** differentiate between those questions that science is currently addressing, those that science cannot yet answer and those that science will never be able to answer	**D1** explain why sometimes there is resistance to new scientific theories
P2 identify public perception about science	**M2** explain whether concerns raised about science in the media are justified	**D2** analyse whether the media makes a positive contribution to the public's perception of science
P3 explain how the media has influenced public perception of science [IE5; RL5,6]		
P4 report on the ethical and moral issues related to scientific developments [IE6]	**M3** discuss how the ethical and moral issues related to scientific developments will affect society	**D3** evaluate whether the ethical and moral issues are important enough to stop scientific developments
P5 identify how different groups and organisations have an influence on science. [TW1,5]	**M4** describe how different groups and organisations have an influence on science.	**D4** compare and contrast how different campaigns, by groups and organisations, influence science.

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

The use of specialist speakers is essential to provide the backdrop needed for this unit. It is intended that after the factual input learners will use their tutors as facilitators but essentially learners should be 'self-driven'.

Learners should negotiate, via individual action planning with their tutor, how they will meet the learning outcomes and grading criteria. The facilitators should be periodically reviewing each action plan to make sure the goals and target dates set are being met. Close monitoring of the learners is necessary to prevent loss of momentum and to ensure the focus is kept on the material to be covered.

In this unit the tutors, facilitators or mentors do not all need to be science specialists. Learners may benefit from having some input from staff from other disciplines. However, it is important that learners are able to consider science objectively and have the opportunity to develop a balanced view.

Learning outcome 1 is an opportunity for learners to explore the nature of science: what is a scientific question and what is not; and why. This is best done through informed discussion. Learners should appreciate that, while there are scientific methods, processes and conventions, science 'facts' are ultimately arrived at by consensus. It is not expected that learners explore the depths of the philosophy of science, but they should show an appreciation of the nature of science: that there is no *one* scientific method, but that scientists do follow general protocols to ensure validity and reliability of information. Learners should understand the ever-changing situation of scientific knowledge as theories are reviewed and improved to give a more realistic reflection of our world and how it works. They could also explore why there are some areas of knowledge that could be subject to scientific investigation but which are not.

Learners can do their own research to define 'the nature of science'. This should cause much discussion, which should be strongly encouraged.

Learning outcome 2 requires learners to understand how their perception of science fits in with the public perception. Additionally, they must consider the way science concerns are reported by the media. Some guidance should be given by the tutors to ensure learners look at all branches of science and technology and a variety of media formats. Learners should consider how the general and specialist media report a science story. They may then choose, after consultation, to consider some topics in line with their particular interests.

Learning outcome 3 allows any scientific advances to be considered from any branch of science or technology. Equally, any moral or ethical issues associated with these advances can be studied. Initially, input from tutors will be needed to get the learners to consider a wide range of advances and the subsequent issues that arise. After that, learners should receive mentoring by the tutors via action planning and tutorials but learners should essentially be 'self-driven'. Monitoring is essential to ensure the research and discussions enable the learning outcome to be met. Tutors should ensure learners consider both sides of an argument and are able to articulate and substantiate their own position.

Learning outcome 4 introduces learners to the funding issues of scientific research along with other pressures, such as those from voluntary and political groups. Learners should be encouraged to research these and must present a balanced view of these groups. A range of visiting speakers presenting differing views would greatly enhance the learning experience. Media reports and documentaries are a good source of stimulus material, especially regarding financial aspects (eg 'postcode-lottery' for healthcare). Learners should also be encouraged to look at historical developments and non-contentious 'spin-offs' from contentious research. To have a successful, meaningful debate, learners must be well prepared with their arguments and supporting evidence.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to unit – tutor input followed by small group activity to identify in general what the public thinks about identified science issues. Action planning.
Visiting speaker followed by group discussions on 'The nature of Science'; individual research to assist in the identification of scientific questions and non-scientific questions. Group and individual research on theories of scientific method.
Development of scientific theory – tutor-presented case studies used by learners to facilitate discussions. This could be supported by additional group research followed by short presentations to identify the main sections in the development of scientific theories using a specific historical example, eg structure of DNA. Review of action plan.
Assignment 1 – The Nature of Science (P1, M1, D1) The learner will carry out individual research, identifying a specific scientific theory that they will describe in order to demonstrate their knowledge of how theories develop and become accepted. Learners will also have an opportunity to differentiate between the types of questions that science can address.
Introduction to science and the media. Identification of different media formats. Group discussions about how science is portrayed in the media. Action planning.
Public concerns about science; consideration of a range of different case studies with class discussions of the issues raised. This could be supported by group research to justify opinions held. Review of action plan.
Assignment 2 – Science, the Media and Public Perceptions (P2, P3, M2, D2) Learners will have the opportunity to bring together the results of group activities and their own individual research to show their knowledge of public concerns about science and how these concerns are influenced or informed by the different types of media. Learners investigate how the media has influenced the uptake of the measles, mumps and rubella (MMR) vaccine. Consideration of both sides of the argument will allow learners to draw their own conclusions, which should be justified using the evidence from their research. Research of additional topics can be used to support arguments presented.
Introductions to ethics and moral issues in science. Tutor input and tutor-led discussions – what are ethics and what are morals? Action planning.
Science and society – group research of media representation of scientific issues and advances and presentation of findings to stimulate classroom discussion and debate. Review action plan.
Individual and group research of scientific advances and developments. Review of action plan.
Assignment 3 – Right or Wrong? (P4, M3, D3) Identification and discussion of ethical and moral issues related to specific scientific developments.
Introduction to science and politics. Tutor input on political influences on scientific developments.
Funding issues – who provides what and why? Visiting speakers to outline the available sources of funding and what benefits the provider of funds would hope to gain.
Use of case studies to consider the funding of medical research and the availability of drugs. Group research and presentations to stimulate class discussion and debate.
Class discussion/brainstorming to identify pressure groups and political groups which influence scientific developments. Research specific groups and prepare presentation.
Learner presentations on pressure groups etc.

Topic and suggested assignments/activities and/assessment
Assignment 4 – Science, Commerce and Politics (P5, M4, D4) Learners will construct a portfolio of information to carry out a presentation which shows the relationship between science, commerce and politics.
Review of unit and assignment programme.

Assessment

All the pass grade criteria must be met in order for a learner to achieve this unit.

For P1, learners have to investigate how science works and must describe the development of a scientific theory. Learners must understand that this is a dynamic process, without specific procedures. Competing theories exist in many areas of science. Learners can take a historical angle if they wish, and describe how from several competing theories one has come to prominence. This is not expected to be an in-depth study or a long complicated piece of work. Learners could present their work verbally, but evidence of research and/or presentation must be maintained for verification purposes.

For M1, learners must be able to differentiate between a scientific question and a non-scientific question (such as a philosophical question) and be able to explain what makes them different. Learners must understand the questions that science can address and be able to explain why there are some questions that science cannot address.

For D1, learners need to be aware of a range of professional journals and understand that this is how scientific developments are communicated to the scientific world. They must understand the process a scientific paper is subject to in order for it to be published, including the peer-review process. Drawing on their understanding of the development of scientific theories, they must then explain using examples, why a new theory is often greeted with scepticism and takes time to become accepted.

For P2, learners must demonstrate that they are aware of the general perception about science as indicated in the *Unit content*. A broad overview rather than detailed consideration of these concerns is required. For P3, learners should give a more detailed consideration of the concerns that are demonstrated by the public in two clearly identified cases and the influence of the media on public perception. Some of the topics chosen may be emotive and personal opinions will probably feature largely in the public perceptions put forward. This is inevitable but learners must provide evidence to support the perceptions outlined.

For M2, learners should consider the different approaches taken by different types of media when reporting scientific topics and should be able to relate public concerns to the way in which material is presented. Learners may look at the way in which a particular chosen topic is reported in the popular press as opposed to a scientific journal, or consider different types of TV or radio programme.

For D2, after researching and reviewing the evidence, learners are required to give their considered opinion about the influence the media has on the public's perception of science. As this could be daunting to start with, the tutor could give a couple of case studies and then allow learners to choose some examples of their own to finish the assignment. Learners must show their ability to analyse information and then synthesise the relevant material to give a coherent commentary on the influences stated. The emphasis is on the validity of the way the media raises concerns about scientific developments. Learners may be familiar with the more lurid headlines associated with some science developments, which on closer inspection may not be quite as they have been represented. Learners need to study these portrayals and then comment critically on the presentations made by the media.

For P4, learners must investigate scientific advances through research, case studies, group discussions or presentations by visiting speakers and give a brief report on the ethical and moral issues that are raised by some advances. This criterion lends itself to a verbal presentation or discussion supported by research and presentation notes. The learners must provide evidence that can be verified, so presentations must be recorded or notes retained (eg preparatory notes, print-out of electronic presentations) for this purpose.

For M3, the emphasis is not on the development process but the attitudes that were shown as a result of the scientific advance. Any area(s) of science or technology can be used providing they give enough material for learners to discuss how the ethical and moral issues will affect society. Choosing topics which gave rise to positive and negative responses is to be encouraged.

For D3, the choice of a reported controversial science development can be made by learners or the tutor but it needs to be evaluated critically. Learners need to make a judgement as to whether the issues are important enough to stop the development. This decision should be made by researching different sources of information. The sources can be newspapers, scientific journals or websites but they need to be sufficiently different in approach and target readership to make the evaluation worthwhile. The reports need to be analysed for accuracy, clarity, scientific content and facts versus opinions. Issues such as animal experimentation and the development of chemical weapons are likely to arise, but the learners should be encouraged to look further afield. Evidence of information collected and analysed must be included in any presentation and its use in making judgements needs to be demonstrated.

For P5, learners should be encouraged to carry out their own web-based research, contact any particular groups in which they are interested. It is important that learners present a balanced summary, identifying the purposes and views of these groups.

For M4, learners need to understand that all science needs funding. Much of this comes in various forms from the government, but a large proportion comes from public funding and learners must demonstrate an understanding of how this may influence the direction and possibly even the outcomes and presentation of scientific research.

For D4, there are many examples of useful everyday products resulting from research in entirely different areas, eg military or space programmes. Some scientific research has been put to very destructive uses: learners must explain an example of this and discuss its effects or perceptions. Learners are encouraged to carry out their own research into an area that interests them and represent their findings, which could take the form of a written or verbal report, a poster or information leaflet.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, M1, D1	The Nature of Science	Researcher for a TV production company preparing information to support a potential programme.	Project portfolio.
P2, P3, M2, D2	Science, the Media and Public Perceptions	Science journalist who has been asked to take part in a debate on public concerns about science.	Portfolio of evidence consisting of research material and notes. Witness statement for participation in the debate.
P4, M3, D3	Right or Wrong?	A representative from the ethics committee of a science body is asked to prepare a report.	Written report.
P5, M4, D4	Science, Commerce and Politics	You are a research scientist who has been asked to give a presentation at a conference which illustrates the relationship between science and social and political groups.	Presentation supported by notes, visual aids, handouts etc.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC in Applied Science sector suite. This unit has particular links with all units within the programme as it enables learners to think about science in greater perspective.

Essential resources

Learners require access to library and internet data but not laboratory space. Relevant journals and daily newspapers, weeklies and periodicals should be available. Access to political material and to television channels via cable and satellite, eg channels with 24-hour news, political shows and other interests, are also needed.

Specialist input from colleagues and/or guest speakers who have knowledge of the media, law, politics, sociology and philosophy (ethical and moral issues) is highly recommended to provide the wider background needed for this unit.

Some learners may require access to recording equipment as they can choose to present some of their material via audio/visual recordings.

Employer engagement and vocational contexts

The choice of topics investigated and reported on in detail may be influenced by employment prospects of learners or by the pathway that they are following.

It would be beneficial for centres to visit the STEMNET website **www.stemnet.org.uk** or Future Morph **www.futuremorph.org** for more ideas about vocational contexts.

Indicative reading for learners

As this unit covers such a wide variety of subjects, the following are suggestions of books which may give a flavour of the kind of material that could come up for discussion. As it is likely that several tutors will input into this unit from different subject disciplines, other texts and websites may be preferred and suggested by each subject specialist.

Textbooks

Foale S, Hocking S, Llewellyn R, Musa I, Patrick E, Rhodes P and Sorensen J – *BTEC Level 3 in Applied Science Student Book* (Pearson, 2010) ISBN 9781846906800

Best J – *Damned Lies and Statistics: Untangling Numbers from the Media, Politicians and Activists* (University of California Press, 2001) ISBN 9780520219786

Brignell J – *The Epidemiologists: Have They Got Scares for You!* (Brignell Associates, 2004) ISBN 9780953910823

Curran J – *Mass Media and Society* (Hodder Arnold, 2005) ISBN 9780953910823

Goliszek A – *In the Name of Science: A History of Secret Programs, Medical Research and Human Experimentation* (St Martin's Press, 2003) ISBN 9780312303563

Jackson A R W and Jackson J – *Forensic Science* (Prentice Hall, 2004) ISBN 9780130432513

Jewkes Y – *Media and Crime: A Critical Introduction* (Sage Publications, 2004) ISBN 9780761947653

Michaels P J – *Meltdown: The Predictable Distortion of Global Warming by Scientists, Politicians and the Media* (Cato Institute US, 2005) ISBN 9781930865792

Moreno J D – *Undue Risk: Secret State Experiments on Humans* (Routledge, 2000) ISBN 9780415928359

Mur C – *Animal Experimentation* (Greenhaven Press, 2004) ISBN 9780737720006

O'Sullivan T et al – *Studying the Media* (Hodder Arnold, 2003) ISBN 9780340807651

Spitz V – *Doctors from Hell: The Horrific Account of Nazi Experiments on Humans* (Sentient Publications, 2005) ISBN 9781591810322

Warren D – *The Nature of Science* (RSC Publications, 2001) ISBN 9780854043767

Websites

www.cdc.gov	Centre for Disease Control and Prevention (American website: has a set of scenarios that could provoke discussion)
www.chemsoc.org	Royal Society of Chemistry's chemical science network
www.indiana.edu	Indiana University
www.kosmoi.com	Science/method science, nature, technology
www.project2061.org	Advancing Science

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	[IE2,3,5,6] planning and carrying out research into scientific developments
Reflective learners	[RL5,6] considering differing public perceptions of science thinking about ethical and moral issues associated with scientific developments
Team workers	[TW1,5] conducting group research and taking responsibility for their role within the group.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Creative thinkers	[CT4] questioning their own assumptions about scientific developments
Reflective learners	[RL3,4,5] providing balanced reports of differing viewpoints justifying own standpoints where appropriate evaluating experiences and learning to inform future progress
Self-managers	[SM2,3,6] action planning for completion of assignments and production of evidence seeking help and support from tutor or mentor when necessary
Effective participators	[EP2,5] contributing to group discussion.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	making appropriate choices of software programs to facilitate research, storage and development of information
Manage information storage to enable efficient retrieval	correctly using folders etc to store researched information about a number of different topics in an efficient manner
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching information using a variety of websites to create reports or presentations
ICT – Develop, present and communicate information	
Bring together information to suit content and purpose	producing a presentation, written report etc
Present information in ways that are fit for purpose and audience	making presentations
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	presenting their findings to the class listening to tutors and visiting speakers listening to peer presentations taking part in group discussions and debate
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reading information from a variety of sources, selecting the relevant information to help form and justify an opinion of their own
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing reports, articles and producing presentations following their own research.