

# Unit 11: The science of the universe and humanity (LEVEL 2)

## Learning outcomes

This unit introduces candidates to the deeper scientific questions, such as the origins of the universe and how human beings have evolved. It also examines the effect we have on the Earth's environment, with our need for useable energy. When delivered in combination with Unit 1 and Unit 2, this unit will meet the requirements of the Key Stage 4 science programme of study.

Candidates will develop a knowledge and understanding of Earth's location in the universe and the changing conditions that affect the Earth. The unit also examines how, as living things, humans are affected by these changes.

Candidates will produce evidence to meet the unit assessment objectives in order to show that they understand that:

- the universe, since its origin, continues to show change
- the solar system is part of the universe
- composition of the surface of the Earth is in flux
- variation within species can lead to evolutionary changes
- organisms are interdependent and adapt to their environment
- electrical energy is readily transferred and controlled
- energy transfers can be measured and controlled
- the effects of human activity can be assessed.

Assessment objectives	Knowledge, understanding and skills
1 Describe the long-term changes that have occurred in the universe, to our solar system and to the Earth	<p>The universe was formed by “the big bang” and contains:</p> <ul style="list-style-type: none"> <li>• galaxies</li> <li>• constellations</li> <li>• stars</li> <li>• nebulae</li> <li>• planets</li> </ul> <p>Our solar system is made of a number of planetary objects which have different surface conditions</p> <p>Planetary objects:</p> <ul style="list-style-type: none"> <li>• Sun</li> <li>• planets</li> <li>• satellites</li> <li>• asteroids</li> </ul> <p>Surface conditions:</p> <ul style="list-style-type: none"> <li>• atmosphere</li> <li>• rock types</li> <li>• temperature</li> <li>• gravity</li> <li>• solar radiation</li> <li>• organic life</li> </ul>

(continued overleaf)

Assessment objectives	Knowledge, understanding and skills
<p>1 Cont.</p> <p>Describe the long-term changes that have occurred in the universe, to our solar system and to the Earth</p>	<p>The surface and the atmosphere of Earth changes due to:</p> <ul style="list-style-type: none"> <li>• rock cycle</li> <li>• plate tectonics</li> <li>• carbon cycle</li> <li>• water cycle</li> <li>• radiation from the Sun</li> <li>• combustion of fossil fuels</li> </ul> <p>Use ICT sources or tools to either gather or present data</p>
<p>2 Describe how astronomers use electromagnetic radiation in the study of the universe</p>	<p>Astronomical objects emit energy in the form of radiation across the whole range of the electromagnetic spectrum. The electromagnetic spectrum comprises:</p> <ul style="list-style-type: none"> <li>• radio waves</li> <li>• microwaves</li> <li>• infrared</li> <li>• visible light</li> <li>• ultraviolet</li> <li>• X-rays</li> <li>• gamma-rays</li> </ul> <p>Electromagnetic radiation communicates information to astronomers from distant objects in space, such as:</p> <ul style="list-style-type: none"> <li>• colour</li> <li>• temperature</li> <li>• composition</li> <li>• velocity</li> </ul> <p>How electromagnetic radiation can be detected more efficiently</p>
<p>3 Examine the weathering and erosion of the Earth's surface by carrying out <b>THREE</b> experiments</p>	<p>Carry out a minimum of <b>THREE</b> experiments to show the effect of climatic conditions on the Earth's surface</p> <p>Climatic conditions could include:</p> <ul style="list-style-type: none"> <li>• freezing</li> <li>• heating and cooling</li> <li>• rainfall</li> <li>• localised conditions – such as: acid rain; torrential storms; sand storms</li> </ul>
<p>4 Describe how the human body responds to the environment to safeguard itself</p>	<p>Select <b>ONE</b> environmental condition and describe how the human body would react to it in terms of body functions and body mechanisms in order to safeguard itself</p> <p>Environmental conditions that might effect the body:</p> <ul style="list-style-type: none"> <li>• heat</li> <li>• drought starvation</li> <li>• predators</li> <li>• danger</li> </ul> <p>Body organs might include:</p> <ul style="list-style-type: none"> <li>• heart</li> <li>• liver</li> <li>• kidneys</li> <li>• adrenal glands</li> </ul> <p style="text-align: right;">(continued overleaf)</p>

Assessment objectives	Knowledge, understanding and skills
<p>4 Cont.</p> <p>Describe how the human body responds to the environment to safeguard itself</p>	<p>Mechanisms that help safeguard the body might include:</p> <ul style="list-style-type: none"> <li>• blood-clotting</li> <li>• sweating</li> <li>• hormones</li> <li>• conscious actions</li> <li>• reflex actions</li> <li>• coma</li> </ul>
<p>5 Describe how variation and selection within species can lead to evolutionary change</p>	<p>Variation arises from genetic differences and environmental differences</p> <p>Genetic differences may arise from:</p> <ul style="list-style-type: none"> <li>• sexual reproduction</li> <li>• inheritance</li> <li>• mutation</li> </ul> <p>Environmental differences may arise from:</p> <ul style="list-style-type: none"> <li>• climate</li> <li>• population size</li> <li>• predication</li> <li>• abundance of resources</li> </ul> <p>Natural selection favours individuals that are well adapted to their environment and leads to evolutionary change over time</p> <p>Artificial selection methods produce faster change and include:</p> <ul style="list-style-type: none"> <li>• cloning</li> <li>• selective breeding</li> <li>• genetic breeding</li> </ul>
<p>6 Carry out a practical investigation into the variation caused by inheritance</p>	<p>Carry out an investigation that will show variation caused by a gene</p> <p>Variation could include:</p> <ul style="list-style-type: none"> <li>• height</li> <li>• hair colour</li> <li>• eye colour</li> <li>• skin tone</li> </ul>
<p>7 Describe modern environmental reasons for variation between humans and consider the impact of these differences</p>	<p>Environmental differences that affect humans might include:</p> <ul style="list-style-type: none"> <li>• medical care</li> <li>• use and misuse of drugs</li> <li>• food resources</li> <li>• economic resources</li> <li>• climate</li> </ul> <p>The impact of these differences on people from different parts of the world might include:</p> <ul style="list-style-type: none"> <li>• physical health</li> <li>• mental health</li> <li>• housing</li> <li>• recreation</li> <li>• economic development</li> </ul>

Assessment objectives	Knowledge, understanding and skills
<p>8 Discuss the need for developing devices that do not rely on electrical energy generated from fossil fuels and carry out investigations into <b>TWO</b> devices producing useable electrical energy</p>	<p>Use practical investigations to compare the useful electrical energy produced by a minimum of <b>TWO</b> devices. These could include:</p> <ul style="list-style-type: none"> <li>• wind turbine</li> <li>• water turbine</li> <li>• steam engine</li> <li>• generator</li> <li>• fuel cell</li> </ul> <p>The investigations should be reported using scientific concepts, such as:</p> <ul style="list-style-type: none"> <li>• forces</li> <li>• kinetic energy</li> <li>• potential energy</li> <li>• electrical energy</li> <li>• work</li> <li>• power</li> <li>• energy transfer</li> <li>• efficiency</li> <li>• cost</li> </ul> <p>Comparison of advantages and disadvantages of energy production from renewable and non-renewable energy devices. Issues include:</p> <ul style="list-style-type: none"> <li>• sustainability</li> <li>• availability</li> <li>• dependability</li> <li>• pollution</li> <li>• storage</li> </ul> <p>Comparison of the economic costs associated with energy production from each of the <b>TWO</b> devices</p>
<p>9 Examine the effects of human activity on the environment, in relation to the production of energy, by carrying out <b>TWO</b> investigations</p>	<p>Carry out <b>TWO</b> investigations into the effects of human activity, one measured by a living indicator and one by a non-living indicator</p> <p>Human activities could include:</p> <ul style="list-style-type: none"> <li>• combustion</li> <li>• quarrying</li> <li>• mining</li> <li>• chemical treatment</li> <li>• waste disposal</li> </ul> <p>Living indicators could include:</p> <ul style="list-style-type: none"> <li>• fresh water invertebrates</li> <li>• lichen</li> <li>• cress</li> <li>• pepper moth</li> <li>• microbes</li> </ul> <p>Non-living indicators could include:</p> <ul style="list-style-type: none"> <li>• universal indicator</li> <li>• carbon dioxide meter</li> <li>• decolourisation by particulates of</li> <li>• sandstone</li> <li>• erosion of limestone</li> </ul>

## Assessment

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This unit is centre-assessed and externally moderated.

In order to achieve this unit candidates must produce a portfolio of evidence showing that they can meet all of the assessment objectives.

Portfolios of work must be produced independently. They will need to be made available, together with witness statements and any other supporting documentation, to the OCR Visiting Moderator when required.

Centres must confirm to OCR that the evidence produced by candidates is authentic. An OCR Authentication Form is provided in the Centre Handbook and includes a declaration for assessors and candidates to sign. It is a requirement of the QCA Common Criteria for all Qualifications that proof of authentication is received.

## Guidance on assessment and evidence requirements

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Working safely and effectively in science requires all candidates to follow instructions correctly and to handle materials and equipment competently.

**Tutors should at all times make sure that candidates comply with any safety considerations that have been published by any regulatory body (refer to COSHH regulations, CLEAPPs handbook and CLEAPPs: hazard and student safety sheets). There may also be relevant safety regulations issued by the DfES or local LEAs, as well as the institution that the course is being carried out in, that need to be considered.**

This unit introduces candidates to the deeper scientific questions, such as:

- what is the universe?
- how did the human species evolve?
- with our need for energy, how do we affect the environment of our planet?

An OCR model assignment is available for this unit. It can be downloaded from our website: [www.ocr.org.uk](http://www.ocr.org.uk) and can also be found in the Model Assignments folder on this CD Rom.

## Describe the long-term changes that have occurred in the universe, to our solar system and to the earth (AO1)

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One major theory is that the Universe began with a “big bang” 15,000 million years ago and that all matter is spreading out from this “big bang”. The underlying premise of this theory is that the universe contains all that exists: millions of galaxies, stars, planets and all the space and gas between them. Candidates should have an awareness of this theory and recognise that theories change over time, through paradigm shifts, and that the scientific community validates currently held theories. They should also recognise that our Sun is just one star amongst several million, in a galaxy known as the Milky Way which is made up of millions of stars forming a spiral that is 100,000 light years across. Candidates should also have an awareness of how a massive blue type star and a small yellow star, like our own Sun, are formed from nebulae and that stars could finally form into a black hole or black dwarf.

By looking at the night sky with a telescope, candidates will be able to see some of the distant stars in the Milky Way and may recognise some of the constellations, with the aid of star charts. Many of these stars will have their own planetary system, like our own Sun, and candidates may see some of the planets in the Solar System as wandering stars whilst looking at the night sky. This approach may lend itself to a historical treatment of theories of the Solar System (Greeks naming the constellations; that planets are wandering stars; sky signs of the Zodiac; or the

Egyptians' idea that the Sun is God's chariot and the early Catholic view that the universe is Earth centred).

Candidates should be introduced to the planets of the Solar System and discuss why the Earth supports life, whereas the other planets do not. They could also consider whether the other planets could have supported life in the past. In order to examine the Solar System, candidates need to develop an understanding of the Sun. They will need to recognise that due to nuclear fusion reactions at the Sun's centre, it radiates energy that travels across space to the planets. Candidates should not only realise that space is a vacuum and the Sun's radiation will transfer energy from it to Earth but some of this energy can be absorbed or reflected and that the greenhouse effect is linked to this.

Ideally, the Earth should be studied in more detail than the other planets and candidates should understand that the Earth is a dynamic planet, which is constantly changing. With a thin crust, broken into plates, which float on a semi-liquid layer called the mantle, the Earth exhibits geological events (volcanoes, earthquakes, mountain building) at the plate boundaries. With these events come the formation and movement of rocks that can be summarised in the "rock cycle". The Earth also importantly has an atmosphere, which is affected both by these geological events and the radiation from the Sun. With an understanding of the carbon cycle, water cycle and weather patterns, candidates should realise the balance required to sustain life on Earth.

The surface temperature and presence/absence of an atmosphere could be researched and discussed. Candidates should realise that the surface temperature of a planet does not only depend on its distance from the sun (eg Earth and the Moon are the same distance away) but that surface temperature also depends on greenhouse gases. Life on Earth depends on the greenhouse effect for its evolution and survival, but combustion of fossil fuels, particularly for electricity generation and transport, is increasing the greenhouse effect and could lead to climate change. Candidates should appreciate that human activity also can affect the Earth.

Evidence to demonstrate this breadth of knowledge could be the following:

- a presentation of the formation of the universe and the predicted life of the Sun
- a comparative (including: surface conditions; atmospheric conditions, size; distance from the Sun) summary of the planets within the Solar System
- tables of data to compare the surface temperature, distance from the sun, and presence or absence of an atmosphere, for planets in the Solar System
- a presentation of dynamic events that occur on Earth
- notes from a discussion of how life exists on Earth.

Candidates **must** use ICT sources or tools to either gather or present their data. To meet this requirement, they could use digital imagery, spreadsheets and other electronic formats in their presentations.

## Describe how astronomers use electromagnetic radiation in the study of the universe (AO2)

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All the time objects in space emit electromagnetic radiation that transfers energy, which can be detected by receivers. These electromagnetic waves transmit information. By measuring the wavelength or frequency of radiation coming from objects in the universe, we can learn something about their nature. By plotting the intensity of light at each wavelength a blackbody curve is obtained. Hotter objects will have shorter wavelength peaks and look blue, whereas cooler objects look red because of the longer wavelength. As we cannot travel to a star or take samples from a galaxy, astronomers depend on electromagnetic radiation to receive information from distant objects in space.

Different wavelengths probe different regions and physical mechanisms in an astronomical object. The range of waves within the electromagnetic spectrum allows astronomers to gather information.

For example:

- radio waves see through clouds of dust to reveal objects
- microwaves are the background “noise” of the big bang
- infrared penetrates dust into the centres of galaxies and starburst regions
- visible light is the oldest and best known branch of astronomy allowing us to see space objects
- ultraviolet is emitted by hot objects such as stars
- X-rays are not absorbed by dust so hidden regions can be revealed eg the Chandra Observatory revealed a hidden huge black-hole in the centre of our galaxy.

Information in the form of visible light, radio waves and ultraviolet from electromagnetic radiation from space reaches the surface of Earth. However astronomers have striven to improve the effectiveness of their communication receivers. This has been accomplished by:

- rising above the Earth’s atmosphere using aircraft and rockets
- increasing the sensitivity of instruments, so the information communicated from the full range of space’s electromagnetic radiation can be accessed.

This has resulted in new instrumentation such as the Hubble Telescope, NASA’s Swift and HETE satellites and in missions, for example NASA’s launch of the New Horizons mission to Pluto, improving the detection of space radiation.

With the growth in use of satellites exploring space, candidates would have the opportunity to examine the methods of communication that might be available or improved on. They should recognise that with space exploration there is the need for efficient communication. To demonstrate the knowledge and understanding required, candidates could produce a summarisation of the properties, sources and detection of the electromagnetic spectrum with reference to space objects.

## Examine the weathering and erosion of the Earth’s surface by carrying out three experiments (AO3)

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It is not only Earth’s dynamic events that alter its surface, climatic conditions also play their part. Constant weathering and erosion changes the surface of the Earth in a short space of time. Candidates should develop an understanding of why certain rock surfaces look the way they do, due to climatic conditions.

Candidates could investigate the forces of freezing water on the Earth, simply by filling and sealing a glass jar and placing it in a freezer. With the expansion of water on freezing, the glass will break. Candidates could also use a porous rock to investigate the impact of weathering. Such a rock could be shattered by heating and then cooling it rapidly.

Candidates should be able to see the evidence of water erosion, in terms of its affect on rocks, hillsides, and coastal cliffs. A long-term study in the laboratory, with the use of soft rock, could easily simulate this. As well as this, the affects of a dilute acid (acid rain) and a blast of sand on rocks can also be investigated in the laboratory.

Evidence could be laboratory notes and conclusions of **three** investigations into the climatic effect on the Earth’s surface.

## Describe how the human body responds to the environment to safeguard itself (AO4)

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The human body is a very adaptive organism that is able to respond to changes in the Earth's surface and/or environment, in order to protect itself.

Candidates are expected to select **one** environmental condition and describe how the human body would react to it in terms of body functions and body mechanisms in order to safeguard itself.

Evidence could be in the form of a discussion report linking the response of the human body to an environmental condition.

This assessment objective acts as a bridge between Assessment Objective 4 and 6. Once candidates have considered the ways in which the body responds to changes in the environment in the short-term, they can then consider how the body evolves in the long-term.

## Describe how variation and selection within species can lead to evolutionary change (AO5)

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It is likely that candidates will come to this unit with knowledge of reproduction, from their Key Stage 3 studies. In order to build upon this, candidates should recognise that whilst many people share common physical features, there are also many differences between humans, in terms of their physical characteristics. Humans in some families look very alike, as they have inherited common characteristics through their genes.

Although it would not necessarily be practical to conduct experiments into human variation in the school/college laboratory, candidates could conduct a survey of the variation of eye colour, hair type and earlobe type within a group. The collecting of data would lend itself to the use of ICT and the evaluation of methods of data collection. The idea of variation would lead onto the concept of characteristic information carried by chromosomes and DNA sequencing. However due to mutation, when genes are missing, or there are extra genes, or different genes, great change can occur in living organisms and genetic diseases can be inherited. Colour blindness, Down's syndrome, cystic fibrosis and Parkinson's disease are examples of inherited diseases.

With the advent of gene therapy some genetic diseases such as cystic fibrosis is treatable and genetic variation can produce new varieties of fruits, vegetables and livestock, however this could be an opportunity to raise the idea that contemporary scientific developments not only have benefits but they may also have drawbacks and risks. Tutors may refer to the current GM debate and allow candidates an opportunity to discuss the pros and cons of the argument and learners may make reference to this in their evidence. Candidates should also understand the differences between selective breeding and genetic breeding.

Selective breeding would overlap with AO4 introducing candidates to the concept that environmental factors can cause evolutionary change. Tutors could link the idea of evolutionary change to the origin of species and how humans could have evolved.

There are a number of activities that tutors could use with the candidates to support the knowledge and understanding in this assessment objective:

- Interactive CD ROM: Evolution- The 3 billion year journey
- People packs – students learn the concepts of dominant and recessive genes
- Human chromosome analysis set –prints of metaphase cell photographs from which chromosomes are cut out and then karyotypes are prepared.

All of the above are supplied by Philip Harris, a commonly used educational supplier.



Evidence could be:

- spreadsheet containing variation data and an evaluation on the data collection method
- an overall conclusion in the form of a presentation, using scientific terminology, on how a type of organism, such as humans, has and is evolving.

### Carry out a practical investigation into the variation caused by inheritance (AO6)

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Candidates need to carry out **one** investigation, where they measure one variation caused by inheritance. A straightforward investigation is to use a rapidly cycling brassica, which can be grown in a classroom under 24 hour fluorescent illumination. The short generation time (seed to seed in five weeks) of the plants makes it possible to complete three generations within a term.

Maize is a plant that could also be used. There are two main types of maize plants, tall and dwarf. By using a tall parent plant to pollinate a dwarf parent plant, three generations can then be grown on. Pollination within generations and the seeds from the generations can be grown on, to examine tallness, using a dominant gene and dwarfness. This can be done by recording height, number of leaves and length of leaves and establish the ratio of plants looking like the parent plants. Candidates could then examine the reliability of the data and compare it to other measurable outcomes, such as the final dry weight which could be measured with greater sensitivity rather than estimating heights.

An alternative investigation would be to conduct a survey of genetic differences amongst a chosen group of humans.

Evidence could be the test results from **one** investigation, with an analysis.

### Describe modern environmental reasons for variation between humans and consider the impact of these differences (AO7)

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This assessment objective gives candidates the opportunity to consider the current issues that affect all of us. They should realise that even today factors affect our development. This can be seen in stark contrast between what is happening to people in some parts of Africa and when compared to the majority of people living in the United Kingdom. They should consider how and why decisions about science and technology are made, including those that raise ethical, social, economic and environmental issues of such decisions. Candidates should discuss the environmental factors that cause variation between humans, eg the effects of lifestyle with specific reference to the use of drugs such as alcohol and other recreational drugs which can affect the normal functioning of body systems, affecting mental and physical health.

Candidates should carry out research to compare the environmental issues that result from such things as food resources, medical care, use and misuse of drugs, economic resources and health issues that face people from two very different cultures.

Evidence could be in the form of a presentation supported by the use of images, video or text to compare the environmental issues facing two different cultures.

### Carry out investigations into two devices producing useable electrical energy (AO8)

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Candidates should be aware that all humans need energy to stay alive and to remain active. Whilst we get our bodily energy from the food we eat, technological evolution has been driven by humans' use of tools and the use of energy; initially fire. Today one of the main energies is electrical energy, produced by burning fossil fuels. We need to find alternative energy resources

due to the finite nature of fossil fuels and the environmental outcomes of increasing carbon dioxide concentrations.

Candidates should investigate at least **two** devices that produce electricity. They should have an understanding of the conservation of energy (energy can neither be created or destroyed but can be converted from one form to another). Candidates should also recognise that almost all the Earth's energy comes from the Sun. Without the Sun we would not have photosynthesis, which allows green plants, which are at the start of any food chain, to survive. Without the Sun, the fossil fuels, which have come from fossilised plants or animals, could not be produced.

In their investigations, candidates should not only explain the transfer of energy in scientific terms but also comment on the efficiency of the two devices that they investigate. This could be accomplished by completing an energy transfer diagram, which displays the total input energy, the useful energy produced and the wasted energy. The efficiency of the use of energy is also important when considering the economic costs. Candidates could consider the costs of electricity bills in a conventional house compared to a house using solar energy or wind energy as a domestic power source.

Evidence could be presented in the form of laboratory notes from the **two** investigations, with an analysis of the efficiency of both devices.

### Examine the effects of human activity on the environment, in relation to the production of energy, by carrying out two investigations (AO9)

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Candidates should recognise that humans also affect Earth's environment and that this affect can be measured. Candidates will need to collect samples from the environment, choose the correct tests to analyse the samples and report on their results. This assessment objective links to the Best Practice unit and could be used in conjunction with teaching this objective.

Candidates would be expected to:

- follow standard procedures in a safe manner
- carry out sampling operations
- carry out testing operations
- produce a report linking the level activity to local, regional or global with a recommendation to the safety and sustainability of the activity.

Evidence could be the laboratory notes from two investigations and a report for each which might include some ICT with the use of spreadsheets; data loggers; digital photos.

## Signposting to Key Skills

- ✓ The unit contains opportunities for developing the Key Skill, and possibly for generating portfolio evidence, if teaching and learning is focused on that aim. Assessing staff will need to check each candidate's evidence against the specifications to ensure all evidence requirements have been met. Additional evidence may also be required.

Key Skill reference		Key Skill reference		Key Skill reference	
C2.1	✓	N2.1	✓	ICT2.1	✓
C2.2a	✓	N2.2a	✓	ICT2.2	✓
C2.2b	✓	N2.2b	✓	ICT2.3	✓
C2.3	✓	N2.2c	✓		
		N2.2d			
		N2.3	✓		

## Mapping to National Occupational Standards

Occupational Standards	Unit number	Title
LATA	1.01	Complying with Statutory regulations and Safety requirements
LATA	1.04	Take laboratory measurements
LATA	1.05	Perform basic laboratory activities
LATA	2.03	Carry out simple testing operations
LATA	2.04	Carry out simple sampling operations

## Resources

The following are suggestions of resources that could be useful when delivering the unit. They are neither prescriptive nor exhaustive, and candidates should be encouraged to gather information from a variety of sources.

### Books

DfES (1996)	<i>Safety in science education</i> The Stationery Office Books
CLEAPSS Laboratory Handbook (updated 2005)	See <a href="http://www.cleapss.org.uk/">URL:http://www.cleapss.org.uk/</a> for details
CLEAPSS Hazcards (updated 2005)	See <a href="http://www.cleapss.org.uk/">URL:http://www.cleapss.org.uk/</a> for details
Association for Science Education (1996)	<i>Safeguards in the school laboratory</i> ASE
Dept of Education and Science (1985)	<i>Microbiology: A guide for schools and non-advanced further education</i> The Stationery Office Books
Ryan, L. (1996)	<i>Chemistry for you</i> Nelson Thornes

- Johnson, K (1996) *Physics for you*  
Nelson Thornes
- Williams, G. (1996) *Biology for you*  
Nelson Thornes
- Bell, C., Brodie, D., Dawson, B., Tiernan, A. (2003) *GCSE in Applied Science Double Award: Student Book*  
Folens Publishers
- Gadd, K. (2003) *GCSE Applied Science Double Award: Edexcel Student Resource Book*  
Nelson Thornes
- Alderton, G. (2001) *Revise for Science GCSE: Salters Year 10*  
Heinemann Educational Secondary Division
- Uyseg (2002) *Salters GCSE Science: Year 11 – Student Book*  
Heinemann Educational Secondary Division

### **Journals/Magazines/Newspapers**

Protocols and standard operating procedures from local organisations. Science teachers should be familiar with the requirements of COSHH Regulations, with DfEE (DES) memoranda on the use of plants and animals in schools and with regulations applying locally. For information contact science advisor/education department.

### **Websites**

BBC Science and Nature: Space. [URL:http://www.bbc.co.uk/science/space/](http://www.bbc.co.uk/science/space/)  
Information on the solar system and its origins, stars and deep space.

## Grading

Assessment Objective	Pass	Merit	Distinction
<p><b>AO1</b> Describe the long-term changes that have occurred in the universe, to our solar system and to the Earth</p>	<p>Candidates describe in <b>basic</b> terms the formation of the Universe, the predicted life of the Sun, the dynamic geological events that occur on Earth and the electromagnetic spectrum. They also make <b>basic</b> a comparison between the planets within the Solar System and give a <b>brief</b> account of whether life could exist on them. Candidates <b>use</b> ICT sources or tools to either gather or present their data.</p>	<p>Candidates will give a <b>good</b> description of the formation of the Universe, the predicted life of the Sun, the dynamic geological events that occur on Earth and the electromagnetic spectrum. They will also make a <b>detailed</b> comparison between the planets within the Solar System and give a <b>sound</b> account of whether life could exist on them. Candidates <b>use</b> ICT sources or tools to either gather or present their data.</p>	<p>Candidates will give an <b>excellent</b> description of the formation of the Universe, the predicted life of the Sun, the dynamic geological events that occur on Earth and the electromagnetic spectrum. They also make a <b>detailed</b> comparison between the planets within the Solar System and give a <b>comprehensive</b> judgement as to whether life could exist on them. Candidates <b>use</b> ICT sources or tools to either gather or present their data.</p>
<p><b>AO2</b> Describe how astronomers use electromagnetic radiation in the study of the universe</p>	<p>Candidates describe in <b>basic</b> terms the properties, sources and detection of the electromagnetic spectrum with <b>some reference</b> to space objects. They also describe in <b>basic</b> terms how the detection of electromagnetic radiation can be improved upon.</p>	<p>Candidates describe in <b>basic</b> terms the properties, sources and detection of the electromagnetic spectrum linking in <b>detail</b> to space objects. They also describe in <b>detail</b> how the detection of electromagnetic radiation can be improved upon.</p>	<p>Candidates describe in <b>basic</b> terms the properties, sources and detection of the electromagnetic spectrum linking in <b>great detail</b> to space objects. They also describe in <b>great detail</b> how the detection of electromagnetic radiation can be improved upon.</p>

Assessment Objective	Pass	Merit	Distinction
<p><b>AO3</b> Examine the weathering and erosion of the Earth's surface by carrying out <b>THREE</b> experiments</p>	<p>Candidates demonstrate a <b>basic competence</b> when carrying out three investigations into the effect of climatic conditions on the Earth's surface. They report their findings using <b>qualitative</b> data and comment on them in <b>basic</b> terms.</p>	<p>Candidates demonstrate <b>competence</b> when carrying out three investigations into the effect of climatic conditions on the Earth's surface. They report their findings using both <b>qualitative and quantitative</b> data and comment on their findings using scientific terminology.</p>	<p>Candidates demonstrate a <b>high level of competence</b> when carrying out three investigations into the effect of climatic conditions on the Earth's surface. They report their findings using both <b>qualitative and quantitative data</b> and comment on their findings in <b>detail</b> using scientific terminology.</p>
<p><b>AO4</b> Describe how the human body responds to the environment to safeguard itself</p>	<p>Candidates describe in <b>basic</b> terms how <b>one</b> environmental condition affects organs and mechanisms in the human body.</p>	<p>Candidates describe in <b>detail</b> how <b>one</b> environmental condition affects organs and mechanisms in the human body.</p>	<p>Candidates give a <b>full description</b> of how <b>one</b> environmental condition affects organs and mechanisms in the human body. Their evidence is <b>well structured</b>.</p>
<p><b>AO5</b> Describe how variation and selection within species can lead to evolutionary change</p>	<p>Candidates produce an <b>explanation</b>, using scientific terminology, of how an organism, such as humans, have and are evolving. They make reference to at least <b>ONE</b> environmental and <b>ONE</b> genetic factor.</p>	<p>Candidates produce a <b>detailed explanation</b> using scientific terminology of how an organism, such as humans, have and are evolving. They make reference to at least <b>ONE</b> environmental and <b>ONE</b> genetic factor.</p>	<p>Candidates produce a <b>very detailed</b> explanation using scientific terminology of how an organism, such as humans, have and are evolving. They make reference to at least <b>ONE</b> environmental and <b>ONE</b> genetic factor. Evidence is also <b>very well structured</b>.</p>
<p><b>AO6</b> Carry out a practical investigation into the variation caused by inheritance</p>	<p>Candidates demonstrate a <b>basic competence</b> when carrying out an investigation that demonstrates a variation in an organism caused by a gene and give a basic comment using qualitative data on the outcome of the investigation. Candidates produce a <b>basic</b> spreadsheet containing variation data and <b>briefly</b> comment on the reliability of the data collection method that they used.</p>	<p>Candidates demonstrate <b>competence</b> when carrying out an investigation that demonstrates a variation in an organism caused by a gene and gives a detailed account using quantitative data on the outcome of the investigation. Candidates produce a spreadsheet containing variation data and <b>comment in detail</b> on the reliability and validity of the data collection method that they used.</p>	<p>Candidates demonstrate a <b>high level of competence</b> when carrying out an investigation that demonstrates a variation in an organism caused by a gene. They give a very detailed account, using a range of quantitative data, on the outcome of the investigation. Candidates produce a spreadsheet containing variation data. They <b>evaluate</b> the data collection method that they used, in terms of validity and reliability.</p>

Assessment Objective	Pass	Merit	Distinction
<p><b>AO7</b> Describe modern environmental reasons for variation between humans and consider the impact of these differences</p>	<p>Candidates make a <b>brief</b> comparison, based on a <b>few</b> links to environmental differences and their impact, between the lifestyle of people from two different parts of the world.</p>	<p>Candidates make a <b>detailed</b> comparison, based on a <b>range</b> of links to environmental differences and their impact, between the lifestyle of people from two different parts of the world.</p>	<p>Candidates make a <b>very detailed</b> comparison, based on a <b>wide range</b> of links to environmental differences and their impact, between the lifestyle of people from two different parts of the world.</p>
<p><b>AO8</b> Discuss the need for developing devices that do not rely on electrical energy generated from fossil fuels and carry out investigations into <b>TWO</b> devices producing useable electrical energy</p>	<p>Candidates demonstrate a <b>basic competence</b> when carrying out investigations into two devices that produce electrical energy. They give a <b>basic</b> explanation, using scientific terminology, of the energy transfers within the devices and comment briefly on their economic costs and efficiency. Candidates also list, in <b>basic</b> terms, the advantages and disadvantages of the devices, when compared to the production of electricity using non-renewable sources.</p>	<p>Candidates demonstrate <b>competence</b> when carrying out investigations into two devices that produce electrical energy. They give a <b>detailed</b> explanation, using scientific terminology, of the energy transfers within the devices and a <b>quantitative</b> comment on their economic costs and efficiency. Candidates also <b>explain</b> the advantages and disadvantages of the devices when compared to the production of electricity using non-renewable sources.</p>	<p>Candidates demonstrate a <b>high level of competence</b> when carrying out investigations into two devices that produce electrical energy. They give a <b>very detailed</b> explanation, using scientific terminology, of the energy transfers within the devices and an <b>excellent quantitative</b> comment on their economic costs and efficiency. Candidates also explain, in <b>detail</b>, the advantages and disadvantages of the devices, when compared to the production of electricity using non-renewable sources.</p>
<p><b>AO9</b> Examine the effects of human activity on the environment, in relation to the production of energy, by carrying out <b>TWO</b> investigations</p>	<p>Candidates demonstrate a <b>basic competence</b> when carrying out two investigations into the effects of human activity, one measured by a living indicator and one by a non-living indicator. They give a <b>basic</b> report on both of the investigations.</p>	<p>Candidates demonstrate <b>competence</b> when carrying out two investigations into the effects of human activity, one measured by a living indicator and one by a non-living indicator. They give a <b>detailed</b> report using scientific terminology on both of the investigations.</p>	<p>Candidates demonstrate a <b>high level of competence</b> when carrying out two investigations into the effects of human activity, one measured by a living indicator and one by a non-living indicator giving a <b>very detailed</b> report using scientific terminology on both of the investigations.</p>