Unit 5: Physics and Our Universe

Unit reference number: K/505/0359
QCF level: 1
Credit value: 4
Guided learning hours: 40

Unit aim

The aim of this unit is to give learners the opportunity to find out about the fundamental principles of physics and our universe. Learners will be looking at energy, waves, radiation and space exploration. They will also construct simple electric circuits and take electrical measurements.

Unit introduction

Physics has a wide range of applications both in everyday life and in the science laboratory. This unit develops learners' knowledge and understanding of some fundamental principles of physical science and enables them to apply these principles to a range of practical situations.

Electrical power is readily transferred and controlled, and is therefore used in many industrial, service and domestic devices. Technicians need to be familiar with basic electric circuits so that they can handle electrical equipment safely. Learners will have the opportunity to gain hands-on experience of using practical devices and test instruments.

Learners should appreciate that space programmes involve many scientific applications. For example, environmental monitoring and modern astronomy both involve remote sensing. Learners will have the opportunity to explore some of the instrumentation used, and appreciate the benefits that it brings.

Learners will develop relevant practical skills required by employees who work in the science sector.

The way in which this unit is delivered and assessed allows learners to experience applied physical science in authentic contexts.

Essential resources

Learners will need access to a laboratory equipped with an appropriate range of equipment and materials to carry out measurements and observations during practical work.

Learning outcomes and assessment criteria

In order to pass this unit, the evidence that the learners present for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

On completion of this unit learners should:

Learning outcomes		Assessment criteria		Unit amplification
1	Know the importance of energy stores and energy transfers	1.1	identify energy stores and energy transfers and their importance	*Importance of energy stores and energy transfers*: chemical, e.g. fuel and oxygen; kinetic (in a moving object); gravitational (due to the position of an object in a gravitational field); elastic, e.g. in a stretched or compressed spring; thermal (in a warm object); mechanically (when a force moves through a distance); electrically; by heating (because of a temperature difference); by radiation, e.g. light, microwaves, sound *Measuring energy transfers*: energy conservation; power; efficiency; economic costs; unit (Joule)
2	Know the applications of waves and radiation	2.1	list the different types of ionising radiation	*Ionising radiation*: types (alpha, beta and gamma, x-rays); effects on living cells; radiation dose; radiation protection procedures (using absorbers and distance, duration of exposure, irradiation versus contamination)
		2.2	identify the different types of electromagnetic waves and their applications	*Waves for communications and transferring energy*: radio waves; microwaves; infrared; visible light; communication range, speed, security *The electromagnetic spectrum*: radio, x-rays, gamma radiation, microwaves, visible spectrum; ionising and non-ionising; applications, e.g. medical, heating, remote sensing of the Earth (surface temperatures, vegetation including crops)
3	Be able to take measurements in electric circuits	3.1	identify the components of simple electric circuits	*Components:* ammeter, voltmeter, battery, resistor, bulb, cell, wire *Basic circuit theory*: the need for a complete circuit; current (mA, A), voltage (mV, V); resistance (Ω); simple series and parallel circuits; use of ammeter, voltmeter, multimeter to take measurements *Power supplies*: types of battery, e.g. rechargeable, non-rechargeable; solar cell; simple generators, e.g. bicycle dynamo, rotating a coil in a permanent magnetic field
		3.2	use an ammeter and voltmeter to take electrical measurements	

Learning outcomes		Assessment criteria		Unit amplification
4	Know the methods used to explore space	4.1	describe the structure and dynamic nature of the universe	*Universe*: the structure and dynamic nature of the Universe (solar system, stars and galaxies, large-scale structure); looking back in time *Instrumentation*: optical and thermal infrared telescopes (reflecting, ground based and satellite)
		4.2	identify methods used to investigate space	*Recent technologies*: robotics, e.g. space probes; new materials, e.g. heat and fire resistant materials; CCD detectors

Information for tutors

Delivery

The purpose of this unit is to develop in learners a knowledge of some of the underlying, physical concepts of science – energy, waves and radiation. Learners will explore the practical application of these through building simple electrical circuits and learning about the methods used in space exploration. Delivery strategies should reflect the nature of work within the science sector by using an assignment/portfolio building approach where learners start to take responsibility for their own learning and develop their practical investigative skills.

Learning outcome 1 introduces learners to different types of energy and how it can be stored and transformed, and the principle of energy conservation. Learners should be able to discuss energy stores and energy transfers. Learners will also learn how to measure energy transfers, including using the unit for energy.

Learning outcome 2 focuses on learning about the types of ionising radiation and the different types of electromagnetic waves and their applications.

Learning outcome 3 introduces learners to simple electrical circuits. They will explore how to set up simple series and parallel circuits and measure the current and voltage. Calculations involving these measurements are not required.

For learning outcome 4, learners will find out about the structure of the Universe and methods used to investigate space, focusing on the instrumentation used to collect data about space.

As far as possible the learning outcomes should be delivered using a practical, investigative approach that will enable learners to develop their practical and enquiry skills. Briefings for investigations should be based on scenarios applicable to an industrial laboratory or other organisation that routinely uses physical science applications. Visiting speakers, videos showing practitioners in the workplace or visits/placements to science-related workplaces can usefully place concepts in a vocational setting.

Suggested skills activity

Learners can carry out a number of formative developmental activities and assignments to prepare for summative assignments. Activities that learners could carry out can include:

- building model loudspeakers, microphones or motors that work
- experimenting virtually with radioactive sources and absorbers
- making a simple communication system based on a switch, power supply and remote indicator lamp; operating this communication system using an agreed code
- using an energy or power meter to measure the demand of a mains electrical appliance
- using information sources to research current developments in space science or satellite remote sensing of the Earth.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

Assessment evidence could be generated through the use of scientific investigative assignments, where communication can be considered through learners' presentations, scientific laboratory reports, graphs, charts etc.

To carry out the investigative work, learners will require a brief giving guidance about the necessary practical or case study/assignment work and ideas about how to obtain information to solve straightforward problems.

Suggested resources

Books

Goodfellow D, Hocking S and Musa I - *BTEC First Principles of Applied Science Student Book* (Pearson Education, 2012) ISBN 9781446902790

Levesley M, Johnson P, Jones M, Chapman C - *Edexcel GCSE Science: GCSE Science Student Book* (Pearson Education, 2011) ISBN 9781846908897

Sykit S – *Signs, Symbols and Systematics* (The ASE companion to 5 - 16 Science, 2000) ISBN 9780863573125

Twenty First Century Science: GCSE Physics Workbook (Oxford University Press, 2011) ISBN 9780199138463

Journals

Focus

New Scientist

Websites

The Association for Science Education	www.ase.org.uk
BBC – GCSE Bitesize	www.bbc.co.uk/schools/gcsebitesize/science
BBC Science and Nature - Space	www.bbc.co.uk/science/space
Crocodile clips	www.crocodile-clips.com
Faulkes Telescope Project	www.faulkes-telescope.com/
GCSE com	www.gcse.com/energy.htm
Hubble Space Telescope	www.hubblesite.org
NASA — living in space	www.nasa.gov/
National Schools' Observatory	www.schoolsobservatory.org.uk
Particle Physics and Astronomy	www.pparc.ac.uk/Ed/ps_intro.asp
Practical Physics	www.practicalphysics.org
RadiationLab	www.visualsimulations.co.uk