Unit 12: Making Useful Scientific Devices

Unit reference number: K/601/4732
QCF level: 1
Credit value: 2
Guided learning hours: 20

Unit aim

The aim of this unit is to enable learners to apply their scientific knowledge and develop practical skills by making two types of scientific devices and testing their effectiveness.

Unit introduction

The construction of simple devices to meet a need is common to all scientific disciplines. In this unit learners will develop their practical skills through constructing two scientific devices. Learners will need to develop skills in handling materials and simple tools, and the techniques to use them safely.

Learners will develop their ideas about calibration and accuracy through designing and making a simple balance to weigh small objects, and then testing its effectiveness. Accuracy is a vital part of a science technician's job and is also essential in various other industries.

Learners will also develop an understanding of how electricity can be produced by making batteries safely, using available resources. They will then test the effectiveness of their batteries and develop an awareness of the harmful effects of batteries on the environment.

Essential resources

Learners require access to a laboratory equipped with an appropriate range of tools and materials to construct and test their scientific devices.

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	Be able to construct and test a weighing device	1.1	design a simple balance	*Types of balance*: types, e.g. spring, elastic, lever *Design*: scientific terms, e.g. weight, units of weight (gram), force, lever, fulcrum, counterweight; features, e.g. mechanism, limits on weight, cost; properties of materials, e.g. flexibility, stiffness, strength, ductility, malleability, brittleness
		1.2	construct and test the balance safely, using available resources	*Resources*: object to be weighed; materials, e.g. cardboard, wood, metal, straw, plastic, paper *Testing*: calibration; accuracy; sensitivity; limitations
2	Be able to construct batteries to generate electricity	2.1	describe the components of a battery	*Components of a battery*: scientific terms (electron, electrode, conductor, voltage); construction (anode, cathode, electrolyte)
		2.2	construct and test batteries safely, using available resources	*Resources*: available resources, e.g. oranges, lemons, apples, copper coin, lemon juice, copper sulfate solution, zinc sulfate solution, zinc rod, 2-inch strips of zinc, copper can, porous pot, connecting wire, crocodile clips, coarse sandpaper, cardboard, sellotape, elastic bands *Testing*: e.g. voltmeter, multimeter, LED
		2.3	describe how batteries can harm the environment	*Effects on the environment:* harmful, e.g. production, disposal

Information for tutors

Delivery

The purpose of this unit is to enhance learners' scientific understanding and practical skills in two different contexts. The unit will give learners an understanding of the importance of calibration when designing and constructing weighing equipment. Learners will also construct batteries to generate electricity. Learners must follow health and safety guidelines when planning and carrying out practical activities.

To achieve learning outcome 1, learners need to design and build a device to weigh objects and draw a scale on the device using some known masses in order to calibrate it. The device should then be used to weigh slightly heavier and lighter items and these measurements can be compared with the initial mass as measured on an accurate set of scales. The task should provide a realistic context that means the device produced can be seen to be useful by the learner.

Learners need to look closely at examples of available mechanical weighing devices and use them to weigh objects. There are many ways to make a simple weighing device using ideas from commercial mechanical devices. The device produced could use elastic or a spring to produce a simple spring balance with a scale on card. A lever on a pivot could be used with a movable counterbalance so that the pivot can be balanced by moving a weight towards or away from the pivot point and a scale marked on the lever. The accuracy of the device can be assessed by comparing the measurement of an unknown mass on the weighing device with the measurement made on an accurate laboratory balance.

For learning outcome 2, learners will investigate the production of electricity from batteries. They could be introduced to the chemistry taking place inside a battery by observing practical demonstrations or computer simulations. They will then construct simple batteries safely, by experimenting with available materials. Learners will need to use the correct scientific names and describe the main components of a battery. They will demonstrate the generation of electricity from their batteries, for example using LEDs or by measuring the voltage produced using a voltmeter or multimeter. Finally, they will consider the harmful effects of batteries on the environment.

It is important that learners are introduced to designing products, as they may not have much prior experience of this. Learners should be encouraged to become confident in their approach to producing designs from which to construct devices. Tutors will play a crucial role in ensuring this.

Assessment

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

Learners must meet all assessment criteria to pass the unit.

Assessment strategies need to reflect the evidence required for the assessment criteria and should use scientific investigative design and construction. Evidence for this unit might best be produced in the form of practically observed and assessed tasks and/or presentations.

The assessment strategies used should address the need for learners to design and construct the devices, test them and make conclusions. They should also cover the importance of the underlying scientific principles, health and safety and risk analysis during practical investigations.

Suggested resources

Websites

Energy quest science projects Lemon power	www.energyquest.ca.gov/projects/lemon.html
How stuff works	www.science.howstuffworks.com
Science Enhancement Programme	www.sep.org.uk/
Technology Enhancement Programme	www.tep.org.uk