Unit ASc6: Carrying Out a Scientific Experiment

Level: **1**
Unit type: **Sector (Applied Science)**
Guided learning hours: **40**

Unit in brief

Learners will develop the skills needed to select apparatus, take measurements and carry out a scientific experiment according to a plan.

Unit introduction

Scientific experiments are important as every new idea has to be tried and tested. However, most scientists do not produce new things. Some work in industrial laboratories and schools where they carry out experiments and take measurements to check the quality of manufactured goods. Science technicians work in hospital laboratories to determine blood groups. Although the tests that are carried out are different, there is always a plan that has to be followed, problems that have to be noted and results that have to be reported.

In this unit, you will learn about a range of laboratory apparatus (equipment) and how to take measurements with each piece of equipment. You will plan how to carry out the experiment, using your knowledge of the equipment that is available. The plan should be clear and have a diagram so that someone else could use the plan to repeat the experiment. You will then set up the equipment, take measurements and obtain some results.

The transferable and sector skills you develop in this unit can enable you to progress to further learning. They will also support you in completing the core skills units in Group A of the qualification.

Learning aims

In this unit you will:

A Plan and carry out a scientific experiment

B Demonstrate managing information while carrying out a scientific experiment.

Unit summary

Learning aim	Key teaching areas	Summary of suggested assessment evidence
A Plan and carry out a scientific experiment	• Completing a plan considering safety issues • Identifying and selecting apparatus to measure quantities • Carrying out an experiment • Recording results	• Plan of how to conduct experiment • Observation and witness statements. • Report to include results and conclusions
B Demonstrate managing information while carrying out a scientific experiment		

Key teaching areas include:

Sector skills	Knowledge	Transferable skills
• Using scientific apparatus • Safety in the laboratory • Tabulating experimental results • Interpreting results	• Scientific apparatus • Taking measurements • Steps involved in carrying out an experiment • Relationship between variables • Units of measurement	• Planning • Managing information

There are opportunities to develop functional skills in this unit:

Functional skills	
English	• Present information/points of view clearly and in appropriate language.
Mathematics	• Add, subtract, multiply and divide whole numbers using a range of strategies. • Solve problems requiring calculation with common measures, including money, time, length, weight, capacity and temperature. • Extract and interpret information from tables, diagrams, charts and graphs.

Unit content

Knowledge and sector skills

Completing a plan considering safety issues

- Identifying the variables.
- Finding out what quantities have to be measured to carry out the experiment.
- Deciding which measuring instruments would be suitable for the measurements to be made.
- Trialling some measurements to see if they work.
- Deciding how the experiment can be made as accurate as possible, how many measurements are to be taken and if measurements need to be repeated.
- Making notes of all decisions made, outlining the way the experiment will be carried out.
- Checking the CLEAPSS® Student Safety Sheets to see if it is safe to carry out your experiment.
- Noting any changes you have to make to your plan to carry it out safely and take all the measurements you need.

Identifying and selecting apparatus to measure quantities

- Simple laboratory apparatus – metre rule, ruler, measuring tape, Vernier callipers beaker, test tube, conical flask measuring cylinders (variety of sizes), stop clock, clamp stand, clamp, thermometer, force meter (variety of maximum forces), laboratory electronic balance, kitchen scales, Bunsen burner, tripod, gauze.
- Identifying simple laboratory apparatus from 2D drawings.
- Selecting correct apparatus to make measurements of different lengths and volumes.

Carrying out an experiment

- Taking measurements using various tools of measurement – metre rules, measuring cylinders, stop clocks, thermometers, force meters and laboratory balances.
- Setting up apparatus as necessary to carry out an experiment.
- Using CLEAPSS Student Safety Sheets to establish if there are any safety requirements for the apparatus being used.
- Taking measurements in the context of an experiment.

Recording results

- Showing results taken from measurements in tabulated or graphic form.
- Making a results table with the quantities and units that are to be measured.
- Completing the results table, finding averages if this is appropriate.
- Presenting the results table in a logical order so a conclusion can be made.
- Displaying the results using a graph or bar chart to show the link between them.

Reporting results

- Verbal feedback on results, including methods used to carry out the experiment.
- Written feedback on methods, results and conclusions using the correct structure for scientific reports.
- Presenting results in graphical formats.

Transferable skills

- Planning: describing how to use the apparatus to complete the experiment.
- Manage information: displaying the results of the experiment in a variety of ways.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Plan and carry out a scientific experiment recording results		
A.P1 Produce an outline plan in preparation to carry out a scientific experiment	**A.M1** Produce a detailed plan in preparation to carry out a scientific experiment	**A.D1** Produce a detailed coherent plan to carry out a scientific experiment,
A.P2 Carry out a scientific experiment identifying readings obtained.	**A.M2** Carry out a scientific experiment describing readings obtained	**A.D2** Carry out a scientific experiment explaining readings obtained
Learning aim B: Present results of a Scientific experiment		
B.P3 Present an outline report identifying the results of a scientific experiment	**B.M3** Present a detailed report describing the results of a scientific experiment	**B.D3** Present a detailed and comprehensive report explaining the results of a scientific experiment

Essential information for tutors

Essential information for assessment decisions

For distinction standard, learners:

- produce a coherent plan, without error, for conducting the experiment. The plan is logical, identifying the variables and including an explanation of the apparatus needed and how measurements are taken
- consider safety requirements with justification using the CLEAPSS Student Safety Sheets
- carry out a scientific experiment using knowledge and skills to meet the overall aim of the experiment
- obtain sufficiently accurate results to fulfil the aims of the experiment
- display results without error to show a relationship between variables in detail, either graphically or in tabulated form, using the correct headings
- produce a report which gives a clear and thorough account of the results of the experiment.

For merit standard, learners:

- produce a detailed plan for conducting the experiment, which must include a description of apparatus needed and how measurements are to be taken
- consider safety requirements using the CLEAPSS Student Safety Sheets
- carry out a scientific experiment using knowledge and skills to meet the most of the aim of the experiment
- obtain results for both variables
- display results with some error to show a relationship between variables, either graphically or in tabulated form.
- produce a report which gives a clear account of the results of the scientific experiment.

For pass standard, learners:

- produce an outline of a plan for conducting the experiment, which must include a list of apparatus needed and the measurements to be taken
- outline safety considerations using the CLEAPSS Student Safety Sheets
- take scientific measurements
- obtain results from scientific measurements
- produce a report which can be a bulleted list of results of the scientific experiment.

Essential resources

For this unit, learners need access to a laboratory setting with relevant apparatus to conduct a scientific experiment.

Delivery guidance

The following are examples of practical activities and workshops that tutors can use when developing skills in the delivery of this unit. Wherever possible, practical activities should be used to help learners develop both personal and sector skills in preparation for the final assessment.

Introduction to unit

Learners are presented with a selection of apparatus and use a worksheet to fill in the name of the apparatus, what it measures and the units it measures in. Tutors should discuss the names and uses of apparatus with learners. Afterwards, learners should be given correctly completed worksheets to use as a reference.

Learners are shown 2D drawings of apparatus and are asked to draw various pieces of apparatus that have been set-up. Apparatus and chemicals must be used safely. Learners should be given the CLEAPSS Student Safety Sheets so that they can appreciate any risks involved in using apparatus and know how to check that work is being carried out safely.

Suggested time: about 6 hours.

Activity: Taking measurements

Learners need to be able to use stop clocks. If the whole class tries to measure the same thing, for example the time it takes to walk across the room, the wide variety of results should convince them that measurements are not necessarily accurate and that precision instruments do not guarantee accurate or precise readings.

The idea of average time and reaction time could be introduced here. The importance of reaction time can be demonstrated by measuring the time it takes for trolleys to run down a slope or the oscillations of a pendulum. Learners are shown how to measure with a metre rule, a measuring cylinder, force meter, balance, and thermometer. Tutors set up a number of things for learners to measure. Learners fill in a worksheet of results and then discuss the results in groups, talking about the reasons why they have different answers.

Suggested time: about 6 hours.

Activity: Taking measurements as accurately as possible

Learners are introduced to the idea of taking measurements as accurately as possible using different measures of length, volume, force or weight. Learners work together to measure things like the length of a corridor, width of a room, length of a textbook, thickness of a sheet of paper so that they can see the relevance of the different instruments that are used to measure length. Volume, weight and mass can be treated similarly. Tutors should introduce the idea of being in line with the measurement (no parallax).

Suggested time: about 6 hours.

Activity: Demonstrating how to start planning an experiment

Learners are introduced to the idea of taking measurements as part of an experiment where they have to work out what to measure, how to measure it and how to keep other variables the same. Tutors demonstrate a simple experiment and ask learners to suggest what should be changed, how they would measure, what is being changed (variables) and what they have to keep the same (controls).

Leaners should be made aware that other people need to know what they are doing, how long it is going to take, and how safe it is. To do this, they should produce a plan or keep a blog. Learners will note any changes to the plan as they go along and explain how they overcame any problems and tried to keep to time. Learners write a plan for the demonstration experiment.

Suggested time: about 6 hours.

Activity: Tabulation of results and use

Learners tabulate the results of their experiment. Before they do this, they need to decide on headings and give some units for the measurements. Learners can then take the readings from the results of their experiment and tabulate them. The results may just be put in order or may be put into a bar chart, or a line graph can be drawn to show the results. Learners are given sets of results to practise tabulation, bar charts and graphs.

Suggested time: about 4 hours.

Activity: Presenting results

Tutor to demonstrate report writing and how the structure of a report should be. Learners are shown an example of a report that covers methods of investigation, results and conclusions.

Suggested time: about 2 hours.

Activity: Conducting an experiment

In pairs, learners carry out an experiment under the guidance of tutors. They will plan and conduct the experiment, taking readings, tabulating their results and producing a graph or bar chart to show what has been found out.

Suggested time: about 4 hours.

Suggested assessment activity

The summative assessment activity takes place after learners have completed their formative development. The activity should be practical, be set in a realistic scenario and draw on learning from the unit, including the transferable skills. You will need to give learners a set period of time and number of hours in which to complete the activity.

Suggested scenario

You are helping the laboratory technician. A tutor has asked you to carry out an experiment to show how temperature affects the time it takes for salt to dissolve in water. You need to put out all of the correct apparatus for the class practical. You will then conduct the experiment by planning, carrying out, obtaining results and finally presenting your findings in an appropriate format. This should take no more than six hours.

If a retake assessment is necessary, an alternative activity must be used. The following is an example of a retake assessment activity.

Your science teacher knows you have a real interest in science. Your teacher has asked you to carry out an experiment to show how the length of a pendulum affects its time of swing so that you can put out all the apparatus needed for the class practical. You will then conduct the experiment by planning, carrying out, obtaining results and displaying the results. This should take no more than six hours.